RASTRIYA PRASARAN GRID COMPANY LIMITED

(An Undertaking of Government of Nepal)

Mewa-Changhe (Dhungesanghu) 132kV Transmission Line Project

BIDDING DOCUMENT
For
THE PROCUREMENT OF

Design, Supply, Installation, Testing and Commissioning of 132kV Line Bays & Associated Underground Cabling Work at Dhungesanghu Substation

National Competitive Bidding (NCB)

Single-Stage: Two-Envelope Bidding Procedure

Invitation for Bids (IFB) No. : RPGCL/NCB/W/MC/SS/083/84-01
Employer : Rastriya Prasaran Grid Company Limited

VOLUME I OF III

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Rastriya Prasaran Grid Company Limited
Mewa-Changhe (Dhungesanghu) 132kV Transmission Line Project
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Abbreviations

BD ... . Bidding Document
BDF ..... Bidding Forms
BDS ..... Bid Data Sheet
APS ... . Activity and Price Schedule
COF ..... Contract Forms
DB ……..Design and Build
DP ... . Development Partners
DoLI ..... Department of Local Infrastructure
e-GP ……Electronic Government Procurement
ELI ... . Eligibility
EPC……. Engineering Procurement and Construction
EQC ... . Evaluation and Qualification Criteria
EXP ... . Experience
FIN ... . Financial
GCC ... . General Conditions of Contract
GoN ..... 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
DB ... . Design and Build
ERQ ... . Employer's Requirements



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RASTRIYA PRASARAN GRID COMPANY LIMITED

(An Undertaking of Government of Nepal)

Mewa-Changhe (Dhungesanghu) 132kV Transmission Line Project

Invitation for Bids

Invitation of Bids for "Design, Supply, Installation, Testing and Commissioning of 132kV Bay Extension & Associated Underground Cabling Work at Dhungesanghu Substation"

Invitation for Bids No: **RPGCL/NCB/W/MC/SS/083/84-01**

Date of First Notice Publication: **2083/05/11 (27th August 2026 AD)**

Date of publication: **2083/05/19 (4th September 2026 AD)**

1. ***Rastriya Prasaran Grid Company Limited (RPGCL)*** *has allocated* towards the cost of ***Mewa-Changhe (Dhungesanghu) 132kV Transmission Line Project*** and intends to apply part of the funds to cover eligible payments under the Contract *for* ***Design, Supply, Installation, Testing and Commissioning of 132kV Bay Extension & Associated Underground Cabling Work at Dhungesanghu Substation***. Bidding is open to all eligible as per Section V of bidding document.
2. ***As per the notice of published by PPMO on 2083/05/11 regarding technical issues currently encountered in the PPMO e-GP system, RPGCL*** invites bidder to submit sealed (hardcopy) bids for the construction of two number of 132kV Bay extension at Dhungesanghu substation ***through Design and Build Contract*** under National Competitive Bidding (NCB) – Single Stage Two Envelope Bidding procedures**.**
3. Under the Single Stage, Two Envelope Procedure, Bidders are required to submit simultaneously two separate sealed envelopes, one containing (i) the Technical Bid and the other (ii) the Price Bid, both in turn enclosed in one sealed envelope as per the provision of ITB 21 of the Bidding Document. Whereas under the Single Stage, Single Envelope Procedure, Bidders are required are required to submit mandatory documents and price bid in one Sealed Envelope as per the provision of ITB 18 of the Bidding Document.
4. Eligible Bidders may obtain further information *at* office of
   Rastriya Prasaran Grid Company Limited office,
   BPC Building, Buddhanagar, Kathmandu
   Tel: 01-4610103, email: info@rpgcl.com.

5. A complete set of Bidding Documents shall be downloaded from website of RPGCL Website: ***https://www.rpgcl.com/pages/bid-notice.***

6. Sealed bids (Hard Copy only) must be submitted to ***Rastriya Prasaran Grid Company Limited office, BPC Building, Buddhanagar, Kathmandu*** as below:

IFB No.	Last date and time for Bid Submission	Last date and time for Bid Opening	Bid Security Amount
RPGCL/NCB/W/MC/SS/083/84-01	2083/05/31 (16th Sept 2026), 12:00 hrs	2083/05/31 (16th Sept 2026), 14:00 hrs	NRs. 62,00,000

7.. Bids received after above mentioned deadline will be rejected.

8. If the last date of 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.

9. The bids will be opened in the presence of Bidders' representatives who choose to attend at ***2:00 PM on 2083/05/31*** at the office of ***Rastriya Prasaran Grid Company Limited office, BPC Building, Buddhanagar, Kathmandu***. Bids must be valid for a period of **120 days** from the date fixed for 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 mention above, which shall be valid for 30 days beyond the validity period of the bid ***(i.e. 2083/10/29).***

10. The Bid Security (Bank Guarantee) previously submitted by the Bidders through e-GP system for above contracts as per previous notices shall remail valid, provided that its expiry data corresponds to the deadline for submission of bids as specified in this notice. Bidders must submit Bid Security along with the Technical Bid as mandatory document.

11. RPGCL 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 RPGCL's action.

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 in the Design and Build contract as specified in Section VI (Employer's 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 and received 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 4.9. (f) a Bidder requests for withdrawal or modification of its bid: (i) after the Bid Submission deadline and during the period of 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. (g) if the bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification pursuant to ITB 28.1. (h) a Bidder changes the prices or substance of the bid while providing information pursuant to ITB 28.1.

	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 33.4 and 79.2(f).
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, firm or consultant 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. or (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. The list of debarred firm is available at the electronic address **specified in the BDS.**
	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 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.
	4.9 For the purpose of ITB 4.8 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 Employer's Requirements (ERQ) Section VII Activity and Price Schedule (APS) 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 23.2.
	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 Design and 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 an 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 23.2. 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 20; (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 21.2; (e) documentary evidence in accordance with ITB 14, establishing the Bidder's eligibility and qualifications to perform the contract; (f) Technical Proposal in accordance with ITB 16;

	(g) documentary evidence in accordance with ITB 15, that the Plant, Materials and Services offered by the Bidder conform to the Bidding Document; (h) In the case of a bid submitted by a Joint Venture, the bid 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; (i) list of subcontractors, in accordance with ITB 16.2 (if any); and (j) Any other documents required in the **BDS**.
	11.3 The Price Bid shall comprise the following: (a) Letter of Price Bid; (b) completed Activity and Price Schedule, in accordance with ITB 12 and ITB 17, 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 (Activity and Price Schedule). 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 alternatives to the Time Schedule are explicitly invited, a statement to that effect will be included in the **BDS**, and the method of evaluating different time schedules will be described in Section III (Evaluation and Qualification Criteria).
	13.3 Except as provided under ITB 13.4 below, Bidders wishing to offer technical alternatives to the Employer's Requirements as described in the Bidding Document must also provide: (i) a price at which they are prepared to offer a plant meeting the Employer's Requirements; and (ii) all information necessary for a complete evaluation of the alternatives by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, and proposed installation methodology and other relevant details. Only the

	technical alternatives, if any, of the evaluated Bidder whose bid price is closest to the Average Bid Price conforming to the basic technical requirements shall be considered by the Employer.
	13.4 When Bidders are invited in the **BDS** to submit alternative technical solutions for specified parts of the facilities, such parts shall be described in Section VI (Employer's Requirements). Technical alternatives for the specific parts of the facilities that comply with the performance and technical criteria specified for the plant and services shall be considered by the Employer on their own merits, pursuant to ITB 32.
14. Documents Establishing Eligibility and Qualifications of the Bidder	14.1 To establish its eligibility and 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).
15. Documents Establishing Conformity of the Plant, Materials and Works	15.1 The documentary evidence of the conformity of the Works with the Bidding Documents may be in the form of literature, drawings and data, and shall include: (a) Detailed description of the essential technical and functional/performance characteristics of the proposed Works, in response to the Employer's Requirements; (b) A list giving full particulars, including available sources, of all spare parts and special tools necessary for the proper and continuing operation of the Works for the period named in the **BDS**, following Contract Completion Date; and (c) Adequate evidence demonstrating the substantial responsiveness of the Works to the Employer's Requirements. Bidders shall note that standards for workmanship, materials and equipment designated by the Employer in the Bidding Document are intended to be descriptive (establishing standards of quality and performance) only and not restrictive. The Bidder may substitute alternative standards, in its technical proposal, provided that it demonstrates to the Employer's satisfaction that the substitutions are substantially equivalent or superior to the standards designated in the Performance / Functional requirements specified by the Employer.
	15.2 The Bidder shall be responsible for ensuring that any proposed subcontractor complies with the requirements of ITB 4, and that any Works to be provided by the subcontractor comply with the requirements of ITB 5 and ITB 16.1
16. Technical Proposal	16.1 The Bidder shall furnish documents establishing conformity of the Works that the Bidder proposes to design and build under the contract along with 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' Technical Proposal to meet the Employer's Requirements and the completion time.
17. Bid Prices and Discounts	17.1 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.

	17.2 The Bidder shall submit a bid for the entire Works on a "single responsibility" basis such that the total Bid Price covers, in accordance with GCC Subclause 51.1, all the Contractor's obligations mentioned in or to be reasonably inferred from the Bidding Document in respect of the design, manufacture and subcontracting (if any), delivery, construction, installation, and completion of the Works under the Contract. 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 to be covered by the rates and prices for other items and prices in the Priced Activity Schedule.
	17.3 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 bid price in the Letter of Bid and Priced Activity Schedule shall result in the rejection of the Bid.
	17.4 Bidders are required to quote the price for all obligations outlined in the Bidding Document.
	17.5 The Bidder shall quote any discounts and the methodology for their application in the Letter of Price Bid, in accordance with ITB 12.1.
	17.6 If so, indicated in ITB 36.4, bids are invited for individual Contracts or for any combination of Contracts (packages). Bidders wishing to offer any price reduction (discounts) 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 17.5, provided the Bids for all Contracts are submitted and opened at the same time.
	17.7 Bidders shall give a breakdown of Prices in the manner and detail called for in the Price Schedules included in Section VII (Activity and Price Schedule). The total amount from each Schedule shall be summarized in a Grand Summary giving the total bid price(s) to be entered in the Letter of Price Bid. Schedule No. 1: Provisional Sum Schedule No. 2: General Items Schedule No. 3: Design Services Schedule No. 4: Construction Items Schedule No. 5: Installation and Other Services Schedule No. 6: Operation & Maintenance (if any) Schedule No….: specify if any other schedule in Section VII (Activity and Price Schedule) Schedule No. 7 Grand Summary (Schedule Nos. 1 to 6)

	(a) Provisional Sum (Schedule No. 1): Shall include the unforeseeable items with appropriated brief description which includes all taxes and shall not be quoted separately by the bidders. (b) General Items (Schedule No. 2) Rates or prices shall include all the rates or prices for the items under this schedule including all taxes, duties, levies, and charges payable in Nepal at the Base Date. (c) Design Services (Schedule No. 3) Rates or prices shall include all taxes, duties, levies, and charges payable in Nepal at the Base Date. (d) Construction Items (Schedule No. 4) shall be quoted separately and shall include all the rates or prices of the material, all labor, contractor's equipment, temporary works, consumables, and all matters including the cost for local transportation, insurance, and other services incidental to delivery and things of whatsoever nature, including testing and preparation of maintenance manuals, training, etc., where identified in the Bidding Document, as necessary for the proper execution of the works and other services, including all taxes, duties, levies, and charges payable in Nepal at the Base Date. (e) Installation and Other Services (Schedule No. 5) shall be quoted separately and shall include all the rates or prices of the installation and other services which shall include all taxes, duties, levies, and charges payable in Nepal at the Base Date. (f) Operation and maintenance (if any) (Schedule No. 6) during Operation and maintenance period or during defects liability period after completion of construction shall be quoted separately which shall include all taxes, duties, levies, and charges payable in Nepal at the Base Date. [Note: Base Date represents as the date 30 days prior to the deadline for submission of Bids.]
	17.8 The applicability of price adjustment to the prices quoted by the Bidder shall be as specified in the **BDS**. If the prices quoted by the Bidder are subject to price adjustment during the performance of the contract to reflect changes in the cost elements such as labor, material, transport, and contractor's equipment in accordance with the procedures specified in the corresponding appendix to the Contract Agreement. The Bidder shall furnish the indices (e.g. for labor, materials and equipment), their weightings and source in the Tables of Adjustment Data included in Section IV (Bidding Forms). The Employer may require the Bidder to justify its proposed indices and weightings. Non-compliance of the data (stipulated by the bidder in Tables of Adjustment Data) with requirements described in Section IV (Bidding Forms) shall not be grounds for bid rejection and such non-compliance will be subject to clarification and rectification prior to contract award.
18. Currency of Bid and Payment	18.1 The currency of the bid and payment shall be in Nepalese Rupees.
19. Period of	19.1 Bids shall remain valid for the period **specified in the BDS**. The bid validity

Validity of Bids	period shall commence from the date fixed for the bid submission deadline as prescribed by the Employer in accordance with ITB 23.1. If the prescribed bid submission deadline falls on a government holiday, the next working day shall be considered the bid submission deadline. In such a case, the validity period of the bids shall still be considered from the original bid submission deadline. 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. Any bid valid for a shorter period shall be rejected by the Employer as nonresponsive.
	19.2 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 20, 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.
20. Bid Security	20.1 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.
	20.2 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 validity period of the bid as per ITB 19.1, or beyond any period of extension if requested under ITB 19.2. A bid security valid for a shorter period shall be rejected by the Employer as nonresponsive.
	20.3 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.
	20.4 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.

	20.5 The public entity shall return the bid securities except those that are to be forfeited as per ITB 20.6 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 43.1 and ITB 44.1.
	20.6 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 19.2: (i) during the period of bid validity specified by the Bidder on the Letter of Technical Bid and Letter of 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 Letter of Price Bid, in case of hard copy submission. (b) a Bidder changes the prices or substance of the bid while providing information pursuant to ITB 28.1; (c) a Bidder involves in fraud and corruption pursuant to ITB 3.1; (d) the successful Bidder fails to: (i) furnish a performance security in accordance with ITB 36.5, ITB 36.9 and ITB 43.1; or (ii) sign the Contract in accordance with ITB 44.1; or (iii) accept the correction of arithmetical errors pursuant to ITB 37.1 (e) if the bidder fails to inform about the saturation of the maximum number of contracts as per ITB 4.8. **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 19.2; or (b) if the successful Bidder fails to (i) ***furnish a performance security in accordance with ITB 36.5, ITB 36.9 and ITB 43.1; or*** (ii) ***sign the Contract in accordance with ITB 44.1; or*** (iii) ***accept arithmetical corrections in accordance with ITB 37.1;***
	20.7 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.
21. Format and Signing of Bid	21.1 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 22.1(b).
	21.2 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.
	21.3 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	
22. Sealing and Marking of Bids	22.1 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 i. Bidders 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 BID" and "COPY OF TECHNICAL BID" and "COPY OF PRICE BID". These envelopes containing the original and the copies shall then be enclosed in one single envelope. ii. 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 23.1;** (cc) bear the specific identification of this bidding process indicated in **BDS 1.1**; and (dd) The outer envelope and the inner envelope containing Technical Bid shall bear a warning not to open before the time and date for the opening of Technical Bid in accordance with ITB 26.1. iii. The inner envelope containing the Price Bid shall bear a warning not to open until advised by the Employer in accordance with ITB 35.1. iv. 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.

(b) Bidders submitting Bids electronically shall follow the electronic bid submission procedure specified in this clause.

i. 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.
ii. 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.
iii. The registered bidders need to maintain their profile data required during preparation of bids.
iv. 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.
v. Bidders (all partners in case of JV) should update their profile data and documents required during preparation and submission of their technical bids.
vi. 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	PDF
5.	Business Registration Licenses	Mandatory	PDF
6.	Tax Clearance Certificate or Tax return submission	Mandatory	PDF

	evidence or evidence of time extension		
7.	Power of Attorney of Bid signatory	Mandatory	PDF
8.	Joint venture agreement	Mandatory in case of JV Bids Only	PDF
9.	Qualification Documents	Mandatory	Using profile data (financial details, contract details etc.) and Technical Proposal
10.	Additional documents specified in ITB 11.2 (j)	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 Priced Activity Schedule (ACS)	Mandatory	Online Forms and schedule of rate and price table should be submitted in PDF
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.

vii. 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.

viii. 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. ix. 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. x. 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.
23. Deadline for Submission of Bids	23.1 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-GP 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.
	23.2 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.
24. Late Bids	24.1 The Employer shall not consider any bid that arrives after the deadline for submission of bids, in accordance with ITB 23. Any bid received by the Employer after the deadline for submission of bids shall be declared late, rejected, and returned unopened to the Bidder.
25. Withdrawal, and Modification of Bids	25.1 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:** 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 21.2. The

	corresponding modification of the bid must accompany the respective written notice. All notices must be: (a) prepared and submitted in accordance with ITB 21 and ITB 22, and in addition, the respective envelopes shall be clearly marked "WITHDRAWAL", "MODIFICATION;" and (b) received by the Employer twenty-four hour prior to the deadline prescribed for submission of bids, in accordance with ITB 23. **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 21.2, (except that withdrawal notices do not require copies). The corresponding modification of the Bid must accompany the respective written notice. All notices must be (a) prepared and submitted in accordance with ITB 21 and ITB 22 (except that withdrawal notices do not require copies), and in addition, the respective envelopes shall be clearly marked "WITHDRAWAL," and "MODIFICATION;" and (b) received by the Employer prior to the deadline prescribed for submission of Bids, in accordance with ITB 23. (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.
	25.2 Bids requested to be withdrawn in accordance with ITB 25.1 shall not be opened. In case of hard copy submission, the Bid will be returned unopened to the Bidders.
	25.3 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 Technical Bid, Letter of Price 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 Letter of 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.
	25.4 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.

	25.5 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.
	25.6 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.
26. Opening of Technical Bid	26.1 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 non- responsive bid.
	26.2 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.
	26.3 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.
	26.4 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 26.1.
	26.5 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 24.1.
	26.6 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.

E. Evaluation and Comparison of Bids	
27. Confidentiality	27.1 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.
	27.2 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.
	27.3 Notwithstanding ITB 27.2, 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.
28. Clarification of Bids	28.1 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 37. 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.
	28.2 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 shall be rejected.
29. Deviations, Reservations, and Omissions	29.1 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.
30. Examination of Technical Bid	30.1 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 is missing, the bid shall be rejected.
	30.2 In case of e-submission bids, the Employer shall confirm that all the documents and information requested in ITB 22.1 have been submitted. If any of these documents or information is missing, the bid shall be rejected.
31 Eligibility and Qualification of the Bidder	31.1 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).
	31.2 The determination shall be based upon an examination of the documentary

	evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB 14. The determination shall not take into consideration the qualifications of other firms such as the Bidder's subsidiaries, parent entities, or affiliates, Subcontractors (other than Specialist Subcontractor, if permitted in ITB 39.2 of the Bidding Document). If two or more companies or firms have been merged prior to the submission of the bid, the qualifications of the companies or firms existing prior to such merger shall be taken into account and shall be deemed to form part of the qualifications of the resulting merged firm or company.
	31.3 An affirmative determination shall be a prerequisite for proceeding with the next step of evaluation under ITB 32 (Determination of Responsiveness of Technical Bid). The Employer reserves the right to reject the Bid of any Bidder found to be in circumstances described in GCC Subclause 79.2(f). 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.
	31.4. The capabilities of the subcontractors proposed in its Bid for the major items of design and services to be used by a Bidder will also be evaluated for acceptability in accordance with Section 3 (Evaluation and Qualification Criteria). Their participation should be confirmed with a letter of intent between the parties, as needed. In case of design subcontractor, the subcontractor must meet the minimum qualification and experience requirements as set out in the bidding document. The bid will be rejected if the design subcontractor does not meet the requirements.
32. Determination of Responsiveness of Technical Bid	32.1 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.
	32.2 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. For the avoidance of doubt, Bidders are free to propose any design solution which deviates from any base design solution provided in the Bidding Document, and this will be considered substantially responsive as long as it does not affect the quality or performance of Plant, Materials, and Services specified in the Employer's Requirements and does not change the Employer's rights and Contractor's obligations under the proposed Contract.
	32.3 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 (Employer's Requirements) have been met without any material deviation, reservation or omission.
	32.4 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.
	32.5 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 28.1, the bid shall not be considered for further evaluation.
	32.6 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.
	32.7 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.
33. Non-conformities Errors, and Omissions	33.1 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.
	33.2 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.
	33.3 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).
	33.4 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 33.3, such bid shall be considered nonresponsive and shall not be involved in evaluation.
34. Detailed Evaluation of Technical Bids	34.1 The Employer will carry out a detailed technical evaluation of the Bids not previously rejected as being substantially nonresponsive, to determine whether the technical aspects are in compliance with the Bidding Document. The Bid that does not meet minimum acceptable standards of completeness, consistency, and detail, and the specified minimum and/or

	maximum requirements for specified functional parameters, will be treated as nonresponsive and hence rejected. To reach such a determination, the Employer will examine and compare the technical aspects of the bids on the basis of the information supplied by the Bidders, taking into account the following: (a). overall completeness and compliance with the Employer's Requirements; deviations from the Employer's Requirements; conformity of the materials and services offered with specified performance criteria; suitability of the material and services offered in relation to the environmental and climatic conditions prevailing at the site. The Bid that does not meet minimum and/or maximum acceptable standards of completeness, consistency, and detail will be rejected for no responsiveness. (b). other relevant factors, if any, listed in Section III (Evaluation and Qualification Criteria).
	34.2 Where alternative technical solutions have been allowed in accordance with ITB 13, and offered by the Bidder, the Employer will make a similar evaluation of the alternatives. Where alternatives have not been allowed but have been offered, they shall be ignored.
35. Opening of Price Bids	35.1 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.
	35.2 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.
	35.3 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.
	35.4 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.

	35.5 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.
36. Evaluation of Price Bids	36.1 The Employer shall use the criteria and methodologies listed in this Clause. No other evaluation criteria or methodologies shall be permitted.
	36.2 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 Priced Activity Schedule**,** but including Day work items, where priced competitively; (b) adjustment for correction of arithmetic errors in accordance with ITB 37.1; (c) adjustment due to discounts offered in accordance with ITB 17.5; (d) adjustment for nonconformities, errors and omission in accordance with ITB 33.3; (e) application of all the evaluation factors indicated in Section III (Evaluation and Qualification Criteria). If the evaluated Bid Price of the Bidder is more than 30 (thirty) percent below the cost estimate, the Employer shall reject the Bid as non-responsive.
	36.3 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.
	36.4 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).
	36.5 If the bid, evaluated as per ITB 38.1 is seriously **unbalanced or front loaded** in the opinion of the Employer, the Employer may require the Bidder to produce detailed rate analysis for any or all items of the Priced Activity Schedule as per ITB 28.1, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the rate 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**.

	36.6 All items in the Priced Activity Schedule must be priced. Items against which no rate or price is entered by the Bidder will not be additionally paid for by the Employer when executed and shall be deemed to be covered by the Rates and Prices for other items.
	36.7 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 28.1, the bid shall not be considered for further evaluation.
	36.8 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.
	36.9 If all the bids evaluated are substantially higher than the cost estimate, the employer may negotiate with the bidder whose evaluated Bid Price is closest to the cost estimate to propose a lump sum discount rate in order to bring the bid price within the approved cost estimate. However, no change in the substance of the bid is permitted during the negotiations.
37. Correction of Arithmetical Errors	37.1 During the evaluation of Price Bids, the Employer shall correct arithmetical errors on the following basis: (a) where there are errors between the total of the amounts given under the column for the price breakdown and the amount given under the Total Price, the amounts given under the column for the price breakdown shall prevail and the Total Price shall be corrected accordingly; (b) where there are errors between the total of the amounts of Schedule and the amount given in the Grand Summary schedule, the total of the amounts of respective Schedule shall prevail and the Grand Summary schedule shall be corrected accordingly; (c) if there is a discrepancy between the grand total price given in the Grand Summary Schedule and the bid amount in item (c) of the Letter of Price Bid, the grand total price given in the Grand Summary Schedule will prevail and the bid amount in item (c) of the Letter of Price Bid will be corrected; and (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.
	37.2 If a Bidder does not accept the correction of errors, its bid shall be disqualified and its bid security shall be forfeited.
38. Comparison of Bids	38.1 The Employer shall compare all substantially responsive bids in accordance with ITB 36.2. The Employer shall determine the Average Bid Price of all

	the substantially responsive Bids. The Bid Price which is closest to the Average Bid Price AND is not substantially higher than the cost estimate shall be selected for awarding the contract. In case two or more Bid Prices are determined to be equally closest to the Average Bid Price, the Bid Price which is below the Average Bid Price shall be selected for awarding the contract.
	38.2 While evaluating the Bid Price as per ITB 38.1,if the Bid Price of two or more bidders' is found to be equal, the Employer shall select the bid for awarding the contract by drawing of lots in presence of Bidders' designated representatives who choose to attend in date, time and place as notified by the Employer in writing to the concerned bidders'. The Bidder's representatives who are present shall be requested to sign a record evidencing their attendance. The omission of a Bidder's signature on the record or the absence of a Bidder during the drawing of lots shall not invalidate the contents and effect of the record. The method of drawing of lots shall be determined by the Employer.
39. Subcontractor	39.1 The Employer may permit subcontracting for certain specialized works as indicated in Section III (Evaluation and Qualification Criteria). When subcontracting is permitted by the Employer, the sub-contractor shall meet the qualifications criteria as indicated in section III (Evaluation and Qualification Criteria). 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.**
	39.2 The Bidder shall provide details of the name and nationality of the proposed Subcontractors, consulting firms, or manufacturers if any, for each activity or item for which subcontracting is permitted. Additionally, the Bidder shall include information in its Bid demonstrating compliance with the requirements specified by the Employer for these activities or items. Bidders may propose more than one subcontractor for each activity or item; however, the quoted rates and prices shall be deemed applicable to whichever subcontractor is ultimately engaged, and no adjustment to the rates or prices will be permitted on this basis.
	39.3 The Bidder shall be responsible for ensuring that any proposed Subcontractor complies with the requirements specified in ITB 4. Furthermore, any works to be executed by the Subcontractor must conform to the requirements outlined in ITB 5 and ITB 14.1.
	39.4 If the proposed Subcontractor fails to meet the qualification and experience criteria specified in Section III (Evaluation and Qualification Criteria), the proposed Subcontractor shall be rejected. In such a case, the Bidder shall remain solely responsible for the execution and completion of the relevant scope of work.

40. Employer's Right to Accept Any Bid, and to Reject Any or All Bids	40.1 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.
	40.2 The public entity shall give notice of the rejection of bids or the cancellation of the procurement proceedings pursuant to ITB 40.1, along with the reasons for such rejection or cancellation, to all bidders.
	40.3 Where any bidder requests, within thirty (30) days of the communication of the notice pursuant to ITB 40.2, 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	
41. Award Criteria	41.1 The Employer shall award the Contract to the Bidder whose Bid Price is selected as per ITB 36.10, ITB 38.1 or ITB 38.2 and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.
42. Letter of Intent to Award the Contract / Notification of Award	42.1 The Employer shall notify the concerned Bidder whose bid has been selected in accordance with ITB 41.1 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.
	42.2 After issuance of the notice under ITB 42.1 if the concerned bidder provides information pursuant to ITB 4.9 regarding saturation of maximum number of contracts, the employer shall disqualify the bidder and shall select the next Bidder whose Bid Price is closest to the previously determined Average Bid Price in accordance with ITB 41.1 and notify accordingly as per ITB 42.1.
	42.3 If no bidder submits an application pursuant to ITB 45 within a period of seven days of the notice provided under ITB 42.1, the Employer shall, accept the bid selected in accordance with ITB 41.1 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.
	42.4 After communicating letter of acceptance under ITB 42.3, if the concerned bidder provides information pursuant to ITB 4.9 regarding saturation of maximum number of contracts, the employer shall reject the bid of that bidder and shall select the next Bidder whose Bid Price is closest to the previously determined Average Bid Price in accordance with ITB 41.1 and shall issue the notice accordingly as per ITB 42.1. In such case bid security of the rejected bidder shall not be forfeited.
	42.5 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.
43. Performance Security	43.1 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 36.5, in an amount equal to 5 (five) percent of the Bid Price from a 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. The Bid Price shall be without VAT but including Provisional Sum.
	43.2 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 Bidder whose Bid Price is closest to the previously determined Average Bid Price in accordance with ITB 38.1 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 42.
44 Signing of Contract	44.1 The Employer and the successful Bidder shall sign the Contract Agreement within the period as stated ITB 43.1.
	44.2 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 ***District Coordination Committee, District Administration Office, Provincial Treasury and Controller Office and District Treasury and Controller Office.*** The Employer may make arrangements to post the notice into its website, if it has; if it does not have, into the website of the Public Procurement Monitoring Office and for electronic submitted bids, in e-GP system , 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.
	44.3 Within thirty (30) days from the date of issuance of notification pursuant to ITB 42.1 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.
	44.4 If the bidder whose bid has been accepted fails to sign the contract as stated ITB 43.1, the Public Procurement Monitoring Office shall blacklist the bidder on recommendation of the Public Entity.

45. Complaint and Review	45.1 Ifa 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 35.2 and ITB 42.1 by the Public Entity, for review of the proceedings stating the factual and legal grounds.
	45.2 Late application filed after the deadline pursuant to ITB 45.1 shall not be processed.
	45.3 The chief of Public Entity shall, within five (5) days after receiving the application, give its decision with reasons, in writing pursuant to ITB 45.1: (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 45.4.
	45.4 If the Bidder is not satisfied with the decision of the Public Entity in accordance with ITB 45.3, or the decision is not given within five (5) days of receipt of application pursuant to ITB 45.1, it can, within seven (7) days of receipt of such decision, file an application to the Public Procurement Review Committee (PPRC)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.
	45.5 Late application filed after the deadline pursuant to ITB 45.4 shall not be processed.
	45.6 Within three (3) days of the receipt of application from the Bidder, pursuant to ITB 45.4, the Public Procurement Review Committee shall notify the concerning Public Entity to furnish its procurement proceedings, pursuant to ITB 45.3.
	45.7 Within three (3) days of receipt of the notification pursuant to ITB 45.6, the Public Entity shall furnish the copy of the related documents to the Public Procurement Review Committee.
	45.8 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 45.4.
	45.9 The Bidder, filing application pursuant to ITB 45.4, 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 in Nepal equivalent to ten percent (10 %) of amount of bid security in case of complaint against decision pursuant to ITB 35.2 and one percent (1%) of its

	quoted Bid amount in case of complaint against decision pursuant to ITB 42.1 with the validity period of at least ninety (90) days from the date of the filing of application pursuant to ITB 45.4.
	45.10 If the claim made by the Bidder pursuant to ITB 45.4 is justified, the Public Procurement Review Committee shall have to return the security deposit to the applicant, pursuant to ITB 45.9, within seven (7) days of such decision made.
	45.11 If the application submitted by the Bidder pursuant to ITB 45.4 is dismissed by the Public Procurement Review Committee, the security deposit (Cash or Bank Guarantee) submitted by the Bidder pursuant to ITB 45.9 shall be forfeited. 45.12 If the Employer does not implement the decision of the Public Procurement Review Committee, the bidder may file an application to the Public Procurement Review Committee.

Section II: Bid Data Sheet

A. General	
ITB 1.1	The number of the Invitation for Bids is: **RPGCL/NCB/W/MC/SS/083/84-01**
ITB 1.1	The Employer is***: Rastriya Prasaran Grid Company Limited (RPGCL)***
ITB 1.1	**Multiple Contract or lots (contracts) is:** ***Not Applicable.***
ITB 2.1	The name of the Project is: **Mewa-Changhe (Dhungesanghu) 132kV Transmission Line Project** The DP is***: Not Applicable*** The implementing agency is: ***Rastriya Prasaran Grid Company Limited*** The source of funds: ***Government of Nepal (GoN)***
ITB 3.3 (e)	For DP Funded: Not Applicable
ITB 4.1 (a)	For GoN Funded: Maximum number of partners in a joint venture shall be: **3 (three)**
ITB 4.4	*For DP: **NA***
ITB 4.8 & ITB 4.9	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: Attention: Mewa-Changhe (Dhungesanghu) 132kV Transmission Line Project Address: Rastriya Prasaran Grid Company Limited BPC Building, Buddhanagar, Kathmandu, Nepal Telephone: +977-01-4610103 Electronic mail address: info@rpgcl.com

ITB 7.4	A Pre-Bid meeting ***shall*** take place. Pre-bid meeting shall be held at ***Rastriya Prasaran Grid Company Limited office, BPC Building, Buddhanagar, Kathmandu*** ***Time: 12:00 noon on 2083/05/18***
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 (j)	The Bidder shall submit with its Technical Bid the following additional documents: 1. Notarized Company legal Firm Registration Certificate (all partner of JV). 2. Copy of Business Registration Certificate (all partner of JV) 3. Notarized JV agreement if bidder is not a single firm or single entity. 4. Work Completion Certificate (on the letter head of the End-User) for all relevant Projects completed with contact person's address and Tel. no. 5. Audited Balance Sheet for the last three years 6. Manufacturers' Authorization Letter for major items as mentioned in Section III Evaluation and Qualification Criteria 7. VAT& PAN Registration Certificate of the bidder (i.e. each partner of JV) 8. Type Test Certificate for major items as mentioned in Section III Evaluation and Qualification Criteria (refer to Section III Evaluation and Qualification Criteria) 9. Scan copies of original bidding documents with each page signed
ITB 11.3 (b)	In accordance with ITB 12 and ITB 17, the following schedules shall be submitted with the bid, including the Priced Bill of Quantities for Unit Rate Contracts and Schedules 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	Alternatives to the Time Schedule ***shall not be*** permitted.
ITB 13.4	Alternative technical solutions shall be permitted for the following parts of the plant and services: ***Not Applicable***
ITB 15.1 (b)	The period after the taking-over of the Works by the Employer, for the Bidder to propose spare parts (i.e. Mandatory Spare Parts and Recommended Spare Parts, if required), special tools, etc.: **Not Applicable**
ITB 17.8	The prices quoted by the Bidder ***shall not be*** subject to adjustment during the performance of the Contract.

ITB 19.1	The bid validity period shall be: ***120 days.***
ITB 20.1	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 **NRs. 6,200,000.00**, which shall be valid for 30 days beyond the validity period of the bid.
ITB 20.2 (b)	Office Name: **Rastriya Prasaran Grid Company Limited** Bank Name: **Nabil Bank Limited** Bank Address: **Tindhara Branch** Account Number: **00201017505882**
ITB 21.1	In addition to the original of the bid, the number of copy/ies is/are: ***Not Applicable***
ITB 21.2	The written confirmation of authorization to sign on behalf of the Bidder shall: (a) Power of Attorney: The name and authority of the signatory to sign the Bid, 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 22.1	Bidders shall submit their bids by electronic only.
ITB 23.1	*For bid submission purposes only, the Employer's address is:* **RPGCL Office, BPC Building, Buddhanagar, Kathmandu** *For electronic submission:* **NA**
ITB 26.1	The Technical Bid opening shall take place at: Address: **RPGCL Office, BPC Building, Buddhanagar, Kathmandu** Date: **2083/05/31.** Time: **2:00 PM**
E. Evaluation and Comparison of Bids	
ITB 36.4	Bidders are ***not permitted*** to quote separate prices for lots (Contracts), and a single Bidder will be awarded multiple lots (Contracts) based on provision of ***Paragraph 1.2, Multiple Contracts Section III (Evaluation and Qualification Criteria):***
ITB 36.5	The amount of the performance security be increased by ***Eight (8)*** percent of the quoted bid price without VAT but including PS.

ITB 39.1	Contractor's proposed subcontracting: Maximum percentage of subcontracting permitted is: **25% of the total contract amount** without VAT but including PS**.**
ITB 44.4	For DP Funded: ***Not Applicable***

Section III: Evaluation and Qualification Criteria

The Bidder shall provide all the information requested in the forms included in Section IV (Bidding Forms).

1. Evaluation

The evaluation criteria listed below required for the project.

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 (Employer's Requirements).

Non-compliance with equipment and personnel requirements described in Section VI (Employer's Requirements) shall not be grounds for bid rejection and such non-compliance will be subject to clarification.

1.2 Multiple Contracts

Multiple Contracts: ***Not Applicable***

1.3 Quantifiable Nonconformities, Errors and Omissions

The evaluation shall be based on the evaluated cost of fulfilling all of the Contract obligations as laid down under this Bidding Document.

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 4.8.	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	must meet requirement	not applicable	must meet requirement	not applicable	Document attachment
Tax Clearance Certificate or Tax return submission evidence or 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 ***Five (5)*** 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	must meet requirement	not applicable	must meet requirement	not applicable	Form FIN - 1 with attachments

positive.					

2.3.2 Average Annual Construction Turnover					
Minimum average annual construction turnover of ***NRs. 241 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

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, unencumbered real assets, and other financial resources, (other than any contractual advance payments) to meet the cash-flow requirement of ***NRs. 109 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 205 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

- *Bidders shall fill the forms as mentioned above but notarized copy of the audit report is mandatory to*

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

verify the forms. The audited balance sheet must have the sign of the auditor with the stamp of the firm. In case of e-submission, Xeroxed copy of audit report is not advised to be uploaded, bidders are to upload the original audit report. The cover page of the Auditor's information and contact Address (Phone no. & the mail address) shall be present.

- *If the Turnover submitted by the bidder is in the name of a Joint Venture in the past, the bidder must submit the Joint Venture Agreement (notarized in case of Hard Copy bid, original scanned copy for e-submission), stating the % of JV for the calculation of the turnover of the respective bidder.*

- *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.*

2.4 Experience

2.4.1 General Construction Experience					
Experience under construction contracts in the role of contractor, subcontractor, or management Contractor for at least ***the last Five (5) years*** prior to the applications submission deadline.	must meet requirement	not applicable	must meet requirement	not applicable	Form EXP - 1

2.4.2 Specific Construction Experience					
(a) Contracts of Similar Size and Nature					
For Works with value above NRs. 100 million					
Criteria	**Compliance Requirements**				**Documents Submission Requirement**
Requirement	**Single Entity**	**Joint Venture**			
		All Partners Combined	**Each Partner**	**One Partner**	
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:	Must meet requirement, in at least One (1) Contract with a value of at least NRs **NRs. 145 Million**	not applicable	not applicable	Must Meet Requirement In at least One (1) Contract with a value of at least NRs least **NRs 145**	Form EXP – 2(A)

the physical size, complexity, methods, technology or other characteristics as described; 1. Design Supply, Installation, Testing and Commissioning of Substation, or Design Supply, Installation, Testing and Commissioning of Line Bay/s, or Design, Supply, Installation, Testing and Commissioning of Transmission Line and Substation Combined in the same contract. or Installation, Testing and Commissioning of substation. 2. The system voltage must be of 110 kV or higher voltage level.				**Million**	

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 contractor, or subcontractor, within a last ten (10) years, For the above or other contracts stipulated in 2.4.2(a) above, a minimum annual production rate on construction experience in the following	must meet all requirements	must meet all requirements	not applicable	not applicable	Form EXP - 2(B)

key activities: 1. Design, supply, construction, installation, testing and commissioning of at least (1) line bay of 110 kV (or above voltage class) 2. XLPE Cable Underground works.					

(c) Similar Design Experience		
Criteria Requirement	**Compliance Requirement**	**Documents Submission Requirement**
Either; participation as a Prime Contractor, Management Contractor, or Subcontractor in EPC/Turnkey/DB contract or similar construction contract; **or;** participation of a consultant nominated by the bidder, in at least one (1) contract within the last ten (10) years, responsible for design of 110 kV or above voltage line bay.	**Either;** The Bidder (as a Single Entity or any one partner in case of a Joint Venture) shall meet all the specified requirements; **Or;** The proposed consultant nominated by the Bidder shall meet all the specified requirements.	Form EXP - 2(C)

2.5 Understanding of the project and proposed design

Criteria	**Compliance Requirements**				**Documents**
Requirement	**Single Entity**	**Joint Venture**			**Submission Requirement**
		All Partners Combined	**Each Partner**	**One Partner**	
(a) Understanding of the Project					
Submission of concept paper highlighting detail about understanding of the project from planning to completion stage including surveying, geotechnical investigation,	must meet requirement	must meet requirement	not applicable	not applicable	Form EXP – 2(D)

environmental and social safeguard study, designing and constructing.					
(b) **Proposed Design**					
Submission of design methodology and concept design including design finalization procedure, assurance about design and relevant codes.	must meet requirement	must meet requirement	not applicable	not applicable	Form EXP – 2(E)

Note: The Employer shall evaluate Clauses 2.5(a) and 2.5(b) based on the submission of documents in the respective forms. Non-submission of either of these documents shall be grounds for bid rejection.

2.6 Subcontractors

Not Applicable

2.7 Manufacturers

The Employer reserves right to choose/select manufacturers from list of qualified manufacturers.

1	Current & Voltage Transformer (132kV)	i. Must have manufacturing experience of at least 10 (ten) years. ii. Must have successfully completed the design, manufactured, tested and supplied 132kV or higher voltage class CT and VT, at least twice the bid quantity as a main supplier over last five years period ending on the last date of bid submission. Out of supplied quantity, a minimum of half the bid quantity shall have been in operation satisfactorily to the end users for at least One (1) year on the date of Bid Opening. iii. Must hold a valid ISO 9001:2015 (including design in scope of registration) certifications. iv. Must submit the type test report carried out by reputed independent accredited laboratory for the size offered. v. In case the Bidder is not the manufacturer of Goods offered; the Bidder shall submit manufacturer's certificate authorizing the Bidder to supply the manufacturer's Goods which shall be on manufacturer's original letterhead with seal and stamp of the manufacturer.
2	132kV Circuit Breakers	i. Must have manufacturing experience of at least 10 (Ten) years. ii. Must have successfully completed the design, manufactured, tested and supplied of 132kV or higher voltage class Circuit breakers, at least twice the bid quantity as a main supplier over last 5 (five) years period ending on the last date of bid submission. Out of supplied quantity, a minimum of half the bid quantity shall have been in operation satisfactorily to the end users for at least one (1) year on the date of Bid

		Opening. iii. Must hold a valid ISO 9001:2015 (including design in scope of registration) certifications. iv. Must submit the type test report carried out by reputed independent accredited testing laboratory.
3	132kV Control and Relay Panels	i. Must have manufacturing experience of at least 10 (ten) years. ii. Must have successfully completed the design, manufactured, tested and supplied 132kV or higher voltage class Control and Relay Panels, at least twice the bid quantity as a main supplier over last five years period ending on the last date of bid submission. Out of supplied quantity, a minimum of half the bid quantity shall have been in satisfactory operation for at least 1 (One) year as on the date of bid opening. iii. Must hold a valid ISO 9001:2015 (including design in scope of registration) certifications. iv. Must submit the type test report carried out by reputed independent accredited testing laboratory. v. In case the Bidder is not the manufacturer of Goods offered, the Bidder shall submit manufacturer's certificate authorizing the Bidder to supply the manufacturer's Goods which shall be on manufacturer's original letterhead with seal and stamp of the manufacturer.
4	132kV Disconnecting Switches	i. Must have manufacturing experience of at least 10 (ten) years. ii. Must have successfully completed the design, manufactured, tested and supplied of 132kV or higher voltage class Disconnecting switches, at least twice the bid quantity as a main supplier over last five years period ending on the last date of bid submission. Out of supplied quantity, a minimum of half the bid quantity shall have been in satisfactory operation for at least 1 (One) year as on the date of bid opening. iii. Must hold a valid ISO 9001:2015 (including design in scope of registration) certifications. iv. Must submit the type test report carried out by reputed independent accredited laboratory for the size offered.
5	Substation Automation System (SAS)	i. Must have manufacturing experience of at least 5 (five) years. ii. Must have successfully completed the supply of SAS, at least twice the bid quantity as a main supplier over last five years period ending on the last date of bid submission. Out of supplied quantity, a minimum of half the bid quantity shall have been in operation satisfactorily to the end user for at least 1 (one) year.

		iii. Must hold a valid ISO 9001:2015 (including design in scope of registration) certifications. iv. Must submit the type test report carried out by reputed independent accredited testing laboratory.
6	Fibre Optic based Communication System	i. Must have manufacturing experience of at least 5 (five) years. ii. Must have successfully completed the supply at least twice the bid quantity as a main supplier over last five years period ending on the last date of bid submission. Out of supplied quantity, a minimum of half the bid quantity shall have been in operation satisfactorily to the end user for at least one year. iii. Must hold a valid ISO 9001:2015 (including design in scope of registration) certifications. iv. Must submit the type test report carried out by reputed independent accredited testing laboratory.
7	120 kV Lightning Arrestor	i. Must have manufacturing experience of at least 10 (ten) years. ii. Must have successfully completed the design, manufactured, tested and supplied of 132kV or higher voltage class Lightning, at least twice the bid quantity as a main supplier over last seven years period ending on the last date of bid submission. Out of supplied quantity, a minimum of half the bid quantity shall have been in operation satisfactorily to the end users for at least one (1) year on the date of bid opening. iii. Must hold a valid ISO 9001:2015 (including design in scope of registration) certifications. iv. Must submit the type test report carried out by reputed independent accredited laboratory for the size offered.
8	Battery and Battery Charger	i. Must have manufacturing experience of at least 10 (Ten) years. ii. Must have successfully completed the supply of Battery and Battery Charger, at least twice the bid quantity as a main supplier over last five (5) years period ending on the last date of bid submission. Out of supplied quantity, a minimum of half the bid quantity shall have been in operation satisfactorily to the end users for at least one (1) year on the date of bid opening. iii. Must hold a valid ISO 9001:2015 (including design in scope of registration) certification. iv. Must submit the type test report carried out by reputed independent accredited testing laboratory.

9	132kV XLPE Cables	i. Must have manufacturing experience of at least 10 (ten) years. ii. Must have successfully completed the design, manufactured, tested and supplied of 132kV or higher grade XLPE insulated power cables supply as on the date of bid opening over last five year's period ending on the last date of bid submission. Out of supplied quantity, minimum of half the bid quantity shall have been in operation satisfactorily to the end users for at least one (1) year on the date of bid opening. iii. Must hold a valid ISO 9001:2015 (including design in scope of registration) certifications. iv. Must submit the type test report carried out by reputed independent accredited laboratory for the size offered.
10	Steel Structures	i. Must have manufacturing experience of at least 10 (ten) years. ii. Must have successfully completed the design, manufacture, testing and supplied twice the bid quantity or higher fabricated steel structure as a main supplier over last five (5) years period ending on the last date of bid submission. iii. Must hold a valid ISO 9001:2015 (including design in scope of registration) certifications. iv. Must submit the test report carried out by reputed independent accredited laboratory for the steel structure eg. Tower, gantry or other structure. v. In case the Bidder is not the manufacturer of Goods offered, the Bidder shall submit manufacturer's certificate authorizing the Bidder to supply the manufacturer's Goods which shall be on manufacturer's original letterhead with seal and stamp of the manufacturer.

Note:

i) 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.

ii) 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.

iii) 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.

iv) Type test certificate shall have been issued by a reputed independent laboratory accredited by International Laboratory Accreditation Corporation (ILAC) or International Accreditation Forum (IAF) or other equivalent reputed accreditation agencies over last 10 years period ending on the last date of bid submission. In case the type test certificates are not as per the requirement, the bidder shall upon the award of the contract, undertake to carry out the required type tests from an independent laboratory accredited by reputed accreditation agencies or in a laboratory nominated by the Client/Employer before the delivery of corresponding equipment at no extra cost to the Client/Employer including any transportation or costs associated with performing such tests. The bidder however shall furnish a declaration letter that they will carry out the type test of the equipment of suitable rating and/or Voltage level without any cost to the employer. The employer reserves right to reject the bid if the bidder does not submit the type test report or the declaration letter as mentioned above even after the clarification requested by the employer.

v) 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

   a) Guaranteed technical particulars (Technical Data Sheet) as per Section VI: Employer's works requirements. The Bidder shall fill and submit the technical data sheet for all the major items with the bid.

   b) Description of equipment, plants and materials offered in conformity with the specification or a statement of deviations and exceptions to provisions of the specifications.

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: ……....

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.

(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 19.1 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, 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 (Employer's Requirement) and our technical proposal, or as otherwise agreed with the Employer.

(l) We declare that we have not yet secured five (5) number of construction contract (in open competitive bidding) as described in ITB Sub-Clause 4.8.

Name: .....

In the capacity of: .....

Signed .....

Duly authorized to sign the Bid for and on behalf of .....

Date .....

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: ……....

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 brief 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 Priced Activity Schedule

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 19.1]*** 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:

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

(h) We understand that this bid, together with your written acceptance thereof *i*ncluded 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 bid closest to the average Bid Price 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]*** **……....**

Table of Price Adjustment Data

[Please Refer to Price Bid]

NOT APPLICABLE

Bid Security

Bank Guarantee

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

(On Letter head of the Bank)

Beneficiary: ***..... 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 29.1 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; or

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

This guarantee will remain in force up to and including the date ***……[Insert 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 letter 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

- Design Methodology
- Construction Management Strategy
- Method Statement for Key Construction Activities
- Work Program (mobilization Schedule/Construction Schedule)
- Contract Personnel Organization Chart
- Risk Assessment
- Contractor's Personnel
- Contractor's Equipment
- Subcontractors
- Others

Subcontractors

Proposed Subcontractors for Major Activities/Sub-Activities

The following Subcontractors and/or manufacturers are proposed for carrying out the activity/subactivity indicated. Bidders are free to propose more than one Subcontractor for each activity/subactivity.

Activity / Sub-Activity	Proposed Subcontractors	Nationality

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 (Employer's 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.					

* As listed in Section VI (Employer's Requirements).

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 (Employer's 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.

Bidder's Information and Qualification Format

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 22.2. 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 22.2. 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 Contracts

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.

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 of 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		

Note: The letter from Bank must be in the prescribed format and stated details/terms and conditions as per the Bid Forms "Letter of Commitment for Bank's Undertaking for Line of Credit"

Form FIN – 4: Bid Capacity

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

Bid Capacity = [(5 x 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									

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: $B = \sum \left[\frac{(e) \times (a)}{(f)} \right] x12$, 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		
Total Contract Amount	☐ NRS ……..	Status of the Contract:	☐ Substantially Completed ☐ Completed
Award Date	Completion/Substantially Completion Date		
Role in Contract	☐ Contractor	☐ Management Contractor	☐ Subcontractor
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			
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; 1. Design Supply, Installation, Testing and Commissioning of Substation, or Design Supply, Installation, Testing and Commissioning Line Bay/s, or Design, Supply, Installation, Testing and Commissioning of Transmission Line and Substation Combined in the same contract. 2. The system voltage must be of 110kV or higher voltage level.			

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

Fill up one (1) form per contract.

Construction Experience in Key Activities			
Contract No…… of……..	Contract Identification		
Total Contract Amount	☐ NRS ……..	Status of the Contract:	☐ Substantially Completed ☐ Completed
Award Date	Completion/Substantially Completion Date		
Role in Contract	☐ Contractor	☐ Management Contractor	☐ Subcontractor
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 (b) of Section III			
Participation as Prime contractor, management contractor, or subcontractor, within a last ten (10) years, For the above or other contracts stipulated in 2.4.2(a) above, a minimum annual production rate on construction experience in the following key activities: 1. Design, supply, construction, installation, testing and commissioning of at least (1) line bay of 110 kV (or above voltage class) 2. 110 kV or above voltage class XLPE Cable works.			

Form EXP - 2(C): Similar Design Experience

For Bidder (Single Entity or Any One Partner in case of JV)

Fill up one (1) form per contract.

Similar Design Experience			
Contract No…… of…….	Contract Identification		
Name of Contractor			
Award Date			
Type of Contract	🗀 EPC	🗀 DB	🗀 If Others, Specify
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 (c) of Section III			
Either; participation as a Prime Contractor, Management Contractor, or Subcontractor in EPC/Turnkey/DB contract or similar construction contract; **or;** participation of a consultant nominated by the bidder, in at least one (1) contract within the last ten (10) years, responsible for design of 110 kV or above Voltage line bay.	**Design Description:**		

Form EXP - 2(C): Similar Design Experience

For Proposed Consultant Nominated by the Bidder

Fill up one (1) form per contract.

<table>
<tr><th colspan="3">Similar Design Experience</th></tr>
<tr><td colspan="2">Project Name:

Contract Identification No.:</td><td>Country and Location:</td></tr>
<tr><td colspan="2">Name of Consultant nominated by bidder:</td><td>Professional Staff Involved:</td></tr>
<tr><td colspan="2">Role of Consultant in the Project:</td><td></td></tr>
<tr><td colspan="2">Employer's Name
Address
Telephone/Fax
Number
E-mail</td><td></td></tr>
<tr><td>Start Date (Month/Year):</td><td>Completion Date (Month/Year):</td><td>Approx. Value of Services</td></tr>
<tr><td colspan="3">Description of the similarity in accordance with Criteria 2.4.2 (c) of Section III</td></tr>
<tr><td colspan="2">Either;
participation as a Prime Contractor, Management Contractor, or Subcontractor in EPC/Turnkey/DB contract or similar construction contract;
or;
participation of a consultant nominated by the bidder,
in at least one (1) contract within the last ten (10) years, responsible for design of 110 kV or above voltage line bay.</td><td>Design Description:</td></tr>
</table>

Form EXP-2(D): Understanding of the project

- Knowledge about project area
- Knowledge about planning stage
- Approach towards surveying and types of surveys to be done,
- Approach for geotechnical investigation and reporting details
- Types of environmental and social safeguard study to be done including the way such studies shall be conducted, Environmental Protection Plan
- Approach for designing
- Construction stage detailing (approach, quality assurance and control mechanism)
- Health Safety Plan
- Finalization of construction & modality of handover
- Mechanism for operation and maintenance (if mentioned in the bidding document)

Form EXP-2(E): Proposed Design format

- Design methodology
- Concept design
- Design finalization procedure
- Assurance about design
- Relevant codes for design

Section V - Eligible Countries

For GoN funded*:*

For the purpose of ITB 4.2: "**Nepal"**; and

For the purpose of Country-of-Origin ITB 5.1 and GCC 79.2: **"all Countries"**

Part II: REQUIREMENTS

Section VI Employer's Requirements (ERQ)

Section VII Activity and Price Schedule (APS)

Section VI - Employer's Requirements (ERQ)

This Section VI, Employer's Requirements contains the scope of Works, the Employer's Requirements and Supplementary Information that describe the Works, the Site Data, Personnel Requirements and Equipment Requirements to be used during the implementation of the Contract.

(Refer to Volume II: Employer's Requirements)

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3. Scope of the Design and Build Contract

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    5.8 Inspection and Testing Requirements

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    5.10 Progress Monitoring and Reporting

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    5.12 Any Other Project-Specific Requirements

6. Drawings

7. Supplementary Information 8. Personnel Requirements

9. Equipment Requirements

1. Introduction and Background

(Refer to Volume II: Employer's Requirements)

2. Purpose of the Works

(Refer to Volume II: Employer's Requirements)

3. Scope of the Design and Build Contract

(Refer to Volume II: Employer's Requirements)

4. Performance Requirement

(Refer to Volume II: Employer's Requirements)

5. Design–Build Period

(Refer to Volume II: Employer's Requirements)

5.1 Site Delineation, Use, Access, and Possession Details

(Refer to Volume II: Employer's Requirements)

5.2 Site Data

(Refer to Volume II: Employer's Requirements)

5.3 Sections and Phasing Requirements

(Refer to Volume II: Employer's Requirements)

5.4 Law, Regulations, Codes, and Standards

(Refer to Volume II: Employer's Requirements)

5.5 Environmental, Health and Safety (EHS) Requirements

(Refer to Volume II: Employer's Requirements)

5.6 Base Design Solution and Drawings

(Refer to Volume II: Employer's Requirements)

5.7 Contractor's Documents and Samples Submissions

Notes for the Employer

As stated in the note above on the drafting on the Employer's Requirements referring to Clause 27 of the Conditions of Contract, the Employer shall insert the list of documents that are required to be submitted by the Contractor, for the Engineer's review and/or approval. A sample list has been indicated below.

	Description	***For Review***	***For Review and approval (if any)***
1	*Design Schedule*		
2	*Preliminary Design*		
3	*Detailed Design*		
4			
5			
6			

The Employer should carefully weigh-in the documents that it requires for review and/or for approval. Unreasonable approval requirements may interfere in the Contractor's design process.

The Employer's Requirements may also require the Contractor to provide some or all of the following (Contractor's Documents for approval):

- *Stakeholder engagement plan.*
- *Environmental and social management plan.*
- *Occupational and health and safety management plan.*

- *Traffic management plan.*

5.8 Inspection and Testing Requirements

(Refer to Volume II: Employer's Requirements)

5.9 Quality Assurance and Control Requirements

5.10 Progress Monitoring and Reporting

Meetings

Notes for the Employer

This section shall detail what is expected with regards to the Management meetings foreseen under the Contract in furtherance to SCC 45.3.

Typically, this can incorporate, as a minimum:

- *monthly progress meetings to be held upon release of the monthly progress report under Clause 41, and*
- *weekly technical Site meetings.*

Consideration can also be given to add other specific meetings, such as:

- *quarterly progress meetings in the presence of senior/high level representatives of the Parties, who are typically not present on Site on a regular basis (e.g., the line manager of the Contractor's Representative, sitting at Headquarter (HQ) level, etc.)*
- *claim meetings,*
- *risk management meetings,*
- *etc.*

5.11 Technical Specifications

(Refer to Volume II: Employer's Requirements)

5.12 Any Other Project-Specific Requirements

(Refer to Volume II: Employer's Requirements)

6. Drawings

(Refer to Volume II: Employer's Requirements)

7. Supplementary Information

(Refer to Volume II: Employer's Requirements)

8. Personnel Requirements

Using Form PER-1 and PER-2 in Section IV (Bidding Forms), the Bidder must demonstrate it has personnel that meet the following requirements:

SN.	Position	Required No.	Academic Qualification *[When position demands]*	Total Work Experience [Years]	Experience in Similar Works [years]
Engineering					
1.	Project Manager	1 (one)	Master's degree in Engineering or Management with Bachelor's degree in Civil/Electrical Engineering	10	5
2.	Electrical Engineer	1 (one)	Bachelor's degree in Electrical Engineering	8	5
3.	Civil Engineer	1 (one)	Bachelor's degree in Civil Engineering	8	5
4.	Surveyor	1 (one)	Diploma in Surveying	5	5

Note: The personnel CV must be original signed.

9. Equipment Requirements

Using Form EQU in Section IV (Bidding Forms), the Bidder must demonstrate it has the key equipment listed below:

No.	Equipment Type and Characteristics	Min. Number Requirement
1	5 kV Megger	1
2	Primary injection kit (≥ 800 Amp)	1
3	Secondary injection kit (≥ 5 Amp)	1
4	Soil resistivity testing meter	1
5	Multi-meters	1
6	Concrete mixer with vibrator	1
7	High Voltage generator	1
8	Contact Resistance Tester	1
9	Cable cutter (Hydraulic pressure type)	1
10	Equipment for D.C Withstand voltage testing (200 kV, 2mA)	1
11	Total station	1

Section VII – Activity and Price Schedule (APS)

(Refer to Volume III: Bid Schedule)

Part III: CONDITIONS OF CONTRACT AND CONTRACT FORMS

Section VIII: General Conditions of Contract

Rastriya Prasaran Grid Company Limited

Design, Supply, Installation, Testing and Commissioning of 132kV Line Bays at Dhungesanghu Substation and Associated Underground Cabling Work

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General Conditions of Contract	
Clause	**Details**
A. General	
1. Definitions	1.1 Boldface type is used to identify defined terms. a) **Accepted Contract Amount** means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects. b) **Activity and Price Schedules** is a schedule of the activities comprising the construction, installation, testing, and commissioning of the Works in a Design and Build contract. It includes price's for each activity, which is used for valuations and for assessing the effects of Variations and Compensation Events. c) **Base Date** means the date 30 days prior to the latest date for submission of the Bid. d) **Compensation Events** are those defined in GCC 35.4 hereunder. e) **Completion Date** is the date of completion of the Works as certified by the Employer. f) "**Conditions of Contract**" or "**these conditions**" means these General Conditions as amended by the Special Conditions. g) **Contract** is the Contract between the Employer and the Contractor to design, execute, complete, and maintain the Works. It consists of the documents listed in GCC 2.3 below. h) **Contractor** is the party whose Bid to carry out the Works has been accepted by the Employer. i) **Contractor's Representative** means the person named by the Contractor in the Contract or appointed from time to time by the Contractor under Clause 12. [Contractor's Representative], who acts on behalf of the Contractor. j) **Contractor's Personnel** means the Contractor's Representative and all personnel whom the Contractor utilizes on Site, who may include the staff, labour and other employees of the Contractor and of each Subcontractor; and any other personnel assisting the Contractor in the execution of the Works. k) **Contractor's Documents** means the calculations, computer programs and other software, drawings, manuals, models and other documents of a technical nature (if any) supplied by the Contractor under the Contract; l) **Contractor's Bid** is the completed bidding document submitted by the Contractor to the Employer. m) **Contract Price** is the Accepted Contract Amount stated in the Letter of Acceptance and thereafter as adjusted in accordance with the Contract. n) **Commencement Date** is given i**n the SCC**. It is the latest date when the Contractor shall commence design and execution of the Works. It does not necessarily coincide with any of the Site Possession Dates. o) "**Contractor's Proposal**" means the document entitled proposal, which the Contractor submitted with the Letter of Bids, as included in the Contract. Such document may include the Contractor's preliminary

	design. p) **Days** are calendar days; months are calendar-months. q) **Dayworks** are varied work inputs subject to payment on a time basis for the Contractor's employees and Equipment, in addition to payments for associated Materials and Plant. r) **Defect** is any part of the Works not completed in accordance with the Contract. s) **Defects Liability Certificate** is the certificate issued by Employer upon correction of defects by the Contractor. t) **Defects Liability Period** is the period, as specified in the SCC, calculated from the Completion Date where the Contractor remains responsible for remedying defects. u) **Latent Defects Liability Period** is the period calculated from the Defects Liability Certificate where the Contractor remains responsible to correct any defect caused due to the design deficiency and quality of construction. v) **Design Checking Procedures** means the procedures set out in the Employer's Requirements for the checking of the Contractor's design for the Works. w) **Drawings** include calculations and other information provided or approved by the Employer for the execution of the Contract. x) **Employer** is the party who employs the Contractor to carry out the Works, as **specified in the SCC**. y) **Employer's Representative** means the person named by the Employer in the Contract or appointed from time to time by the Employer and notified to the Contractor under Clause 13. [The Employer's Representative], who shall carry out the duties assigned to him in the Contract. z) **Employer's Personnel** means the Employer's Representative, the assistants referred to in Clause 13.5 and all other staff, labour and other employees of the Employer's Representative, and any other personnel notified to the Contractor, by the Employer or the Employer's Representative, as Employer's Personnel aa) **Employer's Requirements** means the document entitled Employer's Requirements, as included in the Contract, and any additions and modifications to such document in accordance with the Contract. Such document specifies the purpose, scope, and/or design and/or other technical criteria, for the Works. bb) **Equipment** is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works. cc) **Force Majeure** means an exceptional event or circumstance: which is beyond a Party's control; which such Party could not reasonably have provided against before entering into the Contract; which, having arisen, such Party could not reasonably have avoided or overcome; and, which is not substantially attributable to the other Party. dd) **Initial Contract Price** is the Contract Price listed in the Employer's Letter of Acceptance. ee) **Intended Completion Date** is the date on which it is intended that the

	Contractor shall complete the Works. The Intended Completion Date is **specified in the SCC**. The Intended Completion Date may be revised only by the Employer by issuing an extension of time or an acceleration order. ff) **Letter of Acceptance** means the formal acceptance by the Employer of the Bid, including any annexed memoranda comprising agreements between and signed by both Parties, and denotes the formation of the contract at the date of acceptance. gg) **Materials** are all supplies, including consumables, used by the Contractor for incorporation in the Works. hh) **Party** means the Employer or the Contractor, as the context requires. ii) **Physical conditions** mean natural physical conditions and manmade and other physical obstructions and pollutants, which the Contractor encounters at the Site when executing the Works, including sub-surface and hydrological conditions but excluding climatic conditions. jj) **SCC** means Special Conditions of Contract kk) **Plant** is any integral part of the Works that shall have a mechanical, electrical, chemical, or biological function. ll) **Retention Money** means the aggregate of all monies retained by the Employer pursuant to GCC 60.1 mm) **Schedules** means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Bids, as included in the Contract. Such document may include the Activity and Price Schedules, data, and lists. nn) **Site** means the places **specified in the SCC** where the Permanent Works are to be executed and to which Plant and Materials are to be delivered, and any other places as may be specified in the Contract as forming part of the Site. oo) **Site Investigation Reports** are those that were included in the bidding documents and are factual and interpretative reports about the surface and subsurface conditions at the Site. pp) **Specification** means the Specification of the Works included in the Contract and any modification or addition made or approved by the Employer. qq) **Subcontractor** is a person or corporate body who has a Contract with the Contractor to carry out a part of the works in the Contract, which includes work on the Site. rr) **Temporary Works** are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works. ss) **Tests on Completion** means the tests which are specified in the Contract or agreed by both Parties or instructed as a Variation, and which are carried out before the Works are taken over by the Employer. tt) **Tests after Completion** means the tests (if any) which are specified in the Contract which are carried out after the Works are taken over by the Employer. uu) **Variation** is an instruction given by the Employer which varies the Works vv) **Works** are what the Contract requires the Contractor to design, construct,

	install, and turn over to the Employer, as **defined in the SCC**.
2. Interpretation	2.1 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 recorded in writing, and (d) "written" or "in writing" means hand-written, type-written, 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.
	2.2 If sectional completion is **specified in the SCC**, references in the GCC to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).
	2.3 The documents forming the Contract shall be interpreted in the following order of priority: (a) Contract Agreement, (b) Letter of Acceptance, (c) Letters of Technical Bid and Price Bid, (d) Special Conditions of Contract, (e) General Conditions of Contract, (f) Employer's Requirements, (g) Activity and Price Schedules, and (i) Contractor's Proposal and (j) Any other document **listed in the SCC** as forming part of the Contract.
3. Law and Language	3.1 The law governing the Contract is the law of Nepal.
	3.2 Throughout the execution of the Contract, the Contractor shall comply with the import of goods and services prohibitions in the Employer's country when 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, the Employer's Country prohibits any import of goods from, or any payments to, a particular country, person, or entity. Where the Employer's country prohibits payments to a particular firm or for particular goods by such an act of compliance, that firm may be excluded.
	3.3. The language for communications shall be that stated **in the SCC**. If no language is stated there, the language for communications shall be the language in which the Contract (or most of it) is written.
4. Contract Agreement	4.1 The Contract shall come into full force and effect on the date stated in the Contract Agreement.
	4.2 Without altering the basic nature or scope of work, the agreement could be revised upon mutual written consent as per prevailing Public Procurement Law.

	4.3 The Contractor shall design, execute and complete the Works in accordance with the Contract, and shall remedy any defects in the Works. When completed, the Works shall be fit for the purposes for which the Works are intended as defined in the Contract.
	4.4 The Contractor shall provide the Plant and Contractor's Documents specified in the Contract, and all Contractor's Personnel, Goods, consumables and other things and services, whether of a temporary or permanent nature, required in and for this design, execution, completion and remedying of defects.
	4.5 The Works shall include any work which is necessary to satisfy the Employer's Requirements, Contractor's Proposal and Schedules, or is implied by the Contract, and all works which (although not mentioned in the Contract) are necessary for stability or for the completion, or safe and proper operation, of the Works.
	4.6 Throughout the design and execution of the Works, and as long thereafter as is necessary to fulfil the Contractor's obligations, the Contractor shall provide all necessary superintendence to plan, arrange, direct, manage, inspect and test the work. Superintendence shall be given by a sufficient number of persons having adequate knowledge of the language for communications (defined in Clause 3. [Law and Language]) and of the operations to be carried out (including the methods and techniques required, the hazards likely to be encountered and methods of preventing accidents), for the satisfactory and safe execution of the Works.
	4.7 The Contractor shall be responsible for the adequacy, stability and safety of all Site operations, of all methods of construction and of all the Works.
	4.8 The Contractor shall, whenever required by the Employer, submit details of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works. No significant alteration to these arrangements and methods shall be made without this having previously been notified to the Employer.
	4.9 If the Contractor encounters adverse physical conditions **as stated in SCC** which he considers to have been Unforeseeable, the Contractor shall give notice to the Employer as soon as practicable. This notice shall describe the physical conditions, so that they can be inspected by the Employer, and shall set out the reasons why the Contractor considers them to be Unforeseeable. The Contractor shall continue executing the Works, using such proper and reasonable measures as are appropriate for the physical conditions, and shall comply with any instructions which the Employer may give. If an instruction constitutes a Variation, Clause 53. [Variations] shall apply.
	4.10 If and to the extent that the Contractor encounters physical conditions which are Unforeseeable, gives such a notice, and suffers delay and/or incurs Cost due to these conditions, the Contractor shall be entitled subject to Clause 35. [Contractor's Claims] to: (a) an extension of time for any such delay, if completion is or will be delayed, under Clause 42. [Extension of Intended Completion Date], and (b) Payment for any such Cost, which shall be added to the contract price.
	4.11 After receiving such notice and inspecting and/or investigating these physical

	conditions, the Employer shall proceed in accordance with Clause 32. [Determinations] to agree or determine (i) whether and (if so) to what extent these physical conditions were Unforeseeable, and (ii) the matters described in subparagraphs (a) and (b) above related to this extent.
	4.12 Subject to any mandatory requirements under the governing law of the Contract, termination of the Contract under any Clause of these Conditions shall require no action of whatsoever kind by either Party other than as stated in the Clause.
5. Use of Contractor's Documents	5.1 The Contractor shall retain the copyright and other intellectual Contractor's Documents property rights in the Contractor's Documents and other design documents made by (or on behalf of) the Contractor. The Contractor shall be deemed (by signing the Contract) to give to the Employer a non-terminable transferable non-exclusive royalty-free license to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This license shall: (a) apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works, (b) entitle any person in proper possession of the relevant part of the Works to copy, use and communicate the Contractor's Documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the Works, and (c) in the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the Site and other places as envisaged by the Contract, including replacements of any computers supplied by the Contractor. (d) in the event of termination of the Contract, entitles the Employer to copy, use and communicate the Contractor's Documents and the other design documents made by or for the Contractor for the purpose of completing the Works and/or arranging for any other entities to do so.
	5.2 The Contractor's Documents and other design documents made by (or on behalf of) the Contractor, shall not, without the Contractor's consent, be used, copied of communicated to a third party by (or on behalf of) the Employer for purposes other than those permitted under this Clause.
6. Contractor's Use of Employer's Documents	6.1 The Employer shall retain the copyright and other Employer's intellectual property rights in the Employer's Requirements and other documents made by (or on behalf of) the Employer. The Contractor may, at his cost, copy, use, and obtain communication of these documents for the purposes of the Contract. They shall not, without the Employer's consent, be copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the Contract.
7. Assignment	7.1 Neither Party shall assign the whole or any part of the Contract or any benefit or interest in or under the Contract. However, either Party (a) may assign the whole or any part with the prior agreement of the other Party, at the sole discretion of such other Party; and (b) may, as security in favor of a commercial bank or financial institution, assign the party's right to any moneys due, or to become due, under the Contract without the prior agreement of the other Party.

8. Care and Supply of Documents	8.1 Each of the Contractor's Documents shall be in the custody and care of the Contractor, unless and until taken over by the Employer. Unless otherwise stated in the Contract, the Contractor shall supply to the Employer's Representative six copies of each of the Contractor's Documents.
	8.2 The Contractor shall keep at all times, on the Site, a copy of: a) the Contract; b) the publications (if any) named in the Employer's Requirements; c) the Contractor's Documents (if any); d) the Drawings and e) Variations and other communications given under the Contract. The Employer's Personnel shall have the right of access to all these documents at all reasonable times.
	8.3 If a Party becomes aware of an error or defect in a document which was prepared for use in executing the Works, the Party shall promptly give notice to the other Party of such error or defect.
9. Confidential Details	9.1 The Contractor's and the Employer's Personnel shall disclose all such confidential and other information as may be reasonably required in order to verify the Contractor's compliance with the Contract and allow its proper implementation.
	9.2 Each of them shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out their respective obligations under the Contract or to comply with applicable Laws. Each of them shall not publish or disclose any particulars of the Works prepared by the other Party without the previous agreement of the other Party. However, the Contractor shall be permitted to disclose any publicly available information, or information otherwise required to establish his qualifications to compete for other projects.
	9.3 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 Clause.
10. Compliance with Laws	10.1 The Contractor shall, in performing the Contract, comply with applicable Laws of Nepal. Unless otherwise **stated in the SCC**: (a) the Employer shall have obtained (or shall obtain) the planning, zoning or similar permission for the Permanent Works, and any other permissions described in the Employer's Requirements as having been (or being) obtained by the Employer. The Employer shall indemnify and hold the Contractor harmless against and from the consequences of any failure to do so; and (b) the Contractor shall give all notices, pay all taxes, duties and fees, and obtain all permits, licenses and/or approvals, as required by the Laws in relation to the design, execution and completion of the Works and the remedying of any defects. The Contractor shall indemnify and hold the Employer harmless against and from the consequences of any failure to do so.

	10.2 The Employer shall (where he is in a position to do so) provide reasonable assistance to the Contractor at the request of the Contractor: (a) by obtaining copies of the Laws of Nepal which are relevant to the Contract but are not readily available, and (b) for the Contractor's applications for any permits, licenses or approvals required by the Laws of Nepal: (i) which the Contractor is required to obtain under Clause 10.1, (ii) for the delivery of Goods, including clearance through customs, and (iii) for the mobilization/de-mobilization of Contractor's Equipment on/from the Site.
11. Joint and Several Liability	11.1 If the Contractor is a joint venture of two or more entities, all such entities shall be jointly and severally liable 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. The contractor shall not handover the responsibility of the contract to any one member or some members of Joint Venture or any other parties, not involved in the contract. The composition or the constitution of the joint venture shall not be altered without the prior consent of the Employer.
12. Contractor's Representative	12.1 The Contractor shall appoint the Contractor's Representative and shall give him all authority necessary to act on the Contractor's behalf under the Contract.
	12.2 Unless the Contractor's Representative is named in the Contract, the Contractor shall, prior to the Commencement Date, submit to the Employer for consent the name and particulars of the person the Contractor proposes to appoint as Contractor's Representative. If consent is withheld or subsequently revoked, or if the appointed person fails to act as Contractor's Representative, the Contractor shall similarly submit the name and particulars of another suitable person for such appointment.
	12.3 The Contractor shall not, without the prior consent of the Employer, revoke the appointment of the Contractor's Representative or appoint a replacement. The Contractor's Representative shall, on behalf of the Contractor, receive instructions under Clause 33. [Instructions, Inspection and Audits]. The whole time of the Contractor's Representative shall be given to directing the Contractor's performance of the Contract. The Contractor's Representative shall be based at the Site for the whole time that the Works are being executed at the Site. If the Contractor's Representative is to be temporarily absent from the Site during the execution of the Works, a suitable replacement person shall be appointed, subject to the Employer's prior consent, and the Employer shall be notified accordingly.
	12.4 The Contractor's Representative may delegate any powers, functions and authority to any competent person, and may at any time revoke the delegation. Any delegation or revocation shall not take effect until the Employer has received prior notice signed by the Contractor's Representative, naming the person and specifying the powers, functions and authority being delegated or revoked.
	12.5 The Contractor's Representative and all these persons shall be fluent in

	the language for communications defined in Clause 3. [Law and Language].
13. The Employer's Representative	13.1 The Employer may appoint an Employer's Representative to act on his behalf under the Contract. In this event, he shall give notice to the Contractor of the name, address, duties and authority of the Employer's Representative.
	13.2 The Employer's Representative shall carry out the duties assigned to him, and shall exercise the authority delegated to him, by the Employer. Unless and until the Employer notifies the Contractor otherwise, the Employer's Representative shall be deemed to have the full authority of the Employer under the Contract, except in respect of Clause 79 [Termination by Employer] , to amend the Contract and to relieve either Party of any duties, obligations or responsibilities under the Contract.
	13.3 Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by the Employer or Employer Representative (including absence of disapproval) shall not relieve the Contractor from any responsibility he has under the Contract, including responsibility for errors, omissions, discrepancies and non-compliances.
	13.4 If the Employer wishes to replace any person appointed as Employer's Representative, the Employer shall give the Contractor not less than 15 days' notice of the replacement's name, address, duties and authority, and of the date of appointment.
	13.5 The Employer or the Employer's Representative may from time to time assign duties and delegate authority to assistants, and may also revoke such assignment or delegation, by giving a Notice to the Contractor of the name, assigned duties and delegated authority of the assistant. The assignment, delegation or revocation shall not take effect until this Notice has been received by the Contractor.
	13.6 Assistants shall be suitably qualified persons, who are competent to carry out these duties and exercise this authority, and who are fluent in the language for communications defined in Clause 3. [Law and Language].
14. Delegation	14.1 All these persons, including the Employer's Representative and assistants, to whom duties have been assigned or authority has been delegated, shall only be authorized to issue instructions to the Contractor to the extent defined by the delegation. Any approval, check, certificate, consent, examination, Inspection, instruction, notice, proposal, request, test, or similar act by a delegated person, in accordance with the delegation, shall have the same effect as though the act had been an act of the Employer. However: (a) unless otherwise stated in the delegated person's communication relating to such act, it shall not relieve the Contractor from any responsibility he has under the Contract, including responsibility for errors, omissions, discrepancies and non-compliances; (b) any failure to disapprove any work, Plant or Materials shall not constitute approval, and shall therefore not prejudice the right of the Employer to reject the work, Plant or Materials; and (c) if the Contractor questions any determination or instruction of a delegated person, the Contractor may refer the matter to the Employer, who shall promptly confirm, reverse or vary the determination or instruction.

15. Communications	15.1 Communications between parties that are referred to in the Conditions shall be effective only when in writing. Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices and requests, these communications shall be: (a) in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as **stated in the SCC**; and (b) delivered, sent or transmitted to the address for the recipient's communications as stated in the Contract. However: (i) if the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and (ii) if the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued. Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed.
16. Subcontracting	16.1 The Contractor shall not subcontract the maximum % value of whole Works, **as stated in the SCC**. The Contractor shall be responsible for the acts or defaults of any Subcontractor, his agents or employees, as if they were the acts or defaults of the Contractor. The Sub contractor shall meet the qualification requirement **as specified in SCC**. Unless otherwise **specified in the SCC**: (a) the Contractor shall not be required to obtain consent to suppliers of Materials, or to a subcontract for which the Subcontractor is named in the Contract, (b) the prior consent of the Employer shall be obtained to other proposed Subcontractors; and (c) the Contractor shall give the Employer not less than 30 days' notice of the intended date of commencement of each Subcontractor's work, and the commencement of such work on the Site.
	16.2 In the event of approved subcontracting the Contractor shall ensure that Subcontractors do not further sub-let their contract.
	16.3 The Contractor shall not terminate the engagement of a subcontractor without the prior written consent of the Employer.
	16.4 The Contractor shall keep a log showing the following information on the Sub Contractors, suppliers and transporters engaged in the contract works: • Name and Address • Copy of Sub Contracting Agreement • Works and value contract • Commencement and completion dates • Copy of payment certificates
	16.5 The contractor shall give prior notice to the Employer clearly specifying the nature, scope, and responsibilities of the work to be performed, to engage other subcontractors, material suppliers, equipment suppliers, service providers, or other persons or entities during the implementation of the contract.

	16.6 Before notifying the Employer as per GCC 16.5, the contractor shall enter into a written agreement with the subcontractor, material suppliers, equipment suppliers, service providers, or other persons or entities clearly specifying the scope of work, responsibilities, quality requirements, duration, payment terms, security, labor-related obligations, and conditions relating to performance of the work.
	16.7 Any subcontracting arrangement made in accordance with GCC 16.5 shall not relieve the Contractor of any of its obligations or liabilities under the Contract.
	16.8 The contractor shall provide the Employer with details of the payments made to the subcontractor, material suppliers, equipment suppliers, service providers, or other persons or entities engaged under GCC 16.1 and/or GCC 16.5.
	16.9 If the contractor is found not to have made payment to the subcontractor, material suppliers, equipment suppliers, service providers, or other persons or entities engaged under GCC 16.1 and/or GCC 16.5 in accordance with the terms of the agreement, the Employer may determine the amount payable to such subcontractor, material suppliers, equipment suppliers, service providers, or other persons or entities and make payment to them from any remaining dues to be paid to the contractor, retention money, or forfeited performance security.
17. Other Contractors	17.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer between the dates given in the Schedule of Other Contractors, **as stated in the SCC**. The Contractor shall also provide facilities and services for them as described in the Schedule. The Employer may modify the Schedule of Other Contractors, and shall notify the Contractor of any such modification
18. Personnel and Equipment	18.1 The Contractor shall employ the key personnel and use the equipment identified in its Bid to carry out the Works, or other personnel and equipment approved by the Employer. The Employer shall approve any proposed replacement of key personnel and equipment only if their relevant qualifications or characteristics are substantially equal to or better than those proposed in the Bid.
	18.2 The Contractor's Personnel shall be appropriately qualified, skilled and experienced in their respective trades or occupations. The Employer may require the Contractor to remove (or cause to be removed) any person employed on the Site or Works, including the Contractor's Representative if applicable, who: (a) persists in any misconduct or lack of care, (b) carries out duties incompetently or negligently, (c) fails to conform with any provisions of the Contract, or (d) Persists in any conduct which is prejudicial to safety, health, or the protection of the environment. If appropriate, the Contractor shall then appoint (or cause to be appointed) a suitable replacement person.
	18.3 The Contractor shall be responsible for all Contractor's Equipment. When brought on to the Site, Contractor's Equipment shall be deemed to be exclusively intended for the execution of the Works.

	The Contractor shall not remove from the Site any major items of Contractor's Equipment without the consent of the Employer. However, consent shall not be required for vehicles transporting Goods or Contractor's Personnel off Site.
	18.4 The Contractor shall submit, to the Employer, details showing the number of each class of Contractor's Personnel and of each type of Contractor's Equipment on the Site.
	18.5 Details shall be submitted each calendar month, in a form approved by the Employer, until the Contractor has completed all work.
	18.6 The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst the Contractor's Personnel, and to preserve peace and protection of persons and property on and near the Site.
	18.7 Each item of Plant and Materials shall, to the extent consistent with the Laws of Nepal, become the property of the Employer at whichever is the earlier of the following times, free from liens and other encumbrances: (a) when it is delivered to the Site; (b) when the Contractor is entitled to payment of the value of the Plant and Materials under Clause 44. [Delays Ordered by the Employer].
19.Indemnities	19.1 The Contractor shall indemnify and hold harmless the Employer, the Employer's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of: (a) bodily injury, sickness, disease or death, of any person whatsoever arising out of or in the course of or by reason of the design, execution and completion of the Works and the remedying of any defects, unless attributable to any negligence, willful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and (b) damage to or loss of any property, real or personal (other than the Works), to the extent that such damage or loss; (i) arises out of or in the course of or by reason of the Contractor's design, execution and completion of the Works and the remedying of any defects, and (ii) is attributable to any negligence, willful act or breach of the Contract by the Contractor, the Contractor's Personnel, their respective agents, or anyone directly or indirectly employed by any of them.
	19.2 The Employer shall indemnify and hold harmless the Contractor, the Contractor's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of (a) bodily injury, sickness, disease or death, which is attributable to any negligence, willful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and (b) the matters for which liability may be excluded from insurance cover, is (i) the Employer's right to have the Permanent Works executed on, over, under, in or through any land, and to occupy this land for the Permanent Works, (ii) damage which is an unavoidable result of the Contractor's obligations to execute the Works and remedy any defects, and (iii) a cause listed under Employer's Risks, except to the extent that

	cover is available at commercially reasonable terms.
	19.3 Neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with the Contract, other than under Clause 83.[Payment upon Termination] and Clause 19.1. This Clause shall not limit liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Party.
	19.4 The Contractor shall take full responsibility for the care of the items **listed in the SCC (if any)**, from the respective dates of use or occupation by the Contractor, up to the respective dates of hand-over or cessation of occupation (where hand-over or cessation of occupation may take place after the date stated in the Taking-Over Certificate for the Works). If any loss or damage happens to any of the above items while the Contractor is responsible for their care, arising from any cause whatsoever other than those for which the Employer is liable, the Contractor shall, at his own cost, rectify the loss or damage to the satisfaction of the Employer.
20. Intellectual and Industrial Property Rights	20.1 In this Clause, "infringement" means an infringement (or alleged infringement) of any patent, registered design, copyright, trade mark, trade name, trade secret or other intellectual or industrial property right relating to the Works; and "claim" means a claim (or proceedings pursuing a claim) alleging an infringement.
	20.2 Whenever a Party does not give notice to the other Party of any claim within 30 days of receiving the claim, the first Party shall be deemed to have waived any right to indemnity under this Clause.
	20.3 The Employer shall indemnify and hold the Contractor harmless against and from any claim alleging an infringement which is or was: (a) an unavoidable result of the Contractor's compliance with the Employer's Requirements, or (b) a result of any Works being used by the Employer: (i) for a purpose other than that indicated by, or reasonably to be inferred from, the Contract, or (ii) in conjunction with anything not supplied by the Contractor, unless such use was disclosed to the Contractor prior to the Base Date or is stated in the Contract.
	20.4 The Contractor shall indemnify and hold the Employer harmless against and from any other claim which arises out of or in relation to (i) the Contractor's design, manufacture, construction or execution of the Works, (ii) the use of Contractor's Equipment, or (iii) the proper use of the Works.
	20.5 If a Party is entitled to be indemnified under this Clause, the indemnifying Party may (at its cost) conduct negotiations for the settlement of the claim, and any litigation or arbitration which may arise from it. The other Party shall, at the request and cost of the indemnifying Party, assist in contesting the claim. This other Party (and its Personnel) shall not make any admission which might be prejudicial to the indemnifying Party, unless the indemnifying Party failed to take over the conduct of any negotiations, litigation or arbitration upon being

	requested to do so by such other Party.
21. Employer's Risks	21.1 From the Commencement Date until the Defects Liability Certificate has been issued, the following are Employer's risks: (a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies, (b) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war, within Nepal, (c) riot, commotion or disorder within Nepal by persons other than the Contractor's Personnel, (d) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, within Nepal, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity, . (e) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds, (f) use or occupation by the Employer of any part of the Permanent Works, except as may be specified in the Contract, (g) design of any part of the Works by the Employer's Personnel or by others for whom the Employer is responsible, if any, and (h) any operation of the forces of nature which is Unforeseeable or against which an experienced contractor could not reasonably have been expected to have taken adequate preventive precautions
	21.2 From the Completion Date until the Defects Liability Certificate has been issued, the risk of loss of or damage to the Works, Plant, and Materials is an Employer's risk except loss or damage due to (a) a Defect which existed on the Completion Date, (b) an event occurring before the Completion Date, which was not itself an Employer's risk, or (c) the activities of the Contractor on the Site after the Completion Date.
	21.3 If and to the extent that any of the risks listed in Clause 21.1 above results in loss or damage to the Works, Goods or Contractor's Documents, the Contractor shall promptly give notice to the Employer and shall rectify this loss or damage to the extent required by the Employer.
	21.4 If the Contractor suffers delay and/or incurs Cost from rectifying this loss or damage, the Contractor shall give a further notice to the Employer and shall be entitled subject to Clause 35. [Contractor's Claims] to: (a) an extension of time for any such delay, if completion is or will be delayed, under Clause 42 [Extension of Intended Completion Date], and (b) payment of any such Cost, which shall be added to the Contract Price.
	21.5 After receiving this further notice, the Employer shall proceed in accordance with Sub Clause 32. [Determinations] to agree or determine

	these matters.
22. Contractor's Risks	22.1 From the Commencement Date until the Defects Liability Certificate has been issued; i) the Contractor shall bear all risks arising from design, drawings, geotechnical conditions, commercial matters, technical issues, and any other related causes, except for claims made by the Contractor during the scrutiny period (claim period) relating to unforeseen changes in the physical conditions of the site due to natural disasters. ii) the risks of personal injury, death, and loss of or damage to property (including, without limitation, the Design, Works, Plant, Materials, and Equipment) and other contractor's obligations mentioned in the Contract, which are not Employer's risks are Contractor's risks.
	22.2 If any loss or damage happens to the Works, Goods or Contractor's Documents during the period when the Contractor is responsible for their care, from any cause not listed in Clause 21.1, the Contractor shall rectify the loss or damage at the Contractor's risk and cost, so that the Works, Goods and Contractor's Documents conform with the Contract.
	22.3 The Contractor shall bear the risk of any changes or increases in the cost of labour, materials, or equipment, except to the extent that the provisions for price adjustment, if stated in the Contract, are applicable.
23. Insurance	23.1 The Contractor shall be responsible for effecting and maintaining the insurance specified in the relevant Clause. Each insurance shall be affected with insurers and in terms approved by the Employer. These terms shall be consistent with any terms agreed by both Parties before they signed the Contract Agreement.
	23.2 The Contractor shall provide insurance in the joint names of the Employer and the Contractor from the Commencement Date to the end of the Defects Liability Period, in the amounts and deductibles per occurrence of not more than the amount **stated in the SCC** for the following events which are due to the Contractor's risks: (a) loss of or damage to the Works, Plant, and Materials; (b) loss of or damage to Equipment; (c) loss of or damage to property (except the Works, Plant, Materials, and Equipment) in connection with the Contract; (d) Personal injury or death; and (e) Liability for breach of professional duty. Liability for breach of professional duty : To the extent, if any, that the Contractor is responsible for the design of part of the Permanent Works under the Contract, and consistent with the indemnities specified in Clause 19 [Indemnities]: (a) the Contractor shall effect and maintain professional indemnity insurance against liability arising out of any act, error or omission by the Contractor in carrying out the Contractor's design obligations in an amount not less than that **stated in the SCC** (if not stated, the amount agreed with the Employer); and (b) **if stated in the SCC**, such professional indemnity insurance shall also indemnify the Contractor against liability arising out of any act, error or omission by the Contractor in carrying out the Contractor's design obligations under the Contract that results in the Works (or Section or Part or major item of Plant, if any), when completed,

	not being fit for the purpose(s) for which they are intended under the Contract. The Contractor shall maintain this insurance for the period specified **in the SCC.**
	23.3 The Contractor shall insure the Works, Plant, Materials and Contractor's Documents for not less than the full reinstatement cost including the costs of demolition, removal of debris and professional fees and profit.
	23.4 The Contractor shall insure the Contractor's Equipment for not less than the full replacement value, including delivery to Site. For each item of Contractor's Equipment, the insurance shall be effective while it is being transported to the Site and until it is no longer required as Contractor's Equipment.
	23.5 The Contractor shall insure against each Party's liability for any loss, damage, death or bodily injury which may occur to any physical property (except for Works and Contractor's Equipment) or to any person (except Contractor's Personnel), which may arise out of the Contractor's performance of the Contract and occurring before end of Defect Liability Period.
	23.6 The Contractor shall effect and maintain insurance against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor's Personnel. The Employer shall also be indemnified under the policy of insurance, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel. The insurance shall be maintained in full force and effect during the whole time that these personnel are assisting in the execution of the Works. For a Subcontractor's employees, the insurance may be effected by the Subcontractor, but the Contractor shall be responsible for compliance with this Clause.
	23.7 Policies, certificates and evidence of premium payment for insurance shall be delivered by the Contractor to the Employer for the Employer's approval before the Commencement Date.
	23.8 If the Contractor does not provide any of the policies and certificates required, the Employer may affect the insurance which the Contractor should have provided and recover the premiums the Employer has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.
	23.9 The contractor shall keep the insurers informed of any relevant changes to the execution of the Works and ensure that insurance is maintained in accordance with this Clause
	23.10 Nothing in this Clause limits the obligations, liabilities or responsibilities of the Contractor, under the other terms of the Contract or otherwise. Any amounts not insured or not recovered from the insurers shall be borne by the Contractor in accordance with these obligations, liabilities or responsibilities. However, if the Contractor fails to effect and keep in force an insurance which is available and which it is required to effect and maintain under the Contract, and the Employer neither approves the omission nor effects insurance for the

	coverage relevant to this default, any moneys which should have been recoverable under this insurance shall be paid by the Contractor
	23.11 Alterations to the terms of insurance shall not be made without the approval of the Employer.
	23.12 Both parties shall comply with any conditions of the insurance policies.
24. Site Data and Investigation Reports	24.1 The Contractor, in preparing the Bid, shall rely on any Site Investigation Reports referred to **in the SCC,** if any, supplemented by any information available to the Contractor. The Contractor shall be responsible for verifying and interpreting all such data.
	24.2 The Contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Bid or Works. The Contractor shall be deemed to have inspected and examined the Site, its surroundings, the above data and other available information, and to have been satisfied before submitting the Tender as to all relevant matters, including (without limitation): (a) the form and nature of the Site, including sub-surface conditions, (b) the hydrological and climatic conditions, (c) the extent and nature of the work and Goods necessary for the execution and completion of the Works and the remedying of any defects, (d) the Laws, procedures and labour practices of Nepal, and (e) the Contractor's requirements for access, accommodation, facilities, personnel, power, transport, water and other services.
25. Contractor to Construct the Works	25.1 The Contractor shall construct and install the Works in accordance with the Employer's Requirements.
	25.2 The Contractor shall set out the Works in relation to original points, lines and levels of reference specified in the Contract or notified by the Employer or Employer Representative. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the Works.
	25.3 The Employer shall be responsible for any errors in these specified or notified items of reference, but the Contractor shall use reasonable efforts to verify their accuracy before they are used.
26. Works to Be Completed within intended Completion Date	26.1 The Contractor may commence execution of the Works on the Commencement Date and shall carry out the Works in accordance with the Program submitted by the Contractor, as updated with the approval of the Employer, and complete them within the intended Completion Date
	26.2 The Contractor shall confine his operations to the Site, and to any additional areas which may be obtained by the Contractor and agreed by the Employer as working areas. The Contractor shall take all necessary precautions to keep Contractor's Equipment and Contractor's Personnel within the Site and these additional areas, and to keep them off adjacent land.

	26.3 During the execution of the Works, the Contractor shall keep the Site free from all unnecessary obstruction, and shall store or dispose of any Contractor's Equipment or surplus materials. The Contractor shall clear away and remove from the Site any wreckage, rubbish and Temporary Works which are no longer required.
	26.4 Upon the issue of the Taking-Over Certificate for the Works, the Contractor shall clear away and remove all Contractors' Equipment, surplus material, wreckage, rubbish and Temporary Works. The Contractor shall leave the Site and the Works in a clean and safe condition. However, the Contractor may retain on Site, during the Defects Liability Period, such Goods as are required for the Contractor to fulfil obligations under the Contract.
27. Design by Contractor	27.1 The Contractor shall carry out, and be responsible for, the design of the Works and their related specification, drawings etc. Design shall be prepared by qualified designers who: a) are engineers or other professionals, qualified, experienced and competent in the disciplines of the design for which they are responsible; b) comply with the criteria (if any) stated in the Employer's Requirements; and c) are qualified and entitled under applicable Laws to design the Works. Unless otherwise stated in the Contract, the Contractor shall submit to the Employer for consent the name and particulars of each proposed designer and design Subcontractor. The contractor shall submit the design and drawings, along with the project specifications, to the employer within the period as specified in the **SCC** in order to commence the construction works. The employer shall, through a technical person, a group of technical experts, or third-party specialists, verify whether the submitted design, drawings and Specification conform to the project's scope and standards, incorporating any necessary corrections or addressing shortcomings by the contractor, if any. The employer shall notify the contractor within thirty days from the date of receipt of the design, drawings, and specifications regarding the commencement of construction works.
	27.2 The Contractor warrants that he, his designers and Design Consultant or Design Subcontractor have the experience and capability necessary for the design. The Contractor undertakes that the designers shall be available to attend discussions with the Employer at all reasonable times, until the expiry date of the relevant Defects Liability Period.
	27.3 Upon receiving work order or Site Possession, the Contractor shall scrutinize the Employer's Requirements (including design criteria and calculations, if any) and the items of reference mentioned in Clause 25.2. Within the period **stated in the SCC**, calculated from the Commencement Date, the Contractor shall give notice to the Employer of any error, fault or other defect found in the Employer's Requirements or these items of reference.
	27.4 After receiving this notice, the Employer shall determine whether Clause 53. [Variations] shall be applied, and shall give notice to the Contractor accordingly. If and to the extent that (taking account of cost and time) an experienced contractor exercising due care would have discovered the

	error, fault or other defect when examining the Site and the Employer's Requirements before submitting the Tender, the Time for Completion shall not be extended and the Contract Price shall not be adjusted.
	27.5 The Contractor's Documents shall comprise the technical documents specified in the Employer's Requirements, documents required to satisfy all regulatory approvals, and the documents described in the Clause 78. [Operating and Maintenance Manuals]. Unless otherwise stated in the Employer's Requirements, the Contractor's Documents shall be written in the language for communications defined in Clause 3. [Law and Language].
	27.6 The Contractor shall prepare all Contractor's Documents, and shall also prepare any other documents necessary to instruct the Contractor's Personnel. The Employer's Personnel shall have the right to inspect the preparation of all these documents, wherever they are being prepared.
	27.7 If the Employer's Requirements describe the Contractor's Documents which are to be submitted to the Employer after Design Approval; for review and/or for approval, they shall be submitted accordingly, together with a notice as described below. In the following provisions of this Clause, (i) "**review period**" means the period required by the Employer for review and (if so specified) for approval, and (ii) "Contractor's Documents" exclude any documents which are not specified as being required to be submitted for review and/or for approval.
	27.8 Unless otherwise stated in the Employer's Requirements, each review period shall not exceed 30 days, calculated from the date on which the Employer receives a Contractor's Document and the Contractor's notice. This notice shall state that the Contractor's Document is considered ready, both for review (and approval, if so specified) in accordance with this Clause and for use. The notice shall also state that the Contractor's Document complies with the Contract, or the extent to which it does not comply.
	27.9 The Employer may, within the review period, give notice to the Contractor that a Contractor's Document fails (to the extent stated) to comply with the Contract. If a Contractor's Document so fails to comply, it shall be rectified, resubmitted and reviewed (and, if specified, approved) in accordance with this Clause, at the Contractor's cost.
	27.10 For each part of the Works, and except to the extent that the prior approval or consent of the Employer shall have been obtained: (a) in the case of a Contractor's Document which has (as specified) been submitted for the Employer 's approval: (i) the Employer shall give notice to the Contractor that the Contractor's Document is approved, with or without comments, or that it fails (to the extent stated) to comply with the Contract; (ii) execution of such part of the Works shall not commence until the Employer has approved the Contractor's Document; and (iii) the Employer shall be deemed to have approved the Contractor's Document upon the expiry of the review periods for all the Contractor's Documents which are relevant to the design and execution of such part, unless the Employer has previously

	notified otherwise in accordance with sub-paragraph (i); (b) execution of such part of the Works shall not commence prior to the expiry of the review periods for all the Contractor's Documents which are relevant to its design and execution; (c) execution of such part of the Works shall be in accordance with these reviewed (and, if specified, approved) Contractor's Documents; and (d) if the Contractor wishes to modify any design or document which has previously been submitted for review (and, if specified, approval), the Contractor shall immediately give notice to the Employer. Thereafter, the Contractor shall submit revised documents to the Employer in accordance with the above procedure.
	27.11 If the Employer instructs that further Contractor's Documents are required, the Contractor shall prepare them promptly.
	27.12 No examination or lack of examination of whatsoever nature by the Employer, or Employer's Representatives or Employer Personnel of the Contractor's drawings, documents, calculations or details relating to the execution of the Works or otherwise nor any certification, comment, rejection or approval expressed by such persons in regard thereto, either with or without modification, shall in any respect relieve or absolve the Contractor from any obligations or liability under or in connection with the Contract.
	27.13 The Contractor shall, unless it is otherwise provided in the Contract, have in respect of any errors, omissions, ambiguities, inconsistencies, inadequacies, other defects or insufficiency in the design of the Works (including any further design which the Contractor has to carry out as a result of a Variation) the like liability to the Employer, whether under statute or otherwise, as would an appropriate professional designer holding himself out as competent to take on the design of the Works, provided always that: (a) where the Employer has relied upon the Contractor to select Plant and materials required by the design to be incorporated in the Works the Contractor shall ensure that all such Plant and materials are reasonably fit for the purpose intended by the Contract. (b) subject to Clause (a) above in no circumstances shall the Contractor be obliged to ensure that the design is fit for the purpose intended by the Contract. If for any reason, the Contractor shall wish to change his design of the Works after the design has been checked, he shall comply in all respects with the Design Checking Procedures.
	27.14 In preparing the design and complying with his obligations under Clause 27.15, the Contractor shall, where prescribed in the Employer's Requirements, comply in all respects with the Design Checking Procedures.
	27.15 If errors, omissions, ambiguities, inconsistencies, inadequacies or other defects are found in the Contractor's Documents, they and the Works shall be corrected at the Contractor's cost, notwithstanding any consent or approval under this Clause.
	27.16 The design, the Contractor's Documents, the execution and the completed Works shall comply with Nepal's technical standards, building,

	construction and environmental Laws, Laws applicable to the product being produced from the Works, and other standards specified in the Employer's Requirements, applicable to the Works, or defined by the applicable Laws.
	27.17 All these Laws shall, in respect of the Works and each Section, be those prevailing when the Works are taken over by the Employer under Clause 76. [Taking Over of the Works]. References in the Contract to published standards shall be understood to be references to the edition applicable on the Base Date, unless stated otherwise.
	27.18 If changed or new applicable standards come into force in Nepal after the Base Date, the Contractor shall give notice to the Employer and (if appropriate) submit proposals for compliance. In the event that: (a) the Employer determines that compliance is required, and (b) the proposals for compliance constitute a variation, then the Employer shall initiate a Variation in accordance with Clause 53 [Variations].
	27.19 The Contractor shall carry out the training of Employer's Personnel in the operation and maintenance of the Works to the extent specified in the Employer's Requirements. If the Contract specifies training which is to be carried out before taking-over, the Works shall not be considered to be completed for the purposes of taking-over under Clause 76. [Taking Over of the Works] until this training has been completed.
28. Safety, Security and Protection of the Environment	28.1 The Contractor shall: (a) comply with all applicable safety regulations, (b) take care for the safety of all persons entitled to be on the Site, (c) use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons, (d) provide fencing, lighting, guarding and watching of the Works until completion and taking over under Clause 76. [Taking Over of the Works], and (e) provide any Temporary Works (including roadways, footways, guards and fences) which may be necessary, because of the execution of the Works, for the use and protection of the public and of owners and occupiers of adjacent land.
	28.2 The Contractor shall not interfere unnecessarily or improperly with: (a) the convenience of the public, or (b) the access to and use and occupation of all roads and footpaths, irrespective of whether they are public or in the possession of the Employer or of others.
	28.3 The Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from any such unnecessary or improper interference.
	28.4 Unless otherwise stated in the contract: (a) The Contractor shall be responsible for keeping unauthorized persons off the Site, and (b) authorized persons shall be limited to the Contractor's Personnel

	and the Employer's Personnel; and to any other personnel notified to the Contractor, by (or on behalf of) the Employer, as authorized personnel of the Employer's other contractors on the Site.
	28.5 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. The Contractor shall ensure that any cut or fill slopes are planted in grass or other plant cover as soon as possible to protect them from erosion. Any spoil or material removed from drains shall be disposed of to designated stable tipping areas as directed by the Employer.
	28.6 The Contractor shall ensure that emissions, surface discharges and effluent from the Contractor's activities shall not exceed the values indicated in the Employer's Requirements, and shall not exceed the values prescribed by applicable Laws.
	28.7 The Employer shall have the power to disallow any working practice or activity of the Contractor or direct that such practices or activities be modified should the Employer consider, on the advice of the relevant Government Departments, that the practices or activities will be harmful to wildlife.
	28.8 The Contractor shall provide on the Site such lifesaving apparatus as may be appropriate and an adequate and easily accessible first aid outfit or such outfits as may be required by any government ordinance, factory act, etc., subsequently published and amended from time to time.
29. Discoveries	29.1 Anything of historical or fossils, coins, articles of value or antiquity, and structures or other interest or of significant value unexpectedly discovered on the Site, shall be the property of the employer. The Contractor shall notify the Employer of such discoveries and carry out the Employer's instructions for dealing with them.
	29.2 The Contractor shall take reasonable precautions to prevent Contractor's Personnel or other persons from removing or damaging any of these findings.
	29.3 If the Contractor suffers delay and/or incurs Cost from complying with the instructions, the Contractor shall give a further notice to the Employer and shall be entitled subject to Clause 35. [Contractor's Claims] to: (a) an extension of time for any such delay, if completion is or will be delayed, under Clause 42 [Extension of Intended Completion Date], and (b) payment of any such Cost, which shall be added to the Contract Price.
	29.4 After receiving this further notice, the Employer shall proceed in accordance with Clause 32. [Determinations] to agree or determine these matters.
30. Possession of the Site and it's Access	30.1 The Employer shall give the Contractor right of access to, and possession of, all the Site parts of the Site within the time (or times) **stated in the SCC.** The right and possession may not be exclusive to the Contractor. If, under the Contract, the Employer is required to give (to the Contractor) possession of any foundation, structure, plant or means of access, the Employer shall do so in the time and manner stated in the Employer's Requirements. However, the Employer may withhold any such right or possession until the Performance Security has been

	received. If no such time is stated in the SCC, the Employer shall give the Contractor right of access to, and possession of, the Site within such times as may be required to enable the Contractor to proceed in accordance with the Program submitted under Clause 41 [Program and Progress].
	30.2 Until the Performance Certificate has been issued, the Contractor shall have the right of access to all parts of the Works and to records of the operation and performance of the Works, except as may be inconsistent with the Employer's reasonable security restrictions.
	30.3 If right of access to, and possession of a part is not given by the date **stated in the SCC**, the Employer shall be deemed to have delayed the start of the relevant activities, and this shall be a Compensation Event. However, if and to the extent that the Employer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time and Cost.
	30.4 The Contractor shall allow the Employer and any person authorized by the Employer access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.
31. Access Route and Transport of Goods	31.1 The Contractor shall be deemed to have been satisfied as to the suitability and availability of access routes to the Site. The Contractor shall use reasonable efforts to prevent any road or bridge from being damaged by the Contractor's traffic or by the Contractor's Personnel. These efforts shall include the proper use of appropriate vehicles and routes
	31.2 Except as otherwise stated in these Conditions: (a) the Contractor shall (as between the Parties) be responsible for any maintenance which may be required for his use of access routes; (b) the Contractor shall provide all necessary signs or directions along access routes, and shall obtain any permission which may be required from the relevant authorities for his use of routes, signs and directions; (c) the Employer shall not be responsible for any claims which may arise from the use or otherwise of any access route, (d) the Employer does not guarantee the suitability or availability of particular access routes, and (e) Costs due to non-suitability or non-availability, for the use required by the Contractor, of access routes shall be borne by the Contractor.
	31.3 Unless otherwise **stated in the SCC**: (a) the Contractor shall give the Employer not less than 21 days' notice of the date on which any Plant or a major item of other Goods will be delivered to the Site; (b) the Contractor shall be responsible for packing, loading, transporting, receiving, unloading, storing and protecting all Goods and other things required for the Works; and (c) the Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from the transport of Goods, and shall negotiate and

	pay all claims arising from their transport.
32. Determinations	32.1 When carrying out his/her duties under this Clause, the Employer's Representative shall not be deemed to act for the Employer. Whenever these Conditions provide that the Employer shall proceed in accordance with this Clause 32. [Determination] to agree or determine any matter, the Employer's Representative shall consult with each Party in an endeavor to reach agreement. If agreement is not achieved, the Employer's Representative shall make a fair determination in accordance with the Contract, taking due regard of all relevant circumstances.
	32.2 The Employer's Representative shall give notice to both Parties of each agreement or determination, with supporting particulars. Each Party shall give effect to each agreement or determination, any Party gives notice, to the other Party, of his dissatisfaction with a determination within 15 days of receiving it. After then, parties shall proceed as per Clause 36. [Dispute Settlement] or Clause 37. [Dispute Settlement by Arbitration].
33. Instructions, Inspections and Audits	33.1 The Employer may issue to the Contractor instructions which may be necessary for the Contractor to perform his obligations under the Contract. The Contractor shall carry out all instructions of the Employer, or from the Employer's Representative or an assistant to whom the appropriate authority has been delegated which comply with the applicable laws where the Site is located.
	33.2 Each instruction shall be given in writing and shall state the obligations to which relates and the Clause (or other term of the Contract) in which the obligations are specified. If any such instruction constitutes a Variation, Clause 53 [Variations] shall apply.
	33.3 The Contractor shall keep, and shall make all reasonable efforts to cause its Subcontractors and consultant [if any] to keep accurate and systematic accounts and records in respect of the Works in such form and details as will clearly identify relevant time changes and costs.
	33.4 The Contractor shall permit the GoN/DP and/or persons appointed by the GoN/DP 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/DP if required by the GoN/DP. The Contractor's attention is drawn to Clause 84.2 which provides, inter alia, that acts intended to materially impede the exercise of the GoN's/DP's inspection and audit rights provided for under this Clause constitute an obstructive practice subject to contract termination.
34. Employer's Claims	34.1 If the Employer considers himself to be entitled to reduction in the Contract Price and/or to any payment under any Clause of these Conditions or otherwise in connection with the Contract, and/or to any extension of the Defects Liability Period, he shall give notice and particulars to the Contractor.
	34.2 The notice shall be given as soon as practicable after the Employer became aware of the event or circumstances giving rise to the claim. A notice relating to any extension of the Defects Liability Period shall be

	given before the expiry of such period.
	34.3 The particulars shall specify the Clause or other basis of the claim, and shall include substantiation of the amount and/or extension to which the Employer considers himself to be entitled in connection with the Contract. The Employer's Representative shall then proceed in accordance with Clause 32. [Determinations] to agree or determine (i) the amount (if any) which the Employer is entitled to be paid by the Contractor, and/or (ii) the extension (if any) of the Defects Liability Period in accordance with Clause 49.2.
	34.4 The Employer may deduct this amount from any moneys due, or to become due, to the Contractor. The Employer shall only be entitled to set off against or make any deduction from an amount due to the Contractor, or to otherwise claim against the Contractor, in accordance with this Clause or with sub-paragraph (a) and/or (b) of Clause 55.5.
35.Contractor's Claims	35.1 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 give notice to the Employer of such Compensation Events or cause of additional payments, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 21 days after the Contractor became aware, or should have become aware, of the event or circumstance.
	35.2 If the Contractor fails to give notice of a claim within such period of 21 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.
	35.3 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.
	35.4 The following shall be Compensation Events: (a) The Employer does not give access to a part of the Site by the Site Possession Date pursuant to GCC 30.1. (b) The Employer modifies the Schedule of Other Contractors in a way that affects the work of the Contractor under the Contract. (c) The Employer instructs the Contractor to uncover or to carry out additional tests upon work, which is then found to have no Defects. (d) The Employer unreasonably does not approve a subcontract to be let. (e) The Employer gives an instruction for dealing with an unforeseen condition, caused by the Employer, or additional work required for safety or other reasons. (f) Other contractors, public authorities, utilities, or the Employer does not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor. (g) The advance payment is delayed. (h) The effects on the Contractor of any of the Employer's Risks.

	(i) The Employer unreasonably delays issuing a Taking Over Certificate.
	35.5 The Contractor shall not be entitled to compensation to the extent that the Employer's interests are adversely affected by the Contractor's not having given early warning or not having cooperated with the Employer.
	35.6 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 Employer. Without admitting liability, the Employer may, after receiving any notice under this Clause, monitor the record-keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Employer to inspect all these records, and shall (if instructed) submit copies to the Employer.
	35.7 Within 21 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 Employer, the Contractor shall send to the Employer 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 Employer 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 Employer.
	35.8 Within 21 days after receiving a claim or any further particulars supporting a previous claim, or within such other period as may be proposed by the Employer and approved by the Contractor, the Employer 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.
	35.9 Each interim payment 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.
	35.10 The Employer's Representative shall proceed in accordance with Clause 32. [Determinations] to agree or determine (i) the extension (if any) of the Time for Completion (before or after its expiry) in accordance with Clause 42 [Extension of Intended Completion Date], and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.
	35.11 The requirements of this Clause are in addition to those of any other Clause which may apply to a claim. If the Contractor fails to comply with this or another Clause 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 the Clause 35.2.
36. Dispute Settlement	36.1 The Employer and the Contractor shall attempt to settle amicably by direct negotiation any disagreement or dispute arising between them under or in connection with the Contract.
	36.2 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.
37. Dispute Settlement by Arbitration	37.1 Unless settled amicably, any dispute shall be finally settled by arbitration. In case of arbitration, the arbitration shall be conducted in accordance with the arbitration procedures in accordance with law of Nepal at the place within the territory of Nepal **given in the SCC.**
B. Staff and Labor	
38. Staff, Labour and theirs facilities	38.1 The Contractor shall and make arrangements for the engagement of all staff and labour, local or otherwise, and for their payment, housing, feeding and transport
	38.2 The Contractor shall pay rates of wages, and observe conditions of labour, which are not lower than those established for the trade or industry where the work is carried out.
	38.3 The Contractor shall not employ forced labor, which consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labor, such as indentured labor, bonded labor, or similar labor–contracting arrangements.
	38.4 The Contractor shall not recruit, or attempt to recruit, staff and labour from amongst the Employer's Personnel.
	38.5 The Contractor shall comply with all the relevant labour 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.
	38.6 The Contractor shall require his employees to obey all applicable Laws, including those concerning safety at work.
	38.7 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.
	38.8 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.

	38.9 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 execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.
	38.10 The Contractor shall send, to the Employer, 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 Employer may reasonably require.
	38.11 Except as otherwise stated in the Employer's Requirements, 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 Employer's Requirements.
	38.12 Key Personnel: If no Key Personnel are specified in the Employer's Requirements this Clause shall not apply. The Contractor shall appoint the natural persons named in the Bid to the positions of Key Personnel. If not so named, or if an appointed person fails to act in the relevant position of Key Personnel, the Contractor shall submit to the Employer for consent the name and particulars of another person the Contractor proposes to appoint to such position. If consent is withheld or subsequently revoked, the Contractor shall similarly submit the name and particulars of a suitable replacement for such position. If the Employer does not respond within 15 days after receiving any such submission, by giving a Notice stating an objection to the appointment of such person (or replacement) with reasons, the Employer shall be deemed to have given the Employer's consent. The Contractor shall not, without the Employer's prior consent, revoke the appointment of any of the Key Personnel or appoint a replacement (unless the person is unable to act as a result of death, illness, disability or resignation, in which case the appointment shall be deemed to have been revoked with immediate effect and the appointment of a replacement shall be treated as a temporary appointment until the Employer gives his/her consent to this replacement, or another replacement is appointed, under this Clause). All Key Personnel shall be based at the Site (or, where Works are being executed off the Site, at the location of the Works) for the whole time that the Works are being executed. If any of the Key Personnel is to be temporarily absent during execution of the Works, a suitable replacement shall be temporarily appointed, subject to the Employer's prior consent. All Key Personnel shall be fluent in the language for communications defined in Clause 3. [Law and Language].
39. Child Labor	39.1 The Contractor shall not employ children in a manner that is economically exploitative, or is likely to be hazardous, 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. Where national

	laws have provisions for employment of minors, the Contractor shall follow those laws applicable to the Contractor. Children below the age of 18 years shall not be employed in dangerous work.
40. Non-discrimination and Equal Opportunity	40.1 The Contractor shall not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements. The Contractor shall base the employment relationship on the principle of equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. In countries where national law provides for non-discrimination in employment, the Contractor shall comply with national law. When national laws are silent on nondiscrimination in employment, the Contractor shall meet this Sub clause's requirements. Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job shall not be deemed discrimination.
C. Time Control	
41. Program and Progress	41.1 Within the time **stated in the SCC**, after the date of the Letter of Acceptance, the Contractor shall submit to the Employer for approval a Program showing the general methods, arrangements, order, and timing for all the activities consistent with those in the Activity Schedule.
	41.2 Unless otherwise stated in the Contract, each program shall include: (a) the order in which the Contractor intends to carry out the Works, including the anticipated timing of each stage of design, Contractor's Documents, manufacture, inspection, delivery to Site, construction, erection, testing, commissioning and trial operation, (b) the periods for reviews for Contractor's Documents, (c) the sequence and timing of inspections and tests specified in the Contract, and (d) a supporting report which includes: (i) a general description of the methods which the Contractor intends to adopt for the execution of each major stage of the Works, and (ii) the approximate number of each class of Contractor's Personnel and of each type of Contractor's Equipment for each major stage.
	41.3 Whenever the previous program is inconsistent with actual progress or with the Contractor's obligations, an update of the Program shall be done by the Contractor showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities.
	41.4 The Contractor shall submit an updated Activity Schedule within 15 days of being instructed to by the Employer's Representative, for Approval.
	41.5 The Employer approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Employer again at any time. A revised Program shall show the effect of Variations and Compensation Events.

	41.6 The contractor shall have to keep daily log of the construction activities in a format approved by the Employer. The daily log shall not constitute nor take the place of any notice required to be given by Contractor to Employer pursuant to the Contract Documents. The daily log shall document all activities at the Project site including, but not limited to, the following: (i.) Weather conditions showing the high and low temperatures during work hours, the amount of precipitation received on the Project site, and any other weather conditions which adversely affect the Work; (ii.) Soil conditions which adversely affect the Work; (iii.) The hours of operation by Contractor and subcontractor's personnel; (iv.) The number of Contractor and subcontractor's personnel present and working at the Project site, by subcontract and trade; (v.) All equipment presents at the Project site, description of equipment uses and designation of time equipment was used (specifically indicating any down time); (vi.) Description of Work being performed at the Project site; (vii.) Any unusual or special occurrences at the Project site; (viii.) Materials received at the Project site; and (ix.) A list of all visitors to the Project site.
	41.7 Unless otherwise **stated in the SCC**, monthly progress reports shall be prepared by the Contractor and submitted to the Employer in six copies **or as stated in the SCC**. The first report shall cover the period up to the end of the first calendar month following the Commencement Date. Reports shall be submitted monthly thereafter, each within 7 days after the last day of the period to which it relates. Reporting shall continue until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works. Each report shall include: (a) charts and detailed descriptions of progress, including each stage of design, Contractor's Documents, procurement, manufacture, delivery to Site, construction, erection, testing, commissioning and trial operation; (b) photographs showing the status of manufacture and of progress on the Site; (c) for the manufacture of each main item of Plant and Materials, the name of the manufacturer, manufacture location, percentage progress, and the actual or expected dates of: (i) commencement of manufacture, (ii) Contractor's inspections, (iii) tests, and (iv) shipment and arrival at the Site; (d) the details described in Clause 18.4,18.5; (e) copies of quality assurance documents, test results and certificates

	of Materials; (f) list of Variations, notices given under Clause 34. [Employer's Claims] and notices given under Clause 35. [Contractor's Claims] ; (g) safety statistics, including details of any hazardous' incidents and activities relating to environmental aspects and public relations; and (h) comparisons of actual and planned progress, with details of any events or circumstances which may jeopardize the completion in accordance with the Contract, and the measures being (or to be) adopted to overcome delays.
42. Extension of the Intended Completion Date	42.1 The Contractor shall be entitled subject to Clause 35. [Contractor's Claims] to an extension of the Time for Completion if and to the extent that completion for the purposes of Clause 76. [Taking Over of the Works] is or will be delayed by any of the following causes: (a) a Variation (unless an adjustment to the Time for Completion has been agreed under Clause 53. [Variations]), (b) a cause of delay giving an entitlement to extension of time under a Clause of these Conditions, (c) exceptionally adverse climatic conditions, which for the purpose of these Conditions shall mean adverse climatic conditions at the Site which are Unforeseeable having regard to climatic data made available by the Employer under Clause 41 [Program and Progress] and/or climatic data published in the Country for the geographical location of the Site; (d) Unforeseeable shortages in the availability of personnel or Goods (or Employer-Supplied Materials, if any) caused by epidemic or governmental actions; or (e) any delay, impediment or prevention caused by or attributable to the Employer, the Employer's Personnel, or the Employer's other contractors on the Site.
	42.2 If the Contractor considers himself to be entitled to an extension of the Time for Completion, the Contractor shall give notice to the Employer in accordance with Clause 35 [Contractor's Claims]. When determining each extension of time under Clause 35, the Employer shall review previous determinations and may increase, but shall not decrease, the total extension of time.
	42.3 If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.
43. Acceleration	43.1 When the Employer wants the Contractor to finish before the Intended Completion Date, the Employer shall obtain priced proposals for achieving the necessary acceleration from the Contractor. If the Employer accepts these proposals, the Intended Completion Date shall be adjusted accordingly and confirmed by both the Employer and the Contractor.
	43.2 If the Contractor's priced proposals for acceleration are accepted by the Employer, they are incorporated in the Contract Price and treated as a Variation.
	44.1 The Employer may instruct the Contractor to delay or to suspend

44. Delays Ordered by the Employer	progress of part or all of the Works. During such delay or suspension, the Contractor shall protect, store and secure such part or the Works against any deterioration, loss or damage.
	44.2 The Employer may also notify the cause for the delay or suspension. If and to the extent that the cause is notified and is the responsibility of the Contractor, the following Clauses 44.3, 44.4 and 44.5 shall not apply.
	44.3 If the Contractor suffers delay and/or incurs Cost from complying with the Employer's instructions under Clause 44.2 and/or from resuming the work, the Contractor shall give notice to the Employer and shall be entitled subject to Clause 35. [Contractor's Claims] to: (a) an extension of time for any such delay, if completion is or will be delayed, under Clause 42 [Extension of Intended Completion Date], and (b) Payment of any such Cost, which shall be added to the Contract Price. After receiving this notice, the Employer's Representative shall proceed in accordance with Clause 32. [Determinations] to agree or determine these matters. The Contractor shall not be entitled to an extension of time for, or to payment of the Cost incurred in, making good the consequences of the Contractor's faulty design, workmanship or materials, or of the Contractor's failure to protect, store or secure in accordance with Clause 44.2.
	44.4 The Contractor shall not be entitled to Extension of Time, or to payment of the Cost incurred, in making good: (a) the consequences of the Contractor's faulty or defective design, workmanship, Plant or Materials; and/or (b) any deterioration, loss or damage caused by the Contractor's failure to protect, store or secure in accordance with Sub-Clause 44.1.
	44.5 The Contractor shall be entitled to payment of the value (as at the date of suspension) of Plant and/or Materials which have not been delivered to Site, if: (a) the work on Plant or delivery of Plant and/or Materials, has been suspended for more than 30 days, and (b) the Contractor has marked the Plant and/or Materials as the Employer's property in accordance with the Employer's instructions.
	44.6 If the suspension under Clause 44.2 has continued for more than 90 days, the Contractor may request the Employer's permission to proceed. If the Employer does not give permission within 30 days after being requested to do so, the Contractor may, by giving notice to the Employer, treat the suspension as an omission under Clause 53 [Variations] of the affected part of the Works. If the suspension affects the whole of the Works, the Contractor may give notice of termination under Clause 81. [Termination by Contractor].
	44.7 After the permission or instruction to proceed is given, the Parties shall jointly examine the Works and the Plant and Materials affected by the suspension. The Contractor shall make good any deterioration or defect in or loss of the Works or Plant or Materials, which has occurred during the

	suspension.
45. Management Meetings	45.1 Either the Employer or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.
	45.2 The Employer's Representative shall record the business of management meetings and provide copies of the record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken shall be decided by the Employer either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.
	45.3 The frequency of such meetings shall be as **specified in the SCC.**
46. Early Warning	46.1 The Contractor shall warn the Employer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price, or delay the execution of the Works. The Employer may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate shall be provided by the Contractor as soon as reasonably possible
	46.2 The Contractor shall cooperate with the Employer in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Employer.
D. Quality Control	
47. Quality Assurance	47.1 The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. The system shall be in accordance with the details stated in the Contract. The Employer shall be entitled to audit any aspect of the system.
	47.2 Details of all procedures and compliance documents shall be submitted to the Employer for information before each design and execution stage is commenced. When any document of a technical nature is issued to the Employer, evidence of the prior approval by the Contractor himself shall be apparent on the document itself.
	47.3 Compliance with the quality assurance system shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.
	47.4 The Contractor shall carry out the manufacture of Plant, the production and manufacture of Materials, and all other execution of the Works: (a) in the manner (if any) specified in the Contract, (b) in a proper workmanlike and careful manner, in accordance with recognized good practice, and (c) with properly equipped facilities and non-hazardous Materials, except as otherwise specified in the Contract.
	47.5 The Contractor shall submit samples to the Employer, for review in accordance with the procedures for Contractor's Documents, as specified in the Contract and at the Contractor's cost. Each sample shall be labelled as to origin and

	intended use in the Works.
	47.6 The Employer's Personnel shall at all reasonable times: (a) have full access to all parts of the Site and to all places from which natural Materials are being obtained, and (b) during production, manufacture and construction (at the Site and, to the extent specified in the Contract, elsewhere), be entitled to examine, inspect, measure and test the materials and workmanship, and to check the progress of manufacture of Plant and production and manufacture of Materials.
	47.7 The Contractor shall give the Employer's Personnel full opportunity to carry out these activities, including providing access, facilities, permissions and safety equipment. No such activity shall relieve the Contractor from any obligation or responsibility.
	47.8 The Contractor shall give notice to the Employer whenever any work is ready and before it is covered up, put out of sight, or packaged for storage or transport.
	47.9 The Employer shall then either carry out the examination, inspection, measurement or testing without unreasonable delay, or promptly give notice to the Contractor that the Employer does not require to do so. If the Contractor fails to give the notice, he shall, if and when required by the Employer, uncover the work and thereafter reinstate and make good, all at the Contractor's cost.
48. Tests	48.1 This Clause shall apply to all tests specified in the Contract, other than the Tests after Completion.
	48.2 The Employer shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Employer may instruct the Contractor to search for a Defect and to uncover and test any work that the Employer considers may have a Defect.
	48.3 If the Employer instructs the Contractor to carry out a test not specified in the Employer's Requirements to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect, the test shall be a Compensation Event.
	48.4 The Contractor shall provide all apparatus, assistance, documents and other information, electricity, equipment, fuel, consumables, instruments, labour, materials, and suitably qualified and experienced staff, as are necessary to carry out the specified tests efficiently.
	48.5 The Contractor shall agree, with the Employer, the time and place for the specified testing of any Plant, Materials and other parts of the Works.
	48.6 The Employer shall give the Contractor not less than 24 hours' notice of the Employer's intention to attend the tests. If the Employer does not attend at the time and place agreed, the Contractor may proceed with the tests, unless otherwise instructed by the Employer, and the tests shall then be deemed to have been made in the Employer's presence.
	48.7 If the Contractor suffers delay and/or incurs Cost from complying with these instructions or as a result of a delay for which the Employer is responsible, the

	Contractor shall give notice to the Employer and shall be entitled subject to Clause 35. [Contractor's Claims] to: (a) an extension of time for any such delay, if completion is or will be delayed, under Clause 42 [Extension of Intended Completion Date], and (b) additional payment (if any) to which the Contractor is entitled under the Contract. After receiving this notice, the Employer shall proceed in accordance with Clause 32. [Determinations] to agree or determine these matters.
	48.8 The Contractor shall promptly forward to the Employer duly certified reports of the tests. When the specified tests have been passed, the Employer shall, endorse the Contractor's test certificate, or issue a certificate to him, to that effect. If the Employer has not attended the tests, he shall be deemed to have accepted the readings as accurate.
49. Correction of Defects	49.1 The Employer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at issuance of taking over certificate pursuant to GCC clause 76, and is **defined in the SCC**. The Defects Liability Period shall be extended for as long as Defects remain to be corrected. If, as a result of an examination, inspection, measurement or testing, any Plant, Materials, design or workmanship is found to be defective or otherwise not in accordance with the Contract, the Employer may reject the Plant, Materials, design or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the Contract.
	49.2 In order that the Works and Contractor's Documents shall be in the condition required by the Contract (fair wear and tear excepted) by the expiry date of the Defects Liability Period or as soon as practicable thereafter, the Contractor shall: (a) complete any work which is outstanding on the date stated in a Taking-Over Certificate, within such reasonable time as is instructed by the Employer, and (b) execute all work required to remedy defects or damage, as may be notified by (or on behalf of) the Employer on or before the expiry date of the Defects Liability Period for the Works
	49.3 All work referred to in Sub-Clause 49.2 (b) shall be executed at the risk and cost of the Contractor, if and to the extent that the work is attributable to: (a) the design of the Works, other than a part of the design for which the Employer is responsible (if any), (b) Plant, Materials or workmanship not being in accordance with the Contract, (c) improper operation or maintenance which was attributable to matters for which the Contractor is responsible, or (d) failure by the Contractor to comply with any other obligation.
	49.4 If the Employer requires this Plant, Materials, design or workmanship to be retested, the tests shall be repeated under the same terms and conditions. If the rejection and retesting cause the Employer to incur additional costs, the Contractor shall subject to Clause 34. [Employer's

	Claims] pay these costs to the Employer.
	49.5 Notwithstanding any previous test or certification, the Employer may instruct the Contractor to: (a) remove from the Site and replace any Plant or Materials which is not in accordance with the Contract, (b) remove and re-execute any other work which is not in accordance with the Contract, and (c) execute any work which is urgently required for the safety of the Works, whether because of an accident, unforeseeable event or otherwise. The Contractor shall comply with the instruction within a reasonable time, which shall be the time (if any) specified in the instruction, or immediately if urgency is specified under sub-paragraph (c).
	49.6 If the Contractor fails to comply with any such instruction, which complies with Clause 33. [Instructions, Inspection and Audits], the Employer shall be entitled to employ and pay other persons to carry out the work. Except to the extent that the Contractor would have been entitled to payment for the work, the Contractor shall subject to Clause 34. [Employer's Claims] pay to the Employer all costs arising from this failure.
	49.7 The Employer shall be entitled subject to Clause 34 [Employer's Claims] to an extension of the Defects Liability Period for the Works or a Section if and to the extent that the Works, Section or a major item of Plant (as the case may be, and after taking over) cannot be used for the purposes for which they are intended by reason of a defect or by reason of damage attributable to the Contractor. However, a Defects Notification Period shall not be extended by more than two years. If delivery and/or erection of Plant and/or Materials was suspended under Clause 44.2 or Clause 80. [Contractor's Entitlement to Suspend Work], the Contractor's obligations under this Clause shall not apply to any defects or damage occurring more than two years after the Defects Liability Period for the Plant and/or Materials would otherwise have expired.
	49.8 If the work of remedying of any defect or damage may affect the performance of the Works, the Employer may require the repetition of any of the tests described in the Contract, including Tests on Completion and/or Tests after Completion [if applicable]. The requirement shall be made by notice within 30 days after the defect or damage is remedied. These tests shall be carried out in accordance with the terms applicable to the previous tests.
	49.9 The Contractor shall, if required by the Employer, search for the cause of any defect, under the direction of the Employer. Unless the defect is to be remedied at the cost of the Contractor, additional payment (if any) to which the Contractor is entitled under the Contract shall be agreed or determined in accordance with Clause 32. [Determinations] and shall be added to the Contract Price.
	50.1 If the Contractor has not corrected a Defect within the time specified in the Employer's notice, the Employer shall assess the cost of having the

50. Uncorrected Defects	Defect corrected, and remedial work shall have to be executed at the risk and cost of the Contractor. The Employer may (at his option): (a) carry out the work himself or by others, in a reasonable manner and at the Contractor's risk and cost, and the Contractor shall subject to Clause 34. [Employer's Claims] pay to the Employer the costs reasonably incurred by the Employer in remedying the defect or damage; (b) agree or determine a reasonable reduction in the Contract Price in accordance with Clause 32. [Determinations]; or (c) if the defect or damage deprives the Employer of substantially the whole benefit of the Works or any major part of the Works, terminate the Contract as a whole, or in respect of such major part which cannot be put to the intended use. Without prejudice to any other rights, under the Contract or otherwise, the Employer shall then be entitled to recover all sums paid for the Works or for such part (as the case may be), plus financing costs and the cost of dismantling the same, clearing the Site and returning Plant and Materials to the Contractor.
	50.2 If the defect or damage cannot be remedied expeditiously on the Site and the Employer gives consent, the Contractor may remove from the Site for the purposes of repair such items of Plant as are defective or damaged. This consent may require the Contractor to increase the amount of the Performance Security by the full replacement cost of these items, or to provide other appropriate security.
E. Cost Control	
51. Contract Price	51.1 The Contractor shall be deemed to have satisfied himself as to the Correctness and Sufficiency of the Contract Price. Unless otherwise stated in the Contract, the Contract Price covers all the Contractor's obligations under the Contract (including those under Provisional Sums, if any) and all things necessary for the proper design, execution and completion of the Works and the remedying of any defects.
	51.2 The Contractor shall bear all costs and charges for special and/or temporary rights-of-way which he may require, including those for access to the Site. The Contractor shall also obtain, at his risk and cost, any additional facilities outside the Site which he may require for the purposes of the Works.
	51.3 Each Provisional Sum shall only be used, in whole or in part, in accordance with the Employer's instructions, and the Contract Price shall be adjusted accordingly. The total sum paid to the Contractor shall include only such amounts, for the work, supplies or services to which the Provisional Sum relates, as the Employer shall have instructed. For each Provisional Sum, the Employer may instruct: (a) work to be executed (including Plant, Materials or services to be supplied) by the Contractor and valued under Clause 53. [Variations]; and/or (b) Plant, Materials or services to be purchased by the Contractor, for which there shall be added to the Contract Price less the original Provisional Sums: (i) the actual amounts paid (or due to be paid) by the Contractor,

	and (ii) a sum for overhead charges and profit, calculated as a percentage of these actual amounts by applying the relevant percentage rate (if any) stated in the Contract.
	51.4 The Contractor shall, when required by the Employer, produce quotations, invoices, vouchers and accounts or receipts in substantiation.
	51.5 The Activity Schedule shall contain the priced activities for the Works to be performed by the Contractor. The Activity Schedule is used to monitor and control the performance of activities on which basis the Contractor will be paid. If payment for Materials on Site shall be made separately, the Contractor shall show delivery of Materials to the Site separately on the Activity Schedule.
	51.6 Unless otherwise **stated in the SCC**: (a) payment for the Works shall be made as per progress of priced activity schedule, subject to adjustments in accordance with the Contract; and (b) the Contractor shall pay all taxes, duties and fees required to be paid by him under the Contract, and the Contract Price shall not be adjusted for any of these costs, except as stated in Sub-Clause 53.4.
52. Changes in the Contract Price	52.1 The Activity Schedule in the contract document shall be amended by the Contractor to accommodate changes of Program or method of working made at the Contractor's own discretion. Prices in the Activity Schedule shall not be altered when the Contractor makes such changes to the Activity Schedule.
53. Variations	53.1 Variations may be initiated by the Employer at any time prior to issuing the Taking-Over Certificate for the Works, under the following circumstances: (a) where there is an unforeseen change in the physical conditions of the project site resulting from natural disasters; or (b) where the Employer instructs any addition to, or modification of, the Works. A Variation shall not comprise the omission of any work which is to be carried out by others. Each instruction to execute a Variation, with any requirements for the recording of Costs, shall be issued by the Employer to the Contractor, who shall acknowledge receipt.
	53.2 The Contractor shall execute and be bound by each Variation, unless the Contractor promptly gives notice to the Employer stating (with supporting particulars) that (i) the Contractor cannot readily obtain the Goods required for the Variation, (ii) it will reduce the safety or suitability of the Works, or (iii) it will have an adverse impact on the achievement of the Performance Guarantees. Upon receiving this notice, the Employer shall cancel, confirm or vary the instruction.
	53.3 The Contractor may, at any time, submit to the Employer a written proposal which (in the Contractor's opinion) will, if adopted, (i) accelerate completion, (ii) reduce the cost to the Employer of executing, maintaining or operating the Works, (iii) improve the efficiency or value to the Employer of the completed Works, or (iv) otherwise be of

	benefit to the Employer. The proposal shall be prepared at the cost of the Contractor. The Employer shall, as soon as practicable after receiving such proposal, respond with approval, disapproval or comments. The Contractor shall not delay any work whilst awaiting a response.
	53.4 Upon instructing or approving a Variation, the Employer shall proceed in accordance with Clause 32. [Determinations] to agree or determine adjustments to the Contract Price and the Schedule of Payments. These adjustments shall include reasonable profit, and shall take account of the Contractor's submissions under Clause 53.3, if applicable.
	53.5 Adjustments for Changes in Legislation: The Contract Price shall be adjusted to take account of any increase or decrease in Cost resulting from a change in the Laws of Nepal (including the introduction of new Laws and the repeal or modification of existing Laws) or in the judicial or official governmental interpretation of such Laws, made after the Base Date, which affect the Contractor in the performance of obligations under the Contract. If the Contractor suffers (or will suffer) delay and/or incurs (or will incur) additional Cost as a result of these changes in the Laws or in such interpretations, made after the Base Date, the Contractor shall give notice to the Employer and shall be entitled subject to Clause 35. [Contractor's Claims] to: (a) an extension of time for any such delay, if completion is or will be delayed, under Clause 42 [Extension of Intended Completion Date], and (b) payment of any such Cost, which shall be added to the Contract Price. After receiving this notice, the Employer shall proceed in accordance with Clause 32. [Determinations] to agree or determine these matters. Notwithstanding the foregoing, the Contractor shall not be entitled to an extension of time if the relevant delay has already been taken into account in the determination of a previous extension of time.
54. Cash Flow Forecasts	54.1 When the Program is updated, the Contractor shall provide the Employer with an updated cash flow forecast.
55. Interim Payment Certificate	55.1 The Contractor shall submit a Statement in two copies to the Employer's Representative after the end of the period of payment **stated in the SCC** (if not stated, after the end of each month), in a form approved by the Employer, showing in detail the amounts to which the Contractor considers himself to be entitled, together with supporting documents which shall include the relevant report on progress in accordance with Clause 41. [Program and Progress].
	55.2 The Statement shall include the following items, as applicable, which shall be expressed in the various currencies in which the Contract Price is payable, in the sequence listed: (a) the estimated contract value of the Works executed and the Contractor's Documents produced up to the end of the month (including Variations but excluding items described in sub-paragraphs (b) to (f) below); (b) any amounts to be added and deducted for changes in legislation, in accordance with the Clause 53.5 and for changes in Cost under Sub-

	Clause 59. [Price Adjustments]; (c) any amount to be deducted for retention, calculated by applying the percentage of retention as per the Clause 60. [Retention] to the total of the above amounts, (d) any amounts to be added and deducted for the advance payment and repayments in accordance with Clause 63. [Advance Payment]; (e) any other additions or deductions which may have become due under the Contract or otherwise, including those under Clause 36. [Dispute Settlement], 37. [Dispute Settlement by Arbitration]; and (f) the deduction of amounts included in previous Statements.
	55.3 The estimated contract value of the Works executed shall comprise the value of completed activities in the Activity Schedule and/or as methodology **stated in the SCC**.
	55.4 Schedule of Payments: If the Contract includes a Schedule of Payments specifying the installments in which the Contract Price will be paid, then unless otherwise stated in this Schedule: (a) the installments quoted in the Schedule of Payments shall be the estimated contract values for the purposes of sub-paragraph (a) of Clause 55.2, and (b) if these installments are not defined by reference to the actual progress achieved in executing the Works. If the Contract does not include a Schedule of Payments, the Contractor shall submit non-binding estimates of the payments which he expects to become due during each quarterly period. The first estimate shall be submitted within 42 days after the Commencement Date. Revised estimates shall be submitted at quarterly intervals, until the Taking-Over Certificate has been issued for the Works.
	55.5 The Employer's Representative shall, within 30 days after receiving a statement and supporting documents, issue to the Employer an Interim Payment Certificate which shall state the amount which the Employer's Representative fairly determines to be due, with supporting particulars. An Interim Payments Certificate shall not be withheld, except that: (a) if anything supplied or work done by the Contractor is not in accordance with the Contract, the cost of rectification or replacement may be withheld until rectification or replacement has been completed; and/or (b) if the Contractor was or is failing to perform any work or obligation in accordance with the Contract, and had been so notified by the Employer, the value of this work or obligation may be withheld until the work or obligation has been performed.
	55.6 The Employer may, by any payment, make any correction or modification that should properly be made to any amount previously considered due. Payment shall not be deemed to indicate the Employer's acceptance, approval, consent or satisfaction.
56. Payments	56.1 The Employer shall pay the Contractor the amounts certified by the Employer's Representative within 30 days of the date of each payment certificate.

	56.2 If the Employer makes a late payment, the Contractor shall be paid interest as **indicated in the SCC** on the late payment in the next payment. Interest shall be calculated from the date by which the payment should have been made up to the date when the late payment is made. The Contractor shall be entitled to this payment without formal notice, and without prejudice to any other right or remedy.
	56.3 Activities of the Works which are unpriced in the Activity Schedule, shall not be paid for by the Employer and shall be deemed covered by other activities prices in the Contract.
57. Tax	57.1 The Employer shall adjust the Contract Price if taxes, duties, and other levies are changed between the date 30 days before the submission of bids for the Contract and the date of the last Completion certificate. The adjustment shall be the change in the amount of tax payable by the Contractor, provided such changes are not already reflected in the Contract Price or are a result of GCC 59.
58. Currency	58.1 The currency of Contracts shall be Nepalese Rupees.
59. Price Adjustment	59.1 Prices shall be adjusted for fluctuations in the cost of inputs only if provided for **in the SCC**. If so provided, the amounts certified in each payment certificate, before deducting for Advance Payment, shall be adjusted by applying the respective price adjustment factor to the payment amounts due.
	59.2 Adjustment Formulae: The formulae will be of the following general type: $$pn = A + b\frac{Ln}{Lo} + c\frac{Mn}{Mo} + d\frac{En}{Eo} + etc.$$ Where: *pn* is a price adjustment factor to be applied to the amount for the payment of the work carried out in the subject month, determined in accordance with Clause 55; *A* is a constant, specified in the Bidding Forms- Table of Price Adjustment data, representing the nonadjustable portion in contractual payments;b, c, d, etc., coefficients representing the estimated proportion of each cost element (labor, materials, equipment usage, etc.) in the Works or sections thereof, net of Provisional Sums, **as specified in the SCC;** *Ln, Mn, En,* etc., are the current cost indices or reference prices of the cost elements for month "n," determined pursuant to Sub-Clause 59.4, applicable to each cost element; and *Lo, Mo, Eo,* etc., are the base cost indices or reference prices corresponding to the above cost elements at the date specified in Sub-Clause 59.4.
	59.3 Sources of Indices and Weightings: The sources of indices shall be those listed in the Bidding Forms- Table of Price Adjustment data, as approved by the Employer and **stated in SCC**. Indices shall be appropriate for their purpose and shall relate to the Contractor's proposed source of supply of inputs on the basis of which his Contract shall have been computed. As the proposed basis for price adjustment,

	the Contractor shall have submitted with his bid the tabulation of Weightings and Source of Indices in the Bidding Forms, which shall be subject to approval by the Employer.
	59.4 Base, Current and Provisional Indices: The base cost indices or prices shall be those prevailing on the day 30 days prior to the latest date for submission of bids. Current indices or prices shall be those prevailing on the day 30 days prior to the last day of the period to which a particular Interim Payment Certificate is related. If at any time the current indices are not available, provisional indices as determined by the Employer will be used, subject to subsequent correction of the amounts paid to the Contractor when the current indices become available.
	59.5 Weightings: The weightings for each of the factors of cost given in the Bidding Forms shall be adjusted if, in the opinion of the Employer, they have been rendered unreasonable, unbalanced or inapplicable as a result of varied or additional work already executed or instructed under Clause 53 or for any other reason.
	59.6 Where, price adjustment provision is not applicable pursuant to Sub-clause 59.1 then the Contract is subject to price adjustment only for construction material in accordance with this clause. If the prices of the construction materials stated in the contract is increased or decreased in an unexpected manner in excess of ten (10%) percent in comparison to the base price construction material stated in Section –IV, Bidding Forms-Table of Price Adjustment Data, then the price adjustment for the increase or decrease of price of the construction material beyond 10% shall be made by applying the following formulas: For unexpected increase in price $P = [R1 - (R0 \times 1.10)] \times Q$ For unexpected decrease in price P $= [R1 - (R0 \times 0.90)] \times Q$ Where: "P" is price adjustment amount "R1" is the present price of the construction material (Source of indices shall be those listed in the Bidding forms) "R0" is the base price of the construction material "Q" is quantity of the construction material consumed in construction during the period of price adjustment consideration If the Base price and source is to be proposed by the Bidder as per the provision made in Section –IV, Bidding Forms-Table of Price Adjustment Data then the Base price and source filled by Bidder for the construction material stated in the Bidding Form shall be subject to the approval of the Employer and shall be **as stated in SCC.**
	59.7 The Price Adjustment amount shall be limited to a maximum of the initial Contract Amount **as specified in the SCC**.
	59.8 The Price Adjustment provision shall not be applicable for delayed period if the contract is not completed in time due to the delay caused by the contractor.

60. Retention	60.1 The Employer shall retain from each payment due to the Contractor the proportion **stated in the SCC** until the expiry of the Defect Liability Period.
	60.2 Upon the issue of a Defects Liability Certificate by the Employer, in accordance with **GCC 77,** half the total amount retained shall be repaid to the Contractor and half when the Contractor has submitted the evidence of submission of tax return to the concerned Internal Revenue Office.
	60.3 The Contractor may substitute retention money with an unconditional bank guarantee issued from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal if: (a) at least eighty (80) percent of the whole works have been completed, (b) progress of the works is satisfactory in accordance with the Contract as per approved work schedule, and (c) it can be assured that the works can be completed at the intended completion date.
	60.4 Notwithstanding anything stated in GCC 60.2 and GCC 60.3, if the Contractor submits a request for the release of retention money held pursuant to GCC 60.1 after completion of at least sixty percent (60%) of the total works, up to sixty percent (60%) of the retention amount deducted at the time of interim payments may be released to the Contractor. Prior to such release, the Contractor shall be required to submit an unconditional bank guarantee equivalent to one hundred ten percent (110%) of the amount to be released, issued by a Commercial Bank or Financial Institution authorized to issue such guarantees in accordance with the prevailing laws of Nepal.
	60.5 If retention money is substituted by bank guarantee in accordance with GCC 60.3 and or GCC 60.4, the bank guarantee shall be submitted either using the Retention Money Security Form included in Section X (Contract Forms) or in another Form acceptable to the employer. The validity of the bank guarantee under this sub-clause shall be at least 30 days beyond the end of intended Defect Liability Period.
	60.6 If the Contractor fails to rectify the defects or carry out the required maintenance within the defect liability period or maintenance period, the Public Entity shall have the right to use the retention money, held pursuant to GCC 60.1 or the amount under the bank guarantee pursuant to GCC 60.3 and or GCC 60.4, to rectify such defects or perform the necessary maintenance.
61. Liquidated Damages	61.1 If the Contractor fails to complete the works on or before the last date of intended completion date (initial or extended contract period where the time extension has been granted to the Contractor by the Employer period), the Contractor shall subject to Clause 34. [Employer's Claims] pay delay damages to the Employer for this default. These delay damages shall be the sum **stated in the SCC**, which shall be paid for every day which shall elapse between the relevant Time for Completion and the date stated in the Taking-Over Certificate.
	61.2 The total amount of liquidated damages shall not exceed the amount **defined in the SCC**. The Employer may deduct liquidated damages from payments due to the Contractor.

	61.3 These liquidated delay damages shall be the only damages due from the Contractor for such default, other than in the event of termination under Clause 79. [Termination by Employer] prior to completion of the Works. These damages shall not relieve the Contractor from his obligation to complete the Works, or, from any other duties, obligations or responsibilities which he may have under the Contract.
62. Bonus	62.1 Bonus shall be paid to the Contractor only if **stated in the SCC**. If applicable in the contract, the Contractor shall be paid a Bonus calculated at the rate per calendar day **stated in the SCC** for each day (less any days for which the Contractor is paid for acceleration) that the Completion is earlier than the Intended Completion Date. The Employer shall certify that the Works are complete, although they may not be due to be complete.
	62.2 The total amount of Bonus shall not exceed the amount **defined in the SCC**.
63. Advance Payment	63.1 Unless otherwise stated in SCC, the Employer shall make advance payment to the Contractor of the amounts stated in the SCC in a separate bank account maintained for the contract in two equal installments by the date stated in the SCC, against provision by the Contractor of an unconditional bank guarantee from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal in a form acceptable to the Employer in amounts equal to the advance payment. The guarantee shall remain effective until the advance payment has been repaid, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest shall not be charged on the advance payment. The validity of the bank guarantee under this sub-clause shall be at least 30 days beyond the end of intended completion date. The contractor shall submit the list of activities for which the Advance Payment is to be used along with their time schedules.
	63.2 The Contractor is to use the advance payment only to pay for Design, Equipment, Plant, Materials, and mobilization expenses required specifically for execution of the Contract. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the Employer.
	63.3 The advance payment shall be repaid by deducting proportionate amounts, **as stated in SCC**, from payments otherwise due Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuations of work done, Variations, price adjustments, Compensation Events, Bonuses, or Liquidated Damages.
	63.4 If the advance provided under GCC 63.1 is not settled due to non-performance of the Works under the contract by the Contractor within the time period specified in the Contract, the Employer shall recover the advance by enforcing the bank guarantee as provided under GCC 63.1, and shall also recover interest on the advance amount from the Contractor at a rate **stated in SCC**.
64. Securities	64.1 The Performance Security, including any additional security required as per ITB 36.5 and ITB 43.1, shall be provided to the Employer no later

	than the date specified in the Letter of Acceptance and shall be issued in an amount specified **in the SCC**, by a Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal acceptable to the Employer, and denominated in Nepalese Rupees. The Performance Security shall be valid until a date 30 days beyond the end of the intended Defect Liability Period. However, if the bidder quoted a bid price more than fifteen (15) percent below the estimated cost, the bidder may submit a separate performance security for the amount exceeding five percent of the bid price, as per ITB 43.1 (ii), which shall be valid until a date 30 days beyond the end of the intended completion date. Any additional performance security required as per ITB 36.5 shall be valid until a date 30 days beyond the end of the intended completion date.
	64.2 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.
	64.3 The Employer shall not make a claim under the Performance Security, except for amounts to which the Employer is entitled under the Contract in the event of: (a) failure by the Contractor to extend the validity of the Performance Security as described in Sub-Clause 64.1, in which event the Employer may claim the full amount of the Performance Security, (b) failure by the Contractor to pay the Employer an amount due, as either agreed by the Contractor or determined under Clause 34. [Employer's Claims] or Clause 36. [Dispute Settlement] or Clause 37. [Dispute Settlement by Arbitration] , within 42 days after this agreement or determination, (c) failure by the Contractor to remedy a default within 42 days after receiving the Employer's notice requiring the default to be remedied, or (d) circumstances which entitle the Employer to termination under Clause 79. [Termination by Employer], irrespective of whether notice of termination has been given. Clause 34 [Employer's Claim] shall not apply to claims made under the Performance Security for amounts to which the Employer is entitled under the Contract as set out in sub-paragraphs (a) to (d) above. If the Employer's representative gives notice with supporting particulars to the Contractor that the amount of the Accepted Contract Amount has increased or decreased by more than 15%, the Contractor shall, at the Employer's representative's request promptly increase, or may decrease, as the case may be, the value of the Performance Security by an equal percentage.
	64.4 The Employer shall indemnify and hold the Contractor harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from a claim under the Performance Security to the extent to which the Employer was not entitled to make the claim.
	64.5 The Employer shall return the Performance Security (other than

	additional performance securities) to the Contractor within 21 days after the Contractor has become entitled to receive the Performance Certificate.
65. Day works	65.1 If applicable, the Day works rates in the Contractor's Bid shall be used for small additional amounts of work only when the Employer has given written instructions in advance for additional work to be paid for in that way.
	65.2 For work of a minor or incidental nature, the Employer may instruct that a Variation shall be executed on a daywork basis. The work shall then be valued in accordance with the daywork schedule included in the Contract, and the following procedure shall apply. If a daywork schedule is not included in the Contract, this Clause shall not apply.
	65.3 Before ordering Goods for the work, the Contractor shall submit quotations to the Employer. When applying for payment, the Contractor shall submit invoices, vouchers and accounts or receipts for any Goods.
	65.4 Except for any items for which the daywork schedule specifies that payment is not due, the Contractor shall deliver each day to the Employer accurate statements in duplicate which shall include the following details of the resources used in executing the previous day's work: (a) the names, occupations and time of Contractor's Personnel, (b) the identification, type and time of Contractor's Equipment and Temporary Works, and (c) the quantities and types of Plant and Materials used.
	65.5 One copy of each statement will, if correct, or when agreed, be signed by the Employer and returned to the Contractor. The Contractor shall then submit priced statements of these resources to the Employer, prior to their inclusion in the next Statement under Clause 55. [Interim Payment Certificates].
66. Cost of Repairs	66.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Commencement Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.
F. Force Majeure	
67. Definition of Force Majeure	67.1 In this Clause, "Force Majeure" means an exceptional event or circumstance, (a) which is beyond a Party's control; (b) which such Party could not reasonably have provided against before entering into the Contract; (c) which, having arisen, such Party could not reasonably have avoided or overcome; and (d) which is not substantially attributable to the other Party.
	67.2 Force Majeure may include, but is not limited to, exceptional events or circumstances of the kind listed below, so long as conditions (a) to (d) above are satisfied:

	(a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies; (b) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war; (c) riot, commotion, disorder, strike or lockout by persons other than the Contractor's Personnel; (d) munitions of war, explosive materials, ionizing radiation or contamination by radio-activity, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity; and (e) natural catastrophes such as earthquake, hurricane, typhoon or volcanic activity.
68. Notice of Force Majeure	68.1 If a Party is or will be prevented from performing its substantial obligations under the Contract by Force Majeure, then it shall give notice to the other Party of the event or circumstances constituting the Force Majeure and shall specify the obligations, the performance of which is or will be prevented. The notice shall be given within 14 days after the Party became aware, or should have become aware, of the relevant event or circumstance constituting Force Majeure.
	68.2 The Party shall, having given notice, be excused performance of its obligations for so long as such Force Majeure prevents it from performing them.
	68.3 Notwithstanding any other provision of this Clause, Force Majeure shall not apply to obligations of either Party to make payments to the other Party under the Contract.
69. Duty to Minimize Delay	69.1 Each Party shall at all times use all reasonable endeavors to minimize any delay in the performance of the Contract as a result of Force Majeure.
	69.2 A Party shall give notice to the other Party when it ceases to be affected by the Force Majeure.
70. Consequences of Force Majeure	70.1 If the Contractor is prevented from performing its substantial obligations under the Contract by Force Majeure of which notice has been given under GCC 68, and suffers delay and/or incurs Cost by reason of such Force Majeure, the Contractor shall be entitled subject to GCC 37 to (a) an extension of time for any such delay, if completion is or will be delayed, under GCC42; and (b) if the event or circumstance is of the kind described in sub-paragraphs (a) to (e) of GCC 67.2 and, in the case of subparagraphs (b) to (e), occurs in Nepal, payment of any such Cost, including the costs of rectifying or replacing the Works and/or Goods damaged or destructed by Force Majeure, to the extent they are not indemnified through the insurance policy referred to in GCC 23.
	70.2 After receiving this notice, the Employer's Representative shall proceed in accordance with GCC 32. [Determinations] to agree or determine these matters.

71. Force Majeure Affecting Subcontractor	71.1 If any Subcontractor is entitled under any contract or agreement relating to the Works to relief from force majeure on terms additional to or broader than those specified in this Clause, such additional or broader force majeure events or circumstances shall not excuse the Contractor's nonperformance or entitle him to relief under this Clause.
72. Optional Termination, Payment and Release	72.1 If the execution of substantially all the Works in progress is prevented for a continuous period of 90 days by reason of Force Majeure of which notice has been given under GCC 68, or for multiple periods which total more than 150 days due to the same notified Force Majeure, then either Party may give to the other Party a notice of termination of the Contract. In this event, the termination shall take effect 7 days after the notice is given, and the Contractor shall proceed in accordance with GCC 79.9.
	72.2 Upon such termination, the Employer shall determine the value of the work done and issue a Payment Certificate, which shall include (a) the amounts payable for any work carried out for which a price is stated in the Contract; (b) the Cost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the Contractor is liable to accept delivery: this Plant and Materials shall become the property of (and be at the risk of) the Employer when paid for by the Employer, and the Contractor shall place the same at the Employer's disposal; (c) other Costs or liabilities which in the circumstances were reasonably and necessarily incurred by the Contractor in the expectation of completing the Works; (d) the Cost of removal of Temporary Works and Contractor's Equipment from the Site and the return of these items to the Contractor's works in his country (or to any other destination at no greater cost); and (e) the Cost of repatriation of the Contractor's staff and labor employed wholly in connection with the Works at the date of termination.
73. Release from Performance	73.1 Notwithstanding any other provision related to Force Majeure, if any event or circumstance outside the control of the Parties (including, but not limited to, Force Majeure) arises, which makes it impossible or unlawful for either or both Parties to fulfill its or their contractual obligations or which, under the law governing the Contract, entitles the Parties to be released from further performance of the Contract, then upon notice by either Party to the other Party of such event or circumstance, (a) the Parties shall be discharged from further performance, without prejudice to the rights of either Party in respect of any previous breach of the Contract; and (b) the sum payable by the Employer to the Contractor shall be the same as would have been payable under GCC 72 if the Contract had been terminated under GCC 72.
G. Finishing the Contract	

74. Test on Completion	74.1 The Contractor shall carry out the **Tests on Completion (as stated in the SCC)** in accordance with this Clause and Clause 48. [Tests] after providing the documents in accordance with Clause 78. [Operating and Maintenance Manuals].
	74.2 The Contractor shall give to the Employer not less than 21 days' notice of the date after which the Contractor will be ready to carry out each of the Tests on Completion. Unless otherwise agreed, Tests on Completion shall be carried out within 15 days after this date, on such day or days as the Employer shall instruct.
	74.3 The Tests on Completion shall be carried out in the following sequence: (a) pre-commissioning tests, which shall include the appropriate inspections and ("dry" or "cold") functional tests to demonstrate that each item of Plant can safely under-take the next stage, (b); (b) commissioning tests, which shall include the specified operational tests to demonstrate that the Works can be operated safely and as specified, under all available operating conditions; and (c) trial operation, which shall demonstrate that the Works perform reliably and in accordance with the Contract.
	74.4 During trial operation, when the Works are operating under stable conditions, the Contractor shall give notice to the Employer that the Works are ready for any other Tests on Completion, including performance tests to demonstrate whether the Works conform with criteria specified in the Employer's Requirements and with the Performance Guarantees.
	74.5 Trial operation shall not constitute a taking-over under Clause 76 [Taking Over of the Works]. Unless otherwise **stated in the SCC**, any product produced by the Works during trial operation shall be the property of the Employer.
	74.6 In considering the results of the Tests on Completion, appropriate allowances shall be made for the effect of any use of the Works by the Employer on the performance or other characteristics of the Works. As soon as the Works, have passed each of the Tests on Completion described in GCC Clause 74.3 (a), (b) or (c), the Contractor shall submit a certified report of the results of these Tests to the Employer.
	74.7 If the Tests on Completion are being unduly delayed by the Employer, GCC Clause 48.7 and/or GCC Clause 74.13 shall be applicable.
	74.8 If the Tests on Completion are being unduly delayed by the Contractor, the Employer may by notice require the Contractor to carry out the Tests within 21 days after receiving the notice. The Contractor shall carry out the Tests on such day or days within that period as the Contractor may fix and of which he shall give notice to the Employer.
	74.9 If the Contractor fails to carry out the Tests on Completion; within the period of 21 days, the Employer's Personnel may proceed with the Tests at the risk and cost of the Contractor. These Tests on Completion shall then be deemed to have been carried out in the presence of the Contractor

	and the results of the Tests shall be accepted as accurate.
	74.10 If the Works, fail to pass the Tests on Completion, GCC Clause 49.1 shall apply, and the Employer or the Contractor may require the failed Tests, and Tests on Completion on any related work, to be repeated under the same terms and conditions.
	74.11 If the Works, fail to pass the Tests on Completion repeated under GCC Clause 74.10, the Employer shall be entitled to: (a) order further repetition of Tests on Completion under GCC Clause 74.10; or (b) if the failure deprives the Employer of substantially the whole benefit of the Works, reject the Works, in which event the Employer shall have the same remedies as are provided in sub-paragraph (c) of GCC Clause 50.1.
	74.12 If the Contractor suffers delay and/or incurs Cost as a result of delay in carrying out the Tests on Completion for which the Employer is responsible, the Contractor shall give notice to the Employer and shall be entitled subject to Clause 35. [Contractor's Claims] to: (a) an extension of time for any such delay, if completion is or will be delayed, under Clause 42 [Extension of Intended Completion Date], and (b) payment of any such Cost which shall be added to the Contract Price.
	74.13 After receiving this notice, the Employer's Representative shall proceed in accordance with Clause 32. [Determinations] to agree or determine these matters.
75. Tests after Completion	75.1 If Tests after Completion are specified in the Contract, this Clause shall apply. Unless otherwise **stated in the SCC**, the Employer shall: (a) provide all electricity, water, sewage (if applicable), equipment, fuel, consumables, instruments, labour, materials, and suitably qualified, experienced and competent staff, as are necessary to carry out the Tests after Completion efficiently and properly; and; and (b) carry out the Tests after Completion in accordance with the Employer's Requirements, the manuals supplied by the Contractor under GCC Clause 78 [Operating and Maintenance Manuals] and such guidance as the Contractor may be required to give during the course of these Tests; and in the presence of such Contractor's Personnel as either Party may reasonably request.
	75.2 The Tests after Completion shall be carried out as soon as is reasonably practicable after the Works have been taken over by the Employer. The Employer shall give to the Contractor 21 days' notice of the date after which the Tests after Completion will be carried out. Unless otherwise agreed, these Tests shall be carried out within 15 days after this date, on the day or days determined by the Employer. If the Contractor does not attend at the time and place agreed, the Employer may proceed with the Tests after Completion, which shall be deemed to have been made in the Contractor's presence, and the

	Contractor shall accept the readings as accurate.
	75.3 The results of the Tests after Completion shall be compiled and evaluated by both Parties. Appropriate account shall be taken of the effect of the Employer's prior use of the Works.
	75.4 If the Contractor incurs Cost as a result of any unreasonable delay by the Employer to the Tests after Completion, the Contractor shall (i) give notice to the Employer and (ii) be entitled subject to Clause 35. [Contractor's Claims] to payment of any such Cost which shall be added to the Contract Price.
	75.5 After receiving this notice, the Employer's Representative shall proceed in accordance with Clause 32. [Determinations] to agree or determine this Cost.
	75.6 If, for reasons not attributable to the Contractor, a Test after Completion on the Works cannot be completed during the Defects Liability Period, then the Works shall be deemed to have passed this Test after Completion.
	75.7 If the Works, fail to pass the Tests after Completion: (a) execute all work required to remedy defects or damage, as may be notified by the Employer on or before the expiry date of the Defects Liability Period for the Works, and (b) either Party may then require the failed Tests, and the Tests after Completion on any related work, to be repeated under the same terms and conditions.
	75.8 If and to the extent that this failure and retesting are attributable to any of the matters listed below: (a) the design of the Works, (b) Plant, Materials or workmanship not being in accordance with the Contract, (c) improper operation or maintenance which was attributable to matters for which the Contractor is responsible (under Clauses 78 or otherwise), or (d) failure by the Contractor to comply with any other obligation. and cause the Employer to incur additional costs, the Contractor shall subject to Clause 34. [Employer's Claims] pay these costs to the Employer.
	75.9 If the following conditions apply, namely: (a) the Works, fail to pass any or all of the Tests after Completion, (b) the relevant sum payable as non-performance damages for this failure is stated (or its method of calculation is defined) in the Contract, and (c) the Contractor pays this relevant sum to the Employer during the Defects Liability Period, then the Works shall be deemed to have passed these Tests after Completion. In such case, the method of calculating the non-performance damages

	(based on the extent of the failure) shall be **defined in the SCC or in the Employer's Requirements,** and the minimum acceptable performance criteria shall also be specified. Results lower than minimum acceptable performance criteria, shall be cause of rejection of the Works or Section and Cost shall be recovered from the Contractor as determined as per the Clause 32. [Determinations].
	75.10 If the Works, fail to pass a Test after Completion and the Contractor proposes to make adjustments or modifications to the Works, the Contractor may be instructed by (or on behalf of) the Employer that right of access to the Works cannot be given until a time that is convenient to the Employer. The Contractor shall then remain liable to carry out the adjustments or modifications and to satisfy this Test, within a reasonable period of receiving notice by (or on behalf of) the Employer of the time that is convenient to the Employer. However, if the Contractor does not receive this notice during the relevant Defects Liability Period, the Contractor shall be relieved of this obligation and the Works shall be deemed to have passed this Test after Completion.
	75.11 If the Contractor incurs additional Cost as a result of any unreasonable delay by the Employer in permitting access to the Works or Plant by the Contractor, either to investigate the causes of a failure to pass a Test after Completion or to carry out any adjustments or modifications, the Contractor shall (i) give notice to the Employer and (ii) be entitled subject to Clause 35. [Contractor's Claims] to payment of any such Cost, which shall be added to the Contract Price.
	75.12 After receiving this notice, the Employer's Representative shall proceed in accordance with Clause 32. [Determinations] to agree or determine this Cost.
76. Taking Over of the Works	76.1 Except as stated in Clause 74.11 and 74.12, the Works shall be taken over by the Employer when (i) the Works have been completed in accordance with the Contract, and except as allowed in Clause 76.3 (a), and (ii) a Taking-Over Certificate for the Works has been issued, or is deemed to have been issued in accordance with this Clause.
	76.2 The Contractor may apply by notice to the Employer for a Taking-Over Certificate not earlier than 15 days before the Works will, in the Contractor's opinion, be complete and ready for taking over.
	76.3 The Employer shall, within 30 days after receiving the Contractor's application: (a) issue the Taking-Over Certificate to the Contractor, if the physical progress of works is at least ninety (90) percent in accordance with the Contract, except for any minor outstanding work and defects (as listed in Taking-Over Certificate) which will not substantially affect the use of the Works for their intended purpose (either until or whilst this work is completed and these defects are remedied); or (b) reject the application, giving reasons and specifying the work required to be done by the Contractor to enable the Taking-Over Certificate to be issued. The Contractor shall then

	complete this work before issuing a further notice under this Clause.
	76.4 If the Employer fails either to issue the Taking-Over Certificate or to reject the Contractor's application within the period of 30 days, and if the Works are substantially in accordance with the Contract, the Taking-Over Certificate shall be deemed to have been issued on the last day of that period.
77. Final Account	77.1 Performance Certificate: Performance of the Contractor's obligations shall not be considered to have been completed until the Employer has issued the Performance Certificate to the Contractor, stating the date on which the Contractor completed his obligations under the Contract. The Employer shall issue the Performance Certificate within 30 days after the latest of the expiry dates of the Defects Liability Periods, or as soon thereafter as the Contractor has supplied all the Contractor's Documents and completed and tested all the Works, including remedying any defects. If the Employer fails to issue the Performance Certificate accordingly: (a) the Performance Certificate shall be deemed to have been issued on the date 30 days after the date on which it should have been issued, as required by this Clause, and (b) The Clause 89.1 and sub-paragraph (a) of Clause 77.7 shall be inapplicable. Only the Performance Certificate shall be deemed to constitute acceptance of the Works.
	77.2 Within 60 days after receiving the Performance Certificate, the Contractor shall submit, to the Employer, six copies of a draft Final Account with supporting documents showing in detail in a form approved by the Employer: (a) the value of all work done in accordance with the Contract, and (b) any further sums which the Contractor considers to be due to him under the Contract or otherwise.
	77.3 If the Employer disagrees with or cannot verify any part of the draft Final Account, the Contractor shall submit such further information as the Employer may reasonably require and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Employer the Final Account as agreed. This agreed statement is referred to in these Conditions as the "Final Account".
	77.4 However if, following discussions between the Parties and any changes to the draft Final Account which are agreed, it becomes evident that a dispute exists, the Employer shall pay the agreed parts of the draft Final Account in accordance with Clause 55. [Interim Payment Certificate]. Thereafter, if the dispute is finally resolved under Clause 36. [Dispute Settlement] or Clause 37. [Dispute Settlement by Arbitration], the Contractor shall then prepare and submit to the Employer a Final Account.
	77.5 When submitting the Final Account, the Contractor shall submit a written discharge which confirms that the total of the Final Account represents full and final settlement of all moneys due to the Contractor under or in connection with the Contract. This discharge may state that it becomes effective when the Contractor has received the Performance Security and

	the out-standing balance of this total, in which event the discharge shall be effective on such date.
	77.6 Within 45 days after receiving the Final Account and written discharge, the Employer shall pay to the Contractor the amount which is finally due, less all amounts previously paid by the Employer and any deductions in accordance with Clause 34. [Employer's Claims].
	77.7 The Employer shall not be liable to the Contractor for any matter or thing under or in connection with the Contract or execution of the Works, except to the extent that the Contractor shall have included an amount expressly for it, in the Final Account. However, this Clause shall not limit the Employer's liability under his indemnification obligations, or the Employer's liability in any case of fraud, deliberate default or reckless misconduct by the Employer.
78. Operating and Maintenance Manuals	78.1 As required under the Contract, the Contractor shall prepare, and keep up-to-date, a complete set of "as-built" records of the execution of the Works, showing the exact as-built locations, sizes and details of the work as executed. These records shall be kept on the Site and shall be used exclusively for the purposes of this Clause. Two copies shall be supplied to the Employer prior to the commencement of the Tests on Completion.
	78.2 In addition, the Contractor shall supply to the Employer as-built drawings of the Works, showing all Works as executed, and submit them to the Employer for review under Clause 27. [Design by Contractor]. The Contractor shall obtain the consent of the Employer as to their size, the referencing system, and other relevant details.
	78.3 Prior to the issue of any Taking-Over Certificate, the Contractor shall supply to the Employer the specified numbers and types of copies of the relevant as-built drawings, in accordance with the Employer's Requirements. The Works shall not be considered to be completed for the purposes of taking-over under Clause 76. [Taking Over of the Works] until the Employer has received these documents.
	78.4 As required under the Contract, prior to commencement of the Tests on Completion, the Contractor shall supply to the Employer provisional operation and maintenance manuals in sufficient detail for the Employer to operate, maintain, dismantle, reassemble, adjust and repair the Plant. The Works shall not be considered to be completed for the purposes of taking-over under Clause 76. [Taking Over of the Works] until the Employer has received final operation and maintenance manuals in such detail, and any other manuals specified in the Employer's Requirements for these purposes.
79. Termination by Employer	79.1 If the Contractor fails to carry out any obligation under the Contract, the Employer may by notice require the Contractor to make good the failure and to remedy it within a specified reasonable time.
	79.2 The Employer shall be entitled to terminate the Contract if the Contractor: (a) fails to comply with Clause 64 [Securities] or with a notice under Clause 79.1, (b) abandons the Works or otherwise plainly demonstrates the intention

	not to continue performance of his obligations under the Contract, (c) without reasonable excuse fails: (i) to proceed with the Works in accordance with Clause 41 [Program and Progress], or (ii) to comply with a notice issued for the Correction of Defects under Clause 49, within 30 days after receiving it, (d) subcontracts the whole of the Works, subcontracts Works (including subcontract(s) for part or parts of the Works and for suppliers of Plant, Materials, Works and Services) with a total accumulated value greater than that referred to in SCC 16.1 [*Subcontracting*] or assigns the Contract without the required agreement, (e) becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events, (f) 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 84.1. However, lawful inducements and rewards to Contractor's Personnel shall not entitle termination. (g) The Contractor uses the advance payment for matters other than the contractual obligations, (h) 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 Employer; (i) the Employer 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 Employer; (j) the Employer gives two consecutive Notices to update the Program and accelerate the works to ensure compliance with GCC Sub clause 26.1 and the Contractor fails to update the Program and demonstrate acceleration of the works within a reasonable period of time determined by the Employer; (k) the Contractor does not maintain a Security, which is required; (l) 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**;
	79.3 In any of these events or circumstances, the Employer may, upon giving 15 days' notice to the Contractor, terminate the Contract and expel the Contractor from the Site.
	79.4 However, in the case of sub-paragraph (e) or (f) of Sub-Clause 79.2, the Employer may by notice terminate the Contract immediately.
	79.5 The Employer's election to terminate the Contract shall not prejudice any other rights of the Employer, under the Contract or otherwise.
	79.6 The Contractor shall then leave the Site and deliver any required Goods,

	all Contractors' Documents, and other design documents made by or for him, to the Employer. All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Employer.
	79.7 However, the Contractor shall use his best efforts to comply immediately with any reasonable instructions included in the notice (i) for the assignment of any subcontract, and (ii) for the protection of life or property or for the safety of the Works. After termination, the Employer may complete the Works and/or arrange for any other entities to do so. The Employer and these entities may then use any Goods, Contractor's Documents and other design documents made by or on behalf of the Contractor.
	79.8 The Employer shall then give notice that the Contractor's Equipment and Temporary Works will be released to the Contractor at or near the Site. The Contractor shall promptly arrange their removal, at the risk and cost of the Contractor. However, if by this time the Contractor has failed to make a payment due to the Employer, these items may be sold by the Employer in order to recover this payment. Any balance of the proceeds shall then be paid to the Contractor.
	79.9 The Employer shall be entitled to terminate the Contract, at any time for the Employer's convenience, by giving notice of such termination to the Contractor. The termination shall take effect 30 days after the later of the dates on which the Contractor receives this notice or the Employer returns the Performance Security. The Employer shall not terminate the Contract under this Clause in order to execute the Works himself or to arrange for the Works to be executed by another contractor. After this termination, the Contractor shall proceed in accordance with Clause 82. [Cessation of Work and Removal of Contractor's Equipment] and shall be paid in accordance with Clause 83 [Payment upon Termination].
80. Contractor's Entitlement to Suspend Work	80.1 If the Employer fails to comply with Clause 63. [Advance Payment] or Clause 56.1, the Contractor may, after giving not less than 30 days' notice to the Employer, suspend work (or reduce the rate of work) unless and until the Contractor has received the payment, and as described in the notice. The Contractor's action shall not prejudice his entitlements to the interest on the delayed payment under Clause 56.2 and to termination under Clause 81. [Termination by Contractor].
	80.2 If the Contractor subsequently receives such payment (as described in the relevant Clause and in the above notice) before giving a notice of termination, the Contractor shall resume normal working as soon as is reasonably practicable.
	80.3 If the Contractor suffers delay and/or incurs Cost as a result of suspending work (or reducing the rate of work) in accordance with this Clause, the Contractor shall give notice to the Employer and shall be entitled subject to Clause 35. [Contractor's Claims] to: (a) an extension of time for any such delay, if completion is or will be delayed, under Clause 42. [Extension of Intended Completion Date], and (b) payment of any such Cost, which shall be added to the Contract Price. After receiving this notice, the Employer's Representative shall proceed in

	accordance with Clause 32. [Determinations] to agree or determine these matters.
81. Termination by Contractor	81.1 The Contractor shall be entitled to terminate the Contract if: (a) the Contractor does not receive the reasonable evidence within 45 days after giving notice under Clause 80.1 in respect of a failure to comply Employer's Obligation under the Clause 56. [Payments], (b) the Contractor does not receive the amount due within 90 days after the expiry of the time as per Clause 63.1 within which payment is to be made (except for deductions in accordance with Clause 34. [Employer's Claims]), (c) the Employer substantially fails to perform his obligations under the Contract and such failure constitutes a material breach, (d) the Employer fails to comply with Clause 7. [Assignment], (e) a prolonged suspension affects the whole of the Works as described in Clause 44.5, or (f) the Employer becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events. In any of these events or circumstances, the Contractor may, upon giving 15 days' notice to the Employer, terminate the Contract.
	81.2 The Contractor's election to terminate the Contract shall not prejudice any other rights of the Contractor, under the Contract or otherwise.
82. Cessation of Work and Removal of Contractor's Equipment	82.1 After a notice of termination under Sub-Clause 79.9, Clause 81. [Termination by Contractor] or Clause 72. [Optional Termination, Payment and Release] has taken effect, the Contractor shall promptly: (a) cease all further work, except for such work as may have been instructed by the Employer for the protection of life or property or for the safety of the Works, (b) hand over Contractor's Documents, Plant, Materials and other work, for which the Contractor has received payment, and (c) remove all other Goods from the Site, except as necessary for safety, and leave the Site.
83. Payment upon Termination	83.1 As soon as practicable after a notice of termination under Clause 79. [Termination by Employer] has taken effect, the Employer shall proceed in accordance with Clause 32. [Determinations] to agree or determine the value of the Works, Goods and Contractor's Documents, and any other sums due to the Contractor for work executed in accordance with the Contract.
	83.2 After a notice of termination under Clause 79. [Termination by Employer] other than Termination by Convenience as per Clause 79.9 has taken effect, the Employer may: (a) proceed in accordance with Clause 34. [Employer's Claims], (b) withhold further payments to the Contractor until the costs of design,

	execution, completion and remedying of any defects, liquidated damages (if any), and all other costs incurred by the Employer, have been established, and/or (c) recover from the Contractor any losses and damages incurred by the Employer and any extra costs of completing the Works, after allowing for any sum due to the Contractor. After recovering any such losses, damages and extra costs, the Employer shall pay any balance to the Contractor. (d) forfeit the Performance Security In such case, amount to complete the remaining works as per the Contract shall be recovered from the Contractor as Government dues. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be a debt payable to the Employer.
	83.3 After a notice of termination under Clause 81. [Termination by Contractor] or Termination by Convenience as per Clause 79.9 has taken effect, the Employer shall promptly: (a) return the Performance Security to the Contractor, (b) pay the Contractor in accordance with Clause 72. [Optional Termination, Payment and Release], and (c) pay to the Contractor the amount of any loss of profit or other loss or damage sustained by the Contractor as a result of this termination.
84. Fraud and Corruption	84.1 If the Employer determines that the Contractor has engaged in corrupt, fraudulent, collusive, coercive or obstructive practices, in competing for or in executing the Contract, then the Employer may, after giving 15 days' notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site.
	84.2 Should any employee of the Contractor be determined to have engaged in corrupt, fraudulent, collusive, coercive, or obstructive practice during the execution of the Works, then that employee shall be removed in accordance with GCC Clause 18. For the purposes of this GCC Clause 84; (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 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/DP's inspection and audit rights provided for under GCC Clause 33.4.
	84.3 The contractor shall be prosecuted for offenses under prevailing criminal laws, if the contractor: (i) Misuses the Advance Payment or payments received from the Employer; (ii) Receives payment by submitting false information or documents; (iii) Abandons the works before completion; (iv) Commits a serious violation of the contract; or (v) Causes loss or damage to the Employer.
85. Black Listing	85.1 Without prejudice to any other rights of the Employer under this Contract, GoN, Public Procurement Monitoring Office (PPMO), on the recommendation of procuring entity, may blacklist a Contractor for its conduct for a period of one (1) to three (3) years on the following grounds and seriousness of the act committed by the Contractor: (a) If it is established that the Contractor has committed substantial defect in implementation of the contract or has not substantially fulfilled its obligations under the contract or the completed work is not of the specified quality as per the contract. (b) If convicted from a court of law in a criminal offense liable to be disqualified for taking part in procurement contract, (c) If it is established that the Contractor has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.
86. Release from Performance	86.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Employer or the Contractor, the Employer shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which a commitment was made.
87. Suspension of DP Loan/Credit/Grant	87.1 In the event that the DP suspends the loan/ credit/grant to the Employer from which part of the payments to the Contractor are being made: (a) the Employer is obligated to notify the Contractor of such suspension within 7 days of having received the DP's suspension notice; and (b) if the Contractor has not received sums due him within the 30 days for payment provided for in GCC 56.1, the Contractor may immediately issue a 15-day termination notice.
88. Eligibility	88.1 The Contractor shall have the nationality of an eligible country **as stated in SCC**. The Contractor shall be deemed to have the nationality of a country if the Contractor 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 subcontractors or suppliers for any part of the Contract including related services.
	88.2 The materials, equipment, and services to be supplied under the Contract shall have their origin in eligible source countries **as stated in SCC** and all expenditures under the Contract will be limited to such materials, equipment, and services. At the Employer's request, the Contractor may be required to provide evidence of the origin of materials, equipment, and services.
	88.3 For purposes of GCC 88.2, "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.
89. Quarries and Spoil Dumps	89.1 Upon receiving the Performance Certificate, the Contractor shall remove any remaining Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works from the Site.
	89.2 Any quarry operated as part of this Contract shall be maintained and left in a stable condition without steep slopes and be either refilled or drained and be landscaped by appropriate planting. Rock or gravel taken from a river shall be removed over some distance so as to limit the depth of material removed at any one location, not disrupt the river flow or damage or undermine the river banks. The Contractor shall not deposit excavated material on land in Government or private ownership except as directed by the Employer in writing or by permission in writing of the authority responsible for such land in Government ownership, or of the owner or responsible representative of the owner of such land in private ownership, and only then in those places and under such conditions as the authority, owner or responsible representative may prescribe.
	89.3 If all these items have not been removed within 30 days after the Employer issues the Performance Certificate, the Employer may sell or otherwise dispose of any remaining items. The Employer shall be entitled to be paid the costs incurred in connection with, or attributable to, such sale or disposal and restoring the Site.
	89.4 Any balance of the moneys from the sale shall be paid to the Contractor. If these moneys are less than the Employer's costs, the Contractor shall pay the outstanding balance to the Employer.
90. Local Taxation	90.1 The prices bid by the Contractor shall include all taxes that may be levied in accordance to the laws and regulations in being in Nepal on the Contractor's equipment, plant and materials acquired for the purpose of the Contract and on the services performed under the Contract. Nothing in the Contract shall relieve the Contractor from his responsibility to pay any tax that may be levied in Nepal on profits made by him in respect of the Contract.

91. Value Added Tax	91.1 The Contract is not exempted from value added tax. An amount specified in the schedule of taxes shall be paid by the Contractor in the concerned VAT office within time frame specified in VAT regulation.
92. Income Taxes on Staff	92.1 The Contractor's staff, personnel and labor will be liable to pay personal income taxes in Nepal in respect of their salaries and wages, as are chargeable under the laws and regulations for the time being in force, and the Contractor shall perform such duties in regard to such deductions as may be imposed on him by such laws and regulations.
	92.2 The issue of the Final Account Certificate pursuant to clause GCC 77 shall be made only upon submittal by the Contractor of a certificate of income tax clearance from the Government of Nepal.
93. Duties, Taxes and Royalties	93.1 The Contractor shall pay all royalties, rents and other payments, and shall not be entitled for reimbursement for: (a) natural Materials obtained from outside the Site, and (b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract.
	93.2 Any element of royalty, duty or tax in the price of any goods including fuel oil, and lubricating oil, cement, timber, iron and iron goods locally procured by the Contractor for the works shall be included in the Contract rates and prices and no reimbursement or payment in that respect shall be made to the Contractor.
	93.3 The Contractor shall familiarize himself with GON the rules and regulations with regard to customs, duties, taxes, clearing of goods and equipment, immigration and the like, and it will be necessary for him to follow the required procedures regardless of the assistance as may be provided by the Employer wherever possible.
	93.4 The Contractor shall pay and shall not be entitled to the reimbursement of cost of extracting construction materials such as sand, stone/boulder, gravel, etc. from the river beds or quarries. Such prices will be levied by the District Coordination Committee (DCC) as may be in force at the time. The Contractor, sub-contractor(s) employed directly by him and for whom he is responsible, will not be exempted from payment of royalties, taxes or other kinds of surcharges on these construction materials so extracted and paid for to the DCC.
94. Member of Government, etc., not Personally Liable	94.1 No member or officer of GoN or the Employer or the Employer 'Representatives shall be in any way personally bound or liable for the act or obligations of the Employer under the Contract or answerable for any default or omission in the observance or performance of any of act, matter or thing which are herein contained.
95. Compliance with Regulations for Explosives	95.1 No explosives of any kind shall be used by the Contractor without the prior consent of the Employer in writing and the Contractor shall provide, store and handle these and all other items of every kind whatsoever required for blasting operations, all at his own expense in a manner approved in writing by the Employer.
	95.2 The Contractor shall comply with all relevant ordinances, instructions and regulations which the Government, or other person or persons having due

	authority, may issue from time to time regarding the handling, transportation, storage and use of explosives.
96. Permission for Blasting	96.1 The Contractor shall at all times maintain full liaison with and inform well in advance, and obtain such permission as is required from all Government authorities, public bodies and private parties whatsoever concerned or affected, or likely to be concerned or affected by blasting operation.
97. Records of Explosives	97.1 Before the beginning of the Defects Liability Period, the Contractor shall account to the satisfaction of the Employer for all explosives brought on to the Site during the execution of the Contract and the Contractor shall remove all unused explosives from the Site on completion of works when ordered by the Employer.
98. Traffic Diversion	98.1 The Contractor shall include the necessary safety procedures regarding and pedestrian traffic diversion that is needed in execution of the works. The Contractor shall include in his costing of works, any temporary works or diversion that are needed during the construction period. All traffic diversion should be designed for the safety of both the motoring public and the men at work. It shall ensure the uninterrupted flow of traffic and minimum inconvenience to the public during the period concerned. As such, adequate warning signs, flagmen and other relevant safety precautionary measures shall be provided to warn motorists and pedestrians well ahead of the intended diversion as directed by the Employer. All traffic devices used shall be designed in accordance with the instruction of Employer.
99. Social Security Fund	99.1 The contractor shall enroll the laborers, employees, or other workforce engaged in such work in the Social Security Fund in accordance with prevailing laws.
	99.2 The contractor shall be responsible to disburse the remuneration, benefits, and other payments of the laborers, employees, or workforce into the bank account of the concerned individual.
	99.3 The contractor shall be responsible for ensuring that the required work permit has been obtained in accordance with prevailing laws in respect of foreign personnel.

Section IX: Special Conditions of Contract

The following Special Conditions of Contract shall supplement the GCC. Whenever there is a conflict, the provisions herein shall prevail over those in the GCC

Special Conditions of Contract

A. General	
GCC 1.1 (n)	The Commencement Date shall be **30 days from the date of Contract**
GCC 1.1 (x)	The Employer ***is: Rastriya Prasaran Grid Company Limited, Buddhanagar, Kathmandu.***
GCC 1.1 (y)	The Employer's Representative is **Mewa-Changhe (Dhungesanghu) 132kV Transmission Line Project** Address: Rastriya Prasaran Grid Company Limited BPC Building, Buddhanagar, Kathmandu, Nepal Telephone: +977-01-4610103 Electronic mail address: info@rpgcl.com Employer shall appoint from time to time by the under GCC Clause 13.
GCC 1.1 (ee)	The Intended Completion Date for the whole of the Works shall be: ***10 months from the effective date of contract or date of contract whichever is earlier].***
GCC 1.1 (nn)	***Refer to Employer's Requirements.***
GCC 1.1 (vv)	***Refer Sections of Employer's Requirements.***
GCC 2.2	Sectional Completions are: ***Not Applicable.***
GCC 2.3 (j)	The following documents also form part of the Contract: ***As per GCC***
GCC 3.3	The language of the contract is **ENGLISH.**
GCC 4.9	The following event or situations or Conditions shall be considered as adverse physical conditions: (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.
GCC 10.1	***The Contractor shall, in performing the Contract, comply with applicable Laws of Nepal.***

GCC 15.1 (a)	The agreed electronic transmission shall be; **For Employer: *info@rpgcl.com*** and **For Contractor: ……**
GCC 16.1	The provision for sub-contracting is: **not *permitted*** **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 arises, the qualification requirement of the manufacturer of the major items and sub-**contractor of the major Plant, Equipment and works, shall be as that stipulated in "Part I, "Evaluation and Qualification Requirement" of the bidding document.**
GCC 17.1	***Schedule of other contractors: "Not Applicable"***
GCC 19.4	***Details of the items with the respective dates of use or occupation by the Contractor, up to the respective dates will be provided accordingly.***
GCC 23.2	The minimum insurance amounts and deductibles shall be: 1. The minimum cover for loss of or damage to the Works, Plant and Materials is: ***115 percent*** of the Contract Amount. 2. The maximum deductible for insurance of the Works and of Plant and Materials is: ***5 % of claimed amount*** 3. The minimum cover for loss or damage to immovable Equipment is:100 ***% of Equipment Cost (i.e. Replacement Cost)*** 4. The maximum deductible for insurance of immovable Equipment is: ***5% of sum insured*** 5. The minimum for insurance of other property is: **NRs. 1,000,000.00** with unlimited number of occurrences ***6.*** The maximum deductible for insurance of other property is: **5*% of sum insured.*** 7. The minimum cover for personal injury or death insurance i. for the Contractor's employees is that specified in the Labor act of Nepal and ii. for other people including Employer's Representatives is***: 1 million Nepalese Rupees*** with an unlimited number of occurrences 8. The minimum cover for Liability for breach of professional duty in an amount not less than **100%** of the Contract Amount. The Contractor shall provide this insurance in the joint name of Employer and the Contractor valid for the period **upto defect liability period** days from the Commencement Date.
GCC 24.1	Site Investigation Reports are: ***Site Investigation Reports available with Client, any conducted will be made available to Contractor upon their request. NONE***
GCC 27.1	The contractor shall submit the design and drawings, along with the project specifications, to the employer ***within the period 90 days after signing the contract or from effective date of contract signing whichever is early.***
GCC 27.3	Within ***30 days*** calculated from the Commencement Date, the Contractor shall

	give notice to the Employer of any error, fault or other defect found in the Employer's Requirements or these items of reference.
GCC 30.1 and GCC 30.3	The right of access to and Possession of Site Date(s) shall be: ***30 days from contract effective date.***
GCC 31.3	***Contractor shall give the Employer not less than 7 days' notice of the date on which any Plant or a major item of other Goods are shipped for the project.***
GCC 37.1	The place of arbitration shall be: ***Kathmandu, Nepal***
GCC 38.12	The list of Key Personnel and their Qualifications: ***Contractor shall submit the following:*** **Name of Personnel** — **Qualification** …….. — …….. …….. — …….. …….. — …….. …….. — ……..
C. Time Control	
GCC 41.1	The Contractor shall submit for approval a ***Program for the Works within 14 days*** from the date of the Letter of Acceptance.
GCC 41.7	***Addition to GCC clause 41.7 Contractor shall submit Weekly scheduled work of upcoming month and weekly progress report of past month along with proper manpower deputed for previous month and planning for upcoming month.*** ***Addition to GCC clause 41.7 The Contractor shall submit a weekly schedule of planned work for the upcoming month, together with a weekly progress report for the preceding month, including details of manpower deployed during the previous month and a manpower and resource plan for the upcoming month, all in the approved format and within seven (7) days after the end of each reporting period.***
GCC 45.3	The frequency of Management Meetings in every ***30 days.***
D. Quality Control	
GCC 48	***48.1 Add the following at the end of this Sub-Clause:*** *(a) The Employer and their Project Engineers shall be entitled to attend at his own cost to witness the tests of the following equipment at Manufacturer's/Contractor's factory:* ▪ *SF_6 Circuit Breaker* ▪ *Disconnecting Switch* ▪ *Instrument Transformers (CT and CVT)* ▪ *Control and Relay Panels* ▪ *Substation Automation System and SCADA* ▪ *Communication Systems* ▪ *132kV XLPE Cable* *as per Employers Requirements (Technical Specifications)*

(b) The Contractor shall intimate the Employer 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 & four (4) weeks in advance in case of foreign supplies.

(c) 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 GC 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.

48.8 Add the following at the end of this Sub-Clause:

The Contractor shall provide the Employer with a certified report of the results of any such test and/or inspection within fifteen (15) days after completion of tests"

48.9 Add the following Sub Clauses:

Type Test

The Successful Bidders shall have to furnish copies of type test certificate of all the equipment/Material supplied against this specification for the tests carried out during last five years.

If the successful bidder fails to submit the type test reports, type test would be conducted by the contractor in the presence of authorized representative of the Employer at no additional cost implications to the Employer.

48.10 Add the following sub clause Routine Tests

These tests would be conducted on raw materials and other finished materials in accordance with provisions of internationally accepted Standards. Proper record of all Routine tests has to be maintained and made available to the Employer on demand.

48.11 Add the following sub clause Acceptance Tests

These tests would be conducted as per Quality Assurance Program approved by the Employer on each and every lot of finished material, which is ready for dispatch. The tests shall be conducted in the presence of Employer authorized representative(s). Note: For all type, routine and acceptance test, the acceptance values shall be the values guaranteed by the bidder in the guaranteed technical particulars of his proposal or the acceptance test value specified in this specification, whichever is more stringent for that particular test.

Correct grade and quality of all the materials including steel and zinc shall be used by the Contractor. Employer reserves the right of carrying out any inspection or test of reasonable nature at Contractor's/Manufacturer's works, or at site, or at any approved laboratory in addition to the tests as specified above to satisfy himself that the materials comply with the specifications without any extra cost

48.12 Add the following sub clause Material Dispatch Clearances

After the materials have been found acceptable a Material Dispatch Clearance (MDC) shall be issued in writing by the

	Employer/Representative without which no materials should be dispatched. *Necessary procedure for packing shall be followed before dispatch of material as given in Technical Specifications.*
GCC 49.1	***Employer shall give notice to the Contractor of any Defects before the end of the Defects Liability.***
GCC 49.7	***Add the following paragraph at the end of this Sub-Clause:*** ***The critical components covered under the extended defect liability period are Transformers and the period shall be 5 years.***
E. Cost Control	
GCC 51.6	***Price adjustment shall not be applicable***
GCC 55.1	***The Contractor shall submit a Statement in two copies to the Employer's Representative after the end of each month following the completion of works.***
GCC 55.3	***The estimated contract value of the Works executed shall comprise the value of completed activities in the Activity Schedule***
GCC 56.2	***The interest rate shall be as per the discounted rate of Nepal Rastriya Bank..***
GCC 59.1	***The Contract is not subject to price adjustment.***
GCC 59.6	***The Contract is not subject to price adjustment.***
GCC 59.7	***The Contract is not subject to price adjustment.***
GCC 60.1	The proportion of payments retained is: For GoN Funded: ***5 (five) percent***
GCC 61.1	The ***liquidated damages for the whole of the Works are 0.05 Percent per day of the final Contract Price*** without VAT but including Provisional Sum.
GCC 61.2	***The maximum amount of liquidated damages for the whole of the Works is 10 Percent of the Final Contract Price*** without VAT but including Provisional Sum**.**
GCC 62.1	The provision of bonus is ***not applicable*** in the contract.
GCC 62.2	The provision of bonus is ***not applicable*** in the contract.
GCC 63.1	***The Advance Payments shall be 10% of the Final Contract Price*** without VAT but including Provisional Sum and shall be paid in two equal installments and to the Contractor in following manner. ***The 5% advance payments shall be provided after the signing of contract against provision by the Contractor of an unconditional bank guarantee*** from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal in a form acceptable to the Employer in amounts

	equal to the advance payment. ***Remaining 5% will be provided after the Submission and Approval of detailed method statement of the execution of the contracted work against provision by the Contractor of an unconditional bank guarantee*** from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal in a form acceptable to the Employer in amounts equal to the advance payment.
GCC 63.3	***Deductions from Payment Certificates will commence in the Cumulative value of works executed exceeds 30% of the Initial Contract Price***. ***Deduction will be at the rate of 20% of the respective Interim Payment Certificate until such time as the advance payment has been repaid; provided that the advance payment shall be completely repaid prior to the payment of 80 % of the Contract Price.***
GCC 63.4	***Recover interest on the advance amount from the Contractor should be at a rate of 10 %.***
GCC 64.1	The Performance Security amount is: 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. Or 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 calculated as: **Performance Security Amount = [(0.85 x Cost Estimate –Bid Price) x 0.5] + 5% of Bid Price.** **NRs.** ……... ***[Insert Amount prior to the Contract agreement].***
G. Finishing the Contract	
GCC 74.1	***Refer to Chapter: Inspection, Testing and Commissioning of Employer's Requirements***
GCC 74.5	***Refer to Employer's Requirements***
GCC 75.1	***Refer to Employer's Requirements***
GCC 75.9	***Failure of Test after completion shall cause the Employer to incur additional costs, the Contractor shall subject to Clause 34. [Employer's Claims] pay these costs to the Employer.***
GCC 79.2 (l)	The maximum number of days is: ***200***
GCC 88.1	***List Nationality of an eligible Country: Prime Contractor shall be Nepali.***
GCC 88.2	***List Origin in an eligible Country: All Country***
GCC 93	Add the following sub-clause 93.5, 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. 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. In Nepal General: 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 that may be levied in accordance with the laws and regulations in force or in effect in Nepal as of 28 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. Value Added Tax (VAT): if not included in the costs while submitting bids by the Contractor, sub-contractor or its nominated sub-contractor, shall be eligible for refund on all imported equipment and materials to be supplied and delivered exclusively for use in the Project. Staff Income Tax: The Contractor's staff, personnel and labourers, and those of its subcontractors, will be liable to pay personal income taxes in the Employer's country, irrespective of whether they are 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. Import License: The Contractor shall inform the Employer and the Project Manager in writing the details of the equipment and materials to be imported into Nepal for use on the Works at least 56 days prior to arrival of shipment at disembarkation port, and shall submit a formal written request for assistance from the Employer for importation processing. The Employer will assist the Contractor to obtain necessary permits for import of such equipment and materials into Nepal. Import license fees or any other charges shall be at the cost of the Contractor. The Contractor shall be responsible for transport from the Port of disembarkation to the Site or location of the Works. The Contractor shall be fully responsible to determine these rates and the amount payable at the time of preparing tender document and include such costs in its bids. In failing to do so, the Employer shall not be liable to pay such costs and the Contractor shall pay such charges as local or any customs authorities en-route may impose, which will not be an eligible item for refund from the Employer. Duties on Equipment, Plant, Materials and Supplies: (a) Notwithstanding the provisions of this document, the Contractor's Plant and Equipment, including essential tools thereof, imported for the sole purpose of executing the Contract on condition of re-export

	upon completion of the Works, shall be exempt from payment of customs duties, VAT and applicable taxes. However, the Contractor shall deposit the amount or provide a Bank Guarantee to the GoN Customs office equal to amount of customs duties and other taxes as per the prevailing laws, rules and regulations of Nepal for that imported equipment, plant, materials and supplies at the time of import. Such deposited amounts shall be refunded, or the Bank guarantee cancelled by the Customs Office after Re-export of those imported equipment, plant, materials and supplies. (b) Any plant, materials or supplies imported by the Contractor for the performance of the Works but not incorporated in the Works shall be taken out of Nepal within 90 (Ninety) days from the date of issuance of the Performance Certificate. If the Contractor disposes off or consumes any equipment, spare parts, materials or supplies within Nepal, it shall pay all customs duties, VAT, income tax on the sales proceeds and taxes applicable on such items under the laws and regulation of Nepal in force. (c) Equipment, plant, materials and supplies, imported by the Contractor for execution of the Works, shall be subject to payment of customs duty at a special rate of one percent (1%) or as per the prevailing laws, rules and regulations of Nepal of CIP or Customs entry point value. This customs duty shall be paid by the Contractor at the time of import and will be reimbursed by the Employer to the Contractor upon submission of the original receipt issued by the Customs Department. VAT shall be exempted on all imported materials & equipment purchased for the use in the Works (shall be reimbursed by the Employer in case the Employer is unable to avail exempt facility) (d) VAT applicable on plant & equipment supplied directly from manufacturing plant in Nepal shall be paid by the Employer (e) 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. (f) Income tax assessed in accordance with the prevailing Income Tax Act of Nepal and as per the provision of any specific Double Taxation Agreement, shall be imposed on the Contractor, its sub- contractors and nominated sub- contractors. An advance income tax as per the prevailing income Tax Act and Finance Act shall be deducted from the monthly progress payment of the Contractor. (g) The Contractor shall pay all duties, taxes, fees and contributions levied in Nepal in Nepalese Rupees as directed by the relevant governmental department or office, or any other local statutory agency or body in accordance with the relevant rules and regulations. (h) The provisions of this clause shall apply equally to foreign subcontractors or nominated subcontractors of the Contractor employed for the Works. (i) The Contractor and any foreign subcontractors or nominated

	subcontractors employed on the Works, if not already registered in Nepal, shall be required to get registered with the Inland Revenue Department (IRD) for the purpose of the Contract, which shall be undertaken within 28 days after signing of the Contract Agreement. The Contractor, sub-contractor or the nominated subcontractor shall submit Certified copies of the Registration Certificate(s) to the Project Manager within 14 days of registration. (j) Other local fees and charges (toll taxes) shall be applied in accordance with the prevailing laws and regulations of Nepal. (k) Locally available goods, construction materials including fuel, lubricating oil, cement, timber, iron and steel goods, etc. shall be procured locally. All taxes for such goods procured from the local market shall be included in the Contract Rates and Prices and no reimbursement or payment in that respect shall be made to the Contractor.
Add this new Clause SCC 100 (Supplementing to GCC) **Construction of the Contract Document**	100.1 The Contract agreement will be signed in three (3) originals and the Contractor shall be provided with one signed original and the other two will be retained by the Employer. 100.2 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. 100.3 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

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 evaluated bid closest to the Average Bid Price.

Authorized Signature: ……

Name: ... ……..

Title: ……..

CC:
[Insert name and address of all other Bidders, who submitted the 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 the .....day of …. between……. name of the Employer ***…… (hereinafter "the Employer"),*** of the one part, and ……name of the Contractor …… (hereinafter "the Contractor"), of the other part:

WHEREAS the Employer desires that the Works known as ……..... name of the Contract .....should be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of these Works and the remedying of any defects in the sum of NRs **…..…..** ***[insert amount of contract price in words and figures including taxes]*** (hereinafter "the Contract Price").

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents.
   (a) the Letter of Acceptance;
   (b) the Letters of Technical and Price Bid;
   (c) the Addenda Nos ..... ***Insert addenda numbers if any*** ……
   (d) the Special Conditions of Contract;
   (e) the List of Eligible Countries that was specified in Section V of the bidding document,
   (f) the General Conditions of Contract;
   (g) Employer's Requirements;
   (h) Activity and Price Schedules;
   (i) Table of Price Adjustment Data;
   (j) Contractor's Proposal;
   (k) List of Approved Subcontractors *[For GoN funded project]*
   (l) ..... ***[Specify if there are any other document]***

3. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

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 the Contractor in the presence of
Witness, Name Signature, Address, Date

Signed by……...
for and on behalf of the Employer in the presence of
Witness, Name, Signature, Address, Date

List of Approved Subcontractors

In accordance with GCC Sub-Clause 16.1, The following Subcontractors are approved for carrying out the work as specified below.

Name of Subcontractors	Description of Works	Value/Percentage of subcontract

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 reference 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.

Retention Money Security

(On letterhead paper of the Bank)

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

Beneficiary: …… ***[Insert name and Address of Employer]***

Issue Date: …… ***[Insert date of issue]***

RETENTION MONEY GUARANTEE No.: ***[Insert guarantee reference number]***

We have been informed that …… ***[insert name of 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 reference number of the contract]*** dated …… with the Beneficiary, 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, the Beneficiary retains moneys up to the limit set forth in the Contract ("the Retention Money"), and that when at least eighty (80) percent of the whole works have been completed, progress of the works is satisfactory in accordance with the Contract as per approved work schedule and it can be assured that the works can be completed at the intended completion date, payment of ***[insert the amount of the Retention Money]*** is to be made against a Retention Money guarantee.

At the request of the Contractor, we, …… ***[insert name of the Bank]*** ……., as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of **Nepalese Rupees** …… ***[insert amount in figures and amount in words][1]]*** upon receipt by us of the Beneficiary's complying demand supported by the Beneficiary's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or 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]*** [2], and any demand for payment under it must be received by us at the office indicated above 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)]

[1] *The Guarantor shall insert the amount of the Retention Money.*

[2] *Insert the same expiry date which is 30 days more than the end of Defect Liability Period. The Employer should note that in the event of an extension of this date 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.*

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.



Annex-1

Table of Price Adjustment Data

[SCC 59.1]

Not 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**

Note: Base value and Bidder's proposed weighting coefficient to be filled as per "Bid Form of Table of Price Adjustment Data" in Bidding Forms (Section-IV) after verification by the Employer in case of the alternative provision of Bidder proposed value and weighting coefficient.

Table of Price Adjustment Data

[SCC 59.6]

Not Applicable

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

** For the purpose of calculation of price adjustment, the Ex-factory price of the same source mentioned in the table shall be taken into consideration.

Note: Base Price and source to be filled as per "Bid Form of Table of Price Adjustment Data" in Bidding Forms (Section-IV) after verification by the Employer in case of the alternative provision of Bidder proposed source and base price.

APPENDIXES

Appendix 1 - Terms and Procedures of Payment

Appendix 2 - Price Adjustment

Appendix 3 - Insurance Requirements

Appendix 4 - Time Schedule

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

Appendix 6 - Scope of Works and Supply by the Employer

Appendix 7 - List of Documents for Approval or Review

Appendix 8 - Functional Guarantees

Appendix 9 - Minutes of Meeting held prior to contract signing

Appendix 10 - Price Schedules

Appendix -1: Terms and Procedures of Payment

In accordance with the provisions of GCC Clause 56 Payments, 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 Nepalese Rupees as 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 proceed.

Terms of Payment

Schedule No. 1 – Provisional Sum

Provisional Sum (Schedule No. 1): Shall include the unforeseeable items with appropriated brief description which includes all taxes and shall not be quoted separately by the bidders.

Schedule No. 2 General Items

General Items (Schedule No. 2) Rates or prices shall include all the rates or prices for the items under this schedule including all taxes, duties, levies, and charges payable in Nepal at the Base Date.

Schedule No. 3 – Design Services

Design Services (Schedule No. 3) Rates or prices shall include all taxes, duties, levies, and charges payable in Nepal at the Base Date. This deemed to be included in Price Schedule 4

Schedule No. 4 – Construction Items

Construction Items (Schedule No. 4) shall be quoted separately and shall include all the rates or prices of the material, all labor, contractor's equipment, temporary works, consumables, and all matters including the cost for local transportation, insurance, and other services incidental to delivery and things of whatsoever nature, including testing and preparation of maintenance manuals, training, etc., where identified in the Bidding Document, as necessary for the proper execution of the works and other services, including all taxes, duties, levies, and charges payable in Nepal at the Base Date.

In respect of above mentioned price schedule, the following payments shall be made:

Ten percent (10%) of the total CIP amount 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. 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 shipping and delivery documents.

Seventy percent (70%) of the total or pro rata CIP or amount upon Incoterms "CIP," upon delivery of plant and equipments (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 invoice.



Fifteen percent (15%) of the total or pro rata CIP or amount upon issue of the Completion Certificate, within 45 days after receipt of invoice.

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

Schedule No. 5 Installation & Other Services.

Installation and Other Services (Schedule No. 5) shall be quoted separately and shall include all the rates or prices of the installation and other services which shall include all taxes, duties, levies, and charges payable in Nepal at the Base Date.

In respect of above mentioned price schedule, the following payments shall be made:

Ten percent (10%) of the total installation and other services amount 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. 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.

Eighty percent (80%) of the installation service 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 through direct payment.

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 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.

Schedule No. 6 Operation & Maintenance (if any).

Operation and maintenance (if any) (Schedule No. 6) during Operation and maintenance period or during defects liability period after completion of construction shall be quoted separately which shall include all taxes, duties, levies, and charges payable in Nepal at the Base Date.

Not Applicable

Schedule No. 7 Grand Summary (Schedule No. 1 to 6)

Note:

i) For the release of final five percent (5%) retention amount in respect of above Schedules; the Contractor shall submit the documentary evidence of compliance with the taxation requirements of the Government of Nepal.

ii) The Advance Payment will be recovered as follows:

Deductions from Payment Certificates will commence in the first certificate in which the value of works executed exceeds 30% of the Contract Price. Deduction will be at the rate of 20% of the respective Monthly Interim Payment Certificate until such time as the advance payment has been repaid; provided that the advance payment shall be completely repaid prior to the end of 80 % of the approved contract period.

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 paragraphs. The Employer shall make payments promptly within thirty (30) days of submission of an invoice by the Contractor.

Payment of Taxes & duties:

Provisions in GCC 93 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. The Contractor shall take and record measurements in presence of the authorized representatives of the Employer.
ii. All Measurements recorded in a Measurement Book (MB) 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 MBs 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 GCC Sub-Clause 56.2

RASTRIYA PRASARAN GRID COMPANY LIMITED

(An Undertaking of Government of Nepal)

Mewa-Changhe (Dhungesanghu) 132kV Transmission Line Project

BIDDING DOCUMENT
For
THE PROCUREMENT OF

Design, Supply, Installation, Testing and Commissioning of 132kV Line Bays & Associated Underground Cabling Work at Dhungesanghu Substation

National Competitive Bidding (NCB)

Single-Stage: Two-Envelope Bidding Procedure

Invitation for Bids (IFB) No. : RPGCL/NCB/W/MC/SS/083/84-01
Employer : Rastriya Prasaran Grid Company Limited

VOLUME II OF III

August 2026

Rastriya Prasaran Grid Company Limited
Mewa-Changhe (Dhungesanghu) 132kV Transmission Line Project
Buddhanagar, Kathmandu, Nepal
Tel. :+977-01-4610103
Email: info@rpgcl.com

Volume II

(Employer's Requirements)

Abbreviations

BD ... . Bidding Document

BDF ..... Bidding Forms

BDS ..... Bid Data Sheet

APS ... . Activity and Price Schedule

COF ..... Contract Forms

DB ……..Design and Build

DP ... . Development Partners

DoLI ..... . Department of Local Infrastructure

e-GP ……Electronic Government Procurement

ELI ... . Eligibility

EPC……. Engineering Procurement and Construction

EQC ... . Evaluation and Qualification Criteria

EXP ... . Experience

FIN ... . Financial

GCC ... . General Conditions of Contract

GoN ..... 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

DB ... . Design and Build

ERQ ... . Employer's Requirements

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ABBREVIATIONS **2**

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Chapter 1: Project Specific Requirement

1.0 General

Rastriya Prasaran Grid Company Limited is establishing two 132 kV bays at Dhungesaghu substation at Dhungesaghu, Taplejung under Mewa-Changhe (Dhungesaghu) 132kV Transmission Line Project. The above project is being implemented by Rastriya Prasaran Grid Company Limited funded from Government of Nepal, as part of the above Transmission Line project.

This specification describes the requirement for construction of 132 kV bay extension on a turnkey basis.

Design, supply, construction, installation, testing and commissioning of works shall satisfy the general technical requirements specified in the Specification or ***implied as per relevant IEC/IEEE/ IS/ASTM/British standard codes (B S Codes)/ equivalent International Standards****.*

1.1 Intent of Specification

The specification includes design, engineering, manufacture, fabrication, testing at manufacturers works, delivery, unloading at site, storage, erection, testing and commissioning at site of the complete 132kV switchyard including,

- 132 kV bay extension at Dhungesaghu Substation, Taplejung (2 nos.),
- 132 kV XLPE cable for connecting Line bay form dead end tower to gantry.
- Control and protection system and its integration with the existing system,
- Substation Automation System and its integration with the existing system,
- Associated civil works, internal roads and drains, and
- Other electrical and mechanical auxiliary systems,

The Mewa-Changhe (Dhungesaghu) 132 kV Transmission Line project shall be developed as a interconnection transmission line that connects power generated from Mewa river basin to Dhungesangu substation of Koshi Corridor Transmission Line projects. The contractor is required to design and construct the substation bays as per the actual site conditions based on the indicative layout drawings provided.

1.1.1 It is the intent of this specification to describe primary features, materials, design & performance requirements and to establish minimum standards for the work.

1.1.2 The specification is not intended to specify the complete details of various practices of manufactures/ bidders, but to specify the requirements with regard to performance, durability and satisfactory operation under the specified site conditions.

1.1.3 The detailed scope of work is brought out in subsequent clauses of this section.

2.0 Scope

The scope of this specification covers the following package for 132 kV bay extension works at Dhungesanghu under Mewa-Changhe (Dhungesaghu) 132 kV Transmission Line project.

2.1 132 kV Bay extension at Dhungesaghu Substation

i. 2 (two) nos. of 132 kV line bay (of bay width 10.7 m) for termination 132 kV transmission line.

ii. Complete control, relay and protection system for 132 kV system as specified in Chapter – 12 (Control and Relay Panel).

iii. Complete substation automation system including hardware and software for remote control station along with associated equipments for following bays as specified in Chapter – 13 (Substation Automation System).

S. No:	Description	No. of bays
1.	132 kV system	2

The contractor shall supply necessary BCU for monitoring and control of auxiliary supply including operation of isolators associated with auxiliary transformer.

iv. Instrument transformer, Outdoor circuit breaker, disconnecting switch, surge arrester, bus post insulator for 132 kV as quantity specified in BoQ.

v. Digital Protection Coupler (DPC) shall be used for protection application. Each DPC shall be equipped with 4 commands. The above DPC shall have communication port matching to that being provided in the FO communication SDH panel and all accessories, cabling etc. required to interface with SDH/MUX telecommunication terminal equipment (located in the Control Room) for its commissioning is in present scope of Project. 48-volt power supply cable, Control Cable from DPC to relay panel shall be laid as per location of DPC panel. The specification for the digital protection coupler shall be as per Annexure II.

vi. Air Conditioning System as specified in Chapter – 13 (Air Conditioning System)

vii. LT switchgear (AC/DC distribution board/panel)

viii. 110 V and 48 V DC Battery and Battery Chargers as specified in Chapter – 8 (Battery and Battery Charger).

ix. 1.1 kV grade Power & Control cables along with complete accessories. Auxiliary Power supply and control cables from control room/ switchyard panel room and RTCC panel to common marshalling box of transformer/ reactor are also in present scope of work. HV cable from substation boundary to the LT yard as per requirement.

x. 132 kV XLPE power cables along with cable termination equipments/termination kits with all other accessories to complete the specified scope of works.

xi. Lattice and pipe structures (galvanized) shall be provided for take-off gantry towers, beams, lightning mast tower, equipment support structures etc. as per design and drawings prepared by contractor subject to approval of the employer. However, supply of support structure for outdoor circuit breaker is under scope of CB manufacturer as per the design.

xii. Bus post Insulators, Insulator strings and hardware, clamps & connectors, equipment terminal connectors, conductors, aluminum tubes, bus bar and earthing materials, Bay Marshalling box, Spacers, Cable supporting angles/channels, cable trays & covers, Junction boxes, buried cable trenches etc.

xiii. Complete lighting and illumination for the switchyard including street lighting, control room, transit camps etc.

xiv. Earth mat design & laying the outdoor yard and lightning protection system including top of control building.

xv. Tele communication equipment as per BoQ.

xvi. Testing and Maintenance equipments as specified in Chapter – 21 (Testing and Maintenance Equipments).

xvii. Design, engineering, manufacture, testing at manufacturer's works, transportation, unloading and delivery at site including insurance & storage, erection, testing and commissioning at Site, complete in all respect for the above-mentioned power transformers and all other equipments/ items complying to respective technical specification.

xviii. Design, engineering, manufacture, testing, supply on site basis including transportation and insurance, storage at site of mandatory spares.

xix. Installation, testing and commissioning of complete in all respect for the above mentioned equipments.

xx. Civil Works: The scope of work shall include but shall not be limited to the following based on design and drawings to be developed by the contractor.

a. Civil works for land development for 2 no. of bay construction.

b. All civil works including foundations associated with SF6 gas insulated Circuit breaker, Disconnector, Lightning arrestors, Instrument transformers, post insulators etc.

c. Cable trenches in outdoor switchyard as well as inside control building.

d. Foundation for all towers, equipments supports structures and LT Transformers.

e. Cable trenches along with covers, road/rail crossings, sump pits and cable trench crossings with roads or drains etc.

f. Antiweed treatment, PCC and Stone spreading in switchyard area.

g. Drains along with crossings with cable trenches. Drain layout shall be developed by the contractor.

h. Fencing for switchyard with gates.

i. Layout and details of Water supply and Sewage system.

j. Dewatering pumps if required.

k. Surveying, Soil investigation, contouring, leveling and filling. The leveling and filling (to an approximate depth as per requirement) in the area under present scope of work inside substation is to be carried out to achieve finished ground level. The finished ground level shall be provided during detail engineering.

l. Foundation for lighting poles, Bay marshalling box, panels and control cubicles of equipments wherever required.

m. Construction of random rubble masonry retaining walls.

The bidders are advised to visit the substation site at Dhungesaghu, Taplejung and acquaint themselves with the topography, infrastructure and also the design philosophy. Before proceeding with the construction work of the bay extension, the Contractor shall fully familiarize himself/herself with the site conditions and General arrangements & scheme etc. Though the Owner shall endeavor to provide the information, it shall not be binding for the Owner to provide the same. The bidder shall be fully responsible for providing all equipment, materials, system and services specified or otherwise which are required to complete the construction and successful commissioning, operation & maintenance of the extended bays and substation in all respects. All materials required for the Civil and construction/installation work shall be supplied by the Contractor. The cement and steel shall also be supplied by the Contractor.

The complete design **(unless specified otherwise in specification elsewhere)** and detailed engineering shall be done by the Contractor based on conceptual tender drawings. Drawings enclosed with tender drawings are for information only. However civil drawings shall be developed by the contractor as per his design.

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. It shall be the responsibility of the contractor to coordinate the arrangement for transportation of the Transformers for all the stages from the manufacturer's work to site.

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. The contractor shall carry out the

route survey along with the transporter and submit the detail proposal and methodology for transportation of transformers for approval of Employer within three months from the date of award.

The Contractor shall also be responsible for the overall co-ordination with internal/external agencies; Supplier of Owner's supplied equipment, project management, training of Owner's manpower, loading, unloading, handling, moving to final destination for successful erection, testing and commissioning of the substation/switchyard.

Design of substation and its associated electrical & mechanical auxiliaries systems includes preparation of single line diagrams and electrical layouts including layout arrangement for transformers, foundation layout, cable trench layout, earth mat layout, erection key diagrams, electrical and physical clearance diagrams, design calculations for earthing and lightening protection system (including Direct Stroke Lighting Protection), control and protection schematics, wiring and termination schedules, civil designs **(as applicable)** and drawings, air conditioning system, indoor/outdoor lighting/illumination and other relevant drawings & documents required for engineering of all facilities within the fencing to be provided under this contract, are covered under the scope of the Contractor.

Any other items not specifically mentioned in the specification but which are required for erection, testing and commissioning and satisfactory operation of the bay or substation are deemed to be included in the scope of the specification unless specifically excluded.

Employer has standardized its technical specification for various equipments and works for different voltage levels. Items, which are not applicable for the scope of this package as per schedule of quantities described in Schedules of Rates and Prices, the technical specification for such items should not be referred to.

The Quantities listed in the Schedule of Prices represent the estimated quantities for Tender purpose only. The Contractor shall carryout detail design and shall submit final bill of quantity for approval within 90 days from the signing of contract or 60 days after effective date of contract. The actually required quantity may vary from the quantity as listed in price schedule. The Contractor shall agree to make no claim for anticipated profits or for alleged losses because of any difference between the quantities actually furnished and installed and the estimated quantities as indicated in the price schedule.

3.0 Physical and Other Parameters

3.1 Location of Site

The Dhungesaghu substation is currently under construction and it is situated at Tellabung, Maiwa Khola Rural Municipality, Ward no 1, Taplejung district. It is located at about 10 km east from Suketar airport, Taplejung and about 5 km north from Change village and 4 km east from the confluence of Maiwa khola and Tamor River. The access separates from Bahnande (about 5 km from Taplejung along Mechi highway) towards Dovan via earthen road and from Dovan to Change via rural road. The Dhungesaghu substation is situated at right bank of the Tamor River. There is sufficient space for the required bay extension. The ground level of the proposed area is 1355 m.

3.2 Meteorological data

S.N.	Description	Dhungesaghu SS
1.	Maximum ambient shade temperature	34 degree C
2.	Minimum ambient shade temperature	-5 degree C
3.	Annual average temperature	32 degree C
4.	Maximum wind velocity	47 m/s
5.	Rainfall	195-1000 mm/annum
6.	Monsoon season	June August
7.	Relative humidity	max.100 %, min. 10 %
8.	Altitude	1355 m above Mean Sea Level
9.	Isokeraunic level (thunderstorm days)	30-130

However, for design purposes, ambient temperature should be considered as 50 degree centigrade and relative humidity 100% for the substation.

The fault level of all equipments to be supplied for 132 kV bay extension at Dhungesanghu substation under present scope shall be as indicated below:

S. No:	Voltage Level	Fault Level
1.	132 kV system	40 kA for 1 sec

The detail system parameters are given hereunder:

Sl. No.	Description of Parameters	132kV System
1	System Operating Voltage	132kV
2	Max. Operating voltage of the System (V_{rms})	145kV
3	Rated Frequency	50Hz
4	No. of Phase	3
5	Rated Insulation levels	
a.	Full wave impulse withstand Voltage (1.2/50 microsec.)	750 kV_{peak}
b.	One-minute power frequency dry and wet withstand Voltage (V_{rms})	275 kV_{rms}
6	Minimum creepage distance (25mm/kV)	3625 mm
7	Min. Clearances in air	
a.	Phase to Phase	1300 mm

Sl. No.	Description of Parameters	132kV System
b.	Phase to earth	1300 mm
8	Rated Short Circuit current for 1 sec. duration	40 kA
9	System Neutral Grounding	Solidly Grounded

4.0 Schedule of Quantities

The requirement of various items/equipments and civil works are indicated in Schedules of Rates and Prices.

All equipments/items and civil works for which bill of quantity has been indicated in respective Price Schedules, 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.

The quantities specified in the Schedules of Rates and Prices are only estimates. As soon as practicable, the Contractor shall complete all 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 ±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 shall be considered

5.0 Basic Reference Drawing

Single line diagram and general arrangements are enclosed with the bid documents for reference, which shall be further engineered by the bidder.

The bidder shall maintain the overall dimensions of the substation, phase to earth clearance, phase to phase clearance and sectional clearances.

The enclosed drawings give the basic scheme, layout of substation, substation buildings, associated services etc., which form a part of the specifications, are given at **Annexure – I**. In case of any discrepancy between the drawings and text of specification, the requirements of text shall prevail in general. However, the Bidder is advised to get these clarified from Owner.

6.0 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.

1.	Chapter 1: Project Specification Requirement
2.	Chapter 2: General Technical Requirement
3.	Chapter 3: Outdoor Circuit Breaker
4.	Chapter 4: Disconnecting Switch (Isolator)
5.	Chapter 5: Instrument Transformer
6.	Chapter 6: Lightning Arrester
7.	Chapter 7: Battery and Battery Charger
8.	Chapter 8: Grounding and Lightning Protection System
9.	Chapter 9: Illumination System
10.	Chapter 10: Power and Control Cables
11.	Chapter 11: A.C. and D.C distribution Panel
12.	Chapter 12: Control and Relay Panels
13.	Chapter 13: Substation Automation System
14.	Chapter 14: Fiber Optic Based Communication Equipment
15.	Chapter 15: Switchyard Erection
16.	Chapter 16: Substation Structures
17.	Chapter 17: Civil, Architectural and Building
18.	Chapter 18: Inspection, Testing and Commissioning
19.	Chapter 19: Testing and Maintenance of Equipment
20.	Chapter 20: Guaranteed Technical Particulars
21.	Chapter 21: Tender Drawing

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 individual chapters for various equipments, requirement of individual equipment chapter shall prevail.

7.0 SPARES

Mandatory Spares

The Mandatory Spares shall be included in the bid proposal by the bidder. The prices of these spares shall be given by the Bidder in the relevant schedule of Schedules of Rates and Prices and shall be considered for evaluation of bid. It shall not be binding on the Owner to procure all of these mandatory spares.

The bidder is clarified that no mandatory spares shall be used during the commissioning of the equipment. Any spares required for commissioning purpose shall be arranged by the Contractor.

The unutilized spares if any brought for commissioning purpose shall be taken back by the contractor

8.0 FACILITIES TO BE PROVIDED BY THE OWNER

Employer shall make available the auxiliary HT power supply from NEA on chargeable basis at a single point in the Sub-station. The prevailing energy rates of the state shall be applicable. All further distribution from the same for construction and permanent auxiliary supply shall be made by the contractor. However, in case of failure of power due to any unavoidable circumstances, the contractor shall make his own necessary arrangements like diesel generator sets etc. at his own cost so that progress of work is not affected and Owner shall in no case be responsible for any delay in works because of non-availability of power.

Employer shall facilitate regarding construction water supply at a single point in the substation as far as possible. All further distribution for the same shall be made by the Contractor. In case of non-availability or inadequate availability of water for construction work, the contractor shall make his own arrangement at his own cost and the Employer shall in no case be responsible for any delay in works because of non-availability or inadequate availability of water.

9.0 SPECIFIC REQUIREMENT

a) The Bidders are advised to visit existing Dhungesaghu Sub-station and acquaint themselves with the topography, infrastructure, etc.

b) The bidder shall be responsible for safety of human and equipment during the working. It will be the responsibility of the Contractor to co-ordinate and obtain Electrical Inspector's clearance before commissioning. Any additional items, modification due to observation of such statutory authorities shall be provided by the Contractor at no extra cost to the Owner.

c) 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, wastage and damages shall be to the account of contractor.

d) Augmentation and integration work related to SCADA System

i. The 132 kV bays under present scope shall be integrated by the contractor into existing SCADA system of Siemens 'MAKE" (version 4.3.2) installed at Master Station i.e. Nepal Electricity Authority Load Dispatch Centre (located in Syuchatar, Kathmandu). The integration shall include all hardware and software required at the Control Centre as well as necessary data base, display generation and upgrades for proposed control and monitoring of station and Network Analysis. The above activities shall be carried out as appropriate, in all stations in the route of data communication and the Load Dispatch Centre. The manufacturers of the existing SCADA system are: -

a. LDC facilities: Siemens Germany

b. RTU facilities: ABB, Germany

ii. The details of existing RTU to be installed at existing substations and Data acquisition principles (types of analogue /digital data) for control, monitoring of substation is enclosed at Annexure – III. The existing communication protocol used for SCADA at LDC Kathmandu is IEC 101/104. For the present scope of work, RTU are not envisaged and the Data for SCADA purpose shall be obtained from the Substation Automation System (based on IEC 61850) using Gateway port with communication protocol IEC 101/104 as per requirement being provided at the substations under present scope of contract.

a. Augmentation and integration work related to Communication System

i. The scope of work for supply, installation of Optical Line Termination Equipment, Digital Multiplexer, hardware accessories etc at substations, LDC Katmandu and its integration work (at LDC Kathmandu) for onward transmission of Data and Voice communication up to LDC Kathmandu if necessary.

ii. The scope of work for supply, installation of approach optical fibre (as per requirement from JB to ODF box), Optical Line Termination Equipment, Digital Multiplexer, hardware accessories etc at Dhungesaghu Substation and its integration work at required end including LDC, Kathmandu for onward transmission of Data and Voice communication up to LDC Kathmandu is included in the contract.

b. Erection, testing and commissioning of Circuit breaker, Isolators, Control and protection Panels shall be done by the contractors under the supervision of respective equipment manufacturers. Charges for the above supervision shall be included by the bidder in the erection charges for the respective equipment in the Schedules of Rates and Prices.

c. The lighting fixtures for switchyard lighting shall be mounted on LMs wherever LMs are provided. Where LMs are not available, the fixtures may be mounted on Gantry structures or on lighting poles/LM to be provided by the contractor. Also, for illumination in switchyard panel room average Lux level at ground level shall be 300 lux**.**

d. The Frequency range for the earthquake spectra shall be as per IEC-62271-300 for Circuit Breaker.

e. Design, engineering, drawing and construction of works shall satisfy the general technical requirements specified in the Specification or implied as per relevant IEC/IEEE/ IS/ASTM/British standard codes (B S Codes)/ equivalent International Standards.

f. Non-CFC refrigerant shall be utilized for Air conditioning system, offered for Control room building and switchyard panel room is under the scope of contract.

g. Transmission line side insulator String (including Hardware) i.e. tension insulator on the line side of the take-off gantry for 132 KV lines termination is under the present scope of specification.

h. The Contractor shall provide AC/DC feeders for complete future bays also as per single line diagram in addition to bays under present scope.

i. One number each Energy meter for the record and revenue purpose is to be provided for each 132 kV bays at Substations under present scope of contract, meeting the requirement as specified at Annexure – IV.

j. The distance protection relays to be supplied for 132 kV lines should have feature of load encroachment blinder to safeguard the protection trip during heavy load condition.

k. In the Sub-station automation system, each AIS shall be monitored individually per phase basis. In case it is not possible to monitor in one BCU, the contractor shall supply additional BCU for the monitoring without any additional cost implication to RPGCL.

l. For supply of SF6 Gas, the contractor shall obtain necessary license from the concerned statuary authorities in Nepal. The contractor shall comply with all the legal & statuary requirements as per the local laws for importing, handling & storage of SF6 gas in Nepal. For this purpose, RPGCL shall extend necessary assistance (documentation etc) for obtaining such clearance & licenses, however the complete responsibility for submitting the application and co-ordination with authorities shall be in the scope of contractor.

- In Chapter 2 GTR and other Technical Specifications, the term "Purchaser" and/or "Employer" may be read as "Owner".

10.0 TRAINING FOR PERSONNELS OF EMPLOYER

The Contractor shall impart the necessary training to Employer's Personnel as per SCC 24. The price for the training shall not be quoted separately and shall be included in the price schedule of the respective equipment.

On Job Training in Nepal

The traveling and living expenses of Employer's personnel for the training program conducted in Nepal shall be borne by the Employer.

The training shall be provided to Employer's personnel in the field of erection, testing, operation and maintenance at each substation site as per following: -

S. No:	Description of training	No. of days
1.	Control & Protection	5 days
2.	Substation Automation System including integration aspects of SCADA	5 days
3.	Telecommunication Equipment (SDH, MUX & NMS (Craft Terminal))	5 days

11.0 PRECOMMISSIONING, COMMISSIONING, TRIAL-RUN & COMPLETION

As soon as the Facilities covered by these specifications are physically completed in all respects, the Pre commissioning, Commissioning, Trial-run and Completion of the Facilities, as mentioned below, shall be attained in accordance with the procedure given in the Conditions of Contract, Vol.-I of the Bidding Documents.

(i) Pre commissioning**:** As per relevant Chapters

(ii) Commissioning: Charging of the Facilities at rated voltage

Further, wherever appearing in these specifications, the words – 'commissioning checks', 'installation checks', 'site tests', 'performance guarantee tests for fire protection system', are to be considered as 'pre commissioning checks'.

(iii) Trial-run : Operation of the Facilities or any part thereof by the Contractor immediately after the Commissioning for a continuous period of 72 (Seventy-two) hours continuously. In case of interruption due to problem / failure in the respective equipment, the contractor shall rectify the problem and after rectification, continuous 72 (Seventy-two) hours period start after such rectification.

(iv) Completion : Upon successful completion of Trial-run.

'Guarantee Test(s)' and/or 'Functional Guarantees' are applicable only for Substation Automation System as specified in Chapter-'Substation Automation System.'

Note:

The Contractor shall do the necessary calculations for relay setting required for Pre-commissioning, Commissioning, Trial-run and Completion for the substations under the scope of this Contract. All the relay setting calculations required for the substations (in this scope) with related to Integrated Nepal Power System (INPS) shall be done by the Contractor.

Annexure – I
LIST OF DRAWINGS

S. No:	Description of drawings
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Annexure – II

Technical Specifications of Digital Protection Coupler

1.0 Digital protection coupler for protection signaling through optical fibre cabling system

1.1 The Digital protection signaling equipment is required to transfer the trip commands from one end of the line to the other end in the shortest possible time with adequate security and dependability. It shall also monitor the healthiness of the link from one end to the other and give alarms in case of any abnormality. The protection signaling equipment shall have a proven operating record in similar application over EHV systems and shall operate on 48V DC (+10%, -10%). It shall provide minimum four commands. These commands shall be suitable for direct tripping, inter tripping and blocking protection schemes of EHV lines.

The protection signaling equipment shall communicate to the remote end interfacing with SDH terminal equipment at its 2 Mbps port. It shall provide suitable interfaces for protective relays, which operate at 110V DC. Power supply points shall be immune to electromagnetic interface.

Contractor has to utilize the same fibre for communication and digital protection purpose; no separate fibre shall be provided to the contractor for digital protection. Therefore, bidders are instructed to include all the cost providing necessary equipments/cards and their installation in starting (Dhungesaghu) as well as far end (Papung) substations.

2.2 Principle of operation

During normal operation, protection signaling equipment shall transmit a guard signal/code. In case Protection signaling equipment is actuated by protective relays for transmission of commands, it shall interrupt the guard signal/code and shall transmit the command code to the remote end. The receiver shall recognize the command code and absence of the guard code and will generate the command to the protective relays.

All signal processing i.e. generation of tripping signal and the evaluation of the signals being received shall be performed completely digital using Digital Signal Processing techniques.

2.2.1 Loop Testing

An automatic loop testing routine shall check the tele protection channel. It shall also be possible to initiate a loop test manually at any station by pressing a button on the front of the equipment. Internal test routine shall continuously monitor the availability of the protection signaling equipment. Proper tripping signal shall always take the priority over the test procedure.

The high-speed digital protection signaling equipment shall be designed and provided with following features.

- Shall work in conjunction with SDH terminal equipment.
- It shall communicate on G 703 (E1,2 Mbps)
- Full Duplex operation
- Auto loop facility shall be provided
- Shall meet IEC 60834-1 standard

- Shall be able to transmit up to 4 commands with trip counter simultaneously or sequentially in one 2Mbps channel.

Bidder shall quote for protection signaling equipment suitable for 4 commands with separate trip counters for transmit and receive. With regard to trip counters alternate arrangement i.e Laptop along with software & all accessories to download events including carrier receipt and transmit shall be acceptable. Laptop for the above shall be supplied for Dhungesaghu substation under substation package.

High security and dependability shall be ensured by the manufacturer. Probability of false tripping and failure to trip shall be minimum. Statistical curves/figures indicating above mentioned measures shall be submitted along with the bid. The DPC can be either housed in offered Control & Protection Panel / PLCC Panel or in separate panel.

Reports of the following tests as per clause 9.2 of Chapter 2-GTR shall be submitted for approval for protection signalling equipment and relays associated with the protection signalling equipment and interface unit.

a) General equipment interface tests:

a. Damped oscillatory waves disturbance test

b. Fast transient bursts disturbance test

c. Electrostatic discharge disturbance test

d. Radiated electromagnetic field test

e. RF disturbance emission test

ii) Specific power supply tests

a) Power supply variations

b) Interruptions

c) LF disturbance emission

d) Reverse polarity

iii) Tele-protection system performance tests:

a) Security

b) Dependability

c) Jitter

d) Recovery time

e) Transmission time

f) Alarm functions

g) Temperature and Humidity tests (As per IEC 68-2).

All the above tests at i, ii & iii (except temperature & humidity tests) shall be as per IEC 60834-1 and the standards mentioned therein.

iv) Relays

a) Impulse voltage withstand test as per IEC 60255.

b) High frequency disturbance test as per IEC 60255.

The protection signaling equipment shall be of modular construction and preferably mounted in the Relay panels. Cabling between the protection signaling equipment & Protection relays and between protection signaling equipment & Communication equipment shall be in the scope of bidder.

The input/output interface to the protection equipment shall be achieved by means of relays and the input/output rack wiring shall be carefully segregated from other shelf/cubicle wiring. The isolation requirements of the protection interface shall be for 2kV rms.

1.4 Major Technical Particulars

The major technical particulars of protection signaling equipment shall be as follows.

S. No:	Description		Requirement
1.	Power Supply		48 V DC +10%, -10%
2.	Number of commands		4 (four)
3.	Operating time		< 7 ms
4.	Back to back operate time without propagation delay		< 8 ms
5.	Interface to protection relays		
5.1.	Input	Rated voltage	250 V DC
		Max current rating	5 amps
5.2.	Output	Rated voltage	250 V DC
		Rated current	0.1 A DC
		Other parameters	As per IEC-255-0-20
5.3.	Alarm contact	Rated voltage	250 V DC
		Rated Current	0.1 A DC
		Other parameters	As per IEC-255-0-20
6.	Digital communication interface		G 703 (E1)

Annexure – III
EXISTING RTU BASED SCADA & ITS DATA ACQUISITION

1.0 General Information

1.1 Remote Terminal Units

The Load Dispatch Centre (LDC) at Kathmandu controls and monitors the network of Integrated Nepal Power System (INPS) via RTUs located at its various substations.

In addition to the above, two local RTUs have been installed at the LDC: one to handle local-control-center status inputs and analog inputs and outputs; and the other for training, maintenance and testing purposes.

Manufacturers of existing SCADA system are:

LDC facilities: SIEMENS, Germany

RTU facilities: ABB, Germany

1.2 Data acquisition principles for existing substation

The existing substations are provided with RTU for interfacing of the following supervisory controls and data acquisitions:

Remote Control

- Remote control of all 132 kV circuit breakers.

Status Indications

- Status indications of all 132kV circuit breakers, bus bar and line isolators.

1.3 Integration of SCADA of existing substation

The existing communication protocol used for SCADA at LDC Kathmandu is IEC 101. For the present scope of work no RTU is envisaged and the Data for SCADA purpose shall be obtained from the Substation Automation System (based on IEC 61850) using Gateway port with communication protocol IEC 101/104 as per requirement being provided at Dhungesaghu substation under present contract. The details of substation automation system are included in the separate chapter Substation Automation.

Table: Alarms to be required for each type of bay

Type of alarm	Line bay	Transformer bay	Coupler bay	Busbar	Station
Main protection trip	MPT	MPT	MPT		
Back-up protection trip	BPT	BPT	BPT		
Bay fault	BFA	BFA	BFA		
Circuit breaker fault	CBF	CBF	CBF		

Type of alarm	Line bay	Transformer bay	Coupler bay	Busbar	Station
Auto-re-closer operated	ARO				
Temperature alarm		TAL			
Temperature trip		TTR			
Buchholz alarm		BAL			
Buchholz trip		BTR			
General transformer/ reactor alarm		GTA			
General transformer/ reactor trip		GTT			
Busbar voltage status				BVS	
Station urgent fault					SUF
Station none-urgent fault					SNF
Station control disabled					SCD
SAS alarm					RTU
Communication alarm					COM
Total	**5**	**10**	**4**	**1**	**5**

Measurements

- Busbar voltages (separate for each busbar and section) of all 132/33/11 kV Busbars.
- Active/reactive power for
  - All 132kV Line feeders and 33kV Transformer feeders.
  - Single phase current measurements for all 33kV lines participating in load shedding Scheme.

Annexure – IV
Specification for Revenue/ Tariff Energy Meter

General

The units shall be suitable for operating in Outdoor environment and shall be manufactured by International Reputed ISO 9001 Company.

Energy Meter

The energy meter shall have the following minimum requirement.

Type	**Electronic, 3Phase, 4wire, Wye Connection, Bi-directional**
Accuracy Class	0.2
Applicable Standard	IEC 687 (latest edition) or Equivalent
Measurement	a) Polyphase Quantities kWh, kVARh, kVAh
	b) Instantaneous Quantities Real Time, kW, kVA, PF, Volts, Amps, Frequency
Rated Current (In)	5A or 1A
Rated Maximum Current	1.2xIn
Starting Current	0.001xIn
Voltage (Phase)	110V/√3
Frequency	50Hz
Programmable Interval length	At least 1 to 30 min
Load Profile Memory Storage	At Least 60 days of storage using 4 channels at 15min Intervals
Channels of Load Profile Data	At Least 4 channels of storage (kWh import, kWh export, kVARh Import, kVARh export)
Other features to be included	a) Serial communication port and Accessories b) Optical Port Communication (With optical Probe) c) Remote Download Modem (in built) d) Hardware Key to Prevent any Calibration and configuration change e) PT or CT error gain correction f) Non-Volatile memory g) Inbuilt Super capacitor h) Meter shall be able to record and store in Non-Volatile memory the instant of Power failure and the instant of supply restoration.

Annexure – V
Specification for Time Synchronization Equipment

The Time synchronisation equipment shall receive the coordinated Universal Time (UTC) **transmitted** through Geo Positioning Satellite System (GPS) and synchronise equipments to the Nepal Standard Time in a substation.

Time synchronisation equipment shall include antenna, all special cables and processing equipment etc.

It shall be compatible for synchronisation of Event Loggers, Disturbance recorders and SCADA at a substation through individual port or through Ethernet realised through optic fibre bus.

Equipment shall operate up to the ambient temperature of 50 degree centigrade and 80% humidity.

The synchronisation equipment shall have 2 micro-second accuracy. Equipment shall give real time corresponding to NST (taking into consideration all factors like voltage, & temperature variations, propagation & processing delays etc).

Equipment shall meet the requirement of IEC 60255 for storage & operation.

The system shall be able to track the satellites to ensure no interruption of synchronisation signal.

The output signal from each port shall be programmable at site for either one hour, half hour, minute or second pulse, as per requirement.

The equipment offered shall have six (6) output ports. Various combinations of output ports shall be proposed by contractor subject to approval of employer, during detailed engineering, from the following:

- Potential free contact (Minimum pulse duration of 50 milli Seconds.)
- IRIG-B
- RS232C
- SNTP Port

The equipment shall have a periodic time correction facility of one second periodicity.

Time synchronisation equipment shall be suitable to operate from 110V DC as available at Substation.

Equipment shall have real time digital display in hour, minute, second (24-hour mode) & have a separate time display unit to be mounted on the top of control panels having display size of approx. 100 mm height.

Chapter 2: General Technical Requirement

2. Foreword

2.1.1 The provisions under this chapter are intended to supplement general requirements for the materials, equipment and services covered under other chapters of tender documents and are not exclusive.

2.2 General Requirement

2.2.1 The contractor shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification during detailed engineering.

2.2.2 It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different from those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to Purchaser.

2.2.3 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification and bid price schedule but which are necessary for commissioning and satisfactory operation of the switchyard/substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment provided, shall be inter-changeable with one another.

2.3 Standards

2.3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of Nepal/ relevant IEC standard or Acceptable International Standard.

2.3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the date of bid opening) of standard specified under Annexure-A of this chapter, unless specifically mentioned in the specification.

2.3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other.

2.3.4 The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IEC or equivalent international standard.

2.3.5 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

2.3.6 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified under Annexure-A / individual chapters for various equipment shall also, be accepted, however the salient points of difference shall be clearly brought out in the Additional information schedule of the bid along with English language version of such standard. The equipment conforming to standards other than specified under Annexure-A/ individual chapters for various equipment shall be subject to Purchaser's approval.

2.4 Services to be performed by the Equipment Being Furnished

2.4.1 The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc. under such over voltage conditions.

2.4.2 All equipment's shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

2.4.3 All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

2.4.4 The bidder shall design terminal connectors of the equipment taking into account various forces that are required to withstand.

2.4.5 The equipment shall also comply to the following:

a) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

b) All piping, if any between equipment control cabinet/ operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

2.4.6 Equipment and system shall be designed to meet the following major technical parameters as brought out hereunder

2.4.6.1 System Parameter

(A) 132kV system at Dhungesaghu AIS substation

Table No: 2.1: 132 kV system parameters of Dhugesaghu substation

Sl. No.	Description of Parameters	132kV System
1	System Operating Voltage	132kV
2	Max. Operating voltage of the System (V_{rms})	145kV
3	Rated Frequency	50Hz
4	No. of Phase	3
5	Rated Insulation levels	
a.	Full wave impulse withstand Voltage (1.2/50 microsec.)	750 kV_{peak}
b.	One-minute power frequency dry and wet withstand Voltage (V_{rms})	275 kV_{rms}
6	Minimum creep age distance (25mm/kV)	3625 mm
7	Min. Clearances in air	
a.	Phase to Phase	1300 mm
b.	Phase to earth	1300 mm
8	Rated Short Circuit current	40 kA for 1 sec
9	System Neutral Grounding	Solidly Grounded

2.4.6.2 Major technical parameters of bushings / hollow column / support insulators are given below:

132kV System

Table 2.2: Major technical parameters of bushings/ hollow column and support insulators

S.N.	Parameters	132 kV
(a)	Max. System voltage Um(kV)	145
(b)	Impulse withstand voltage (dry & wet) (kVp)	± 750
(c)	Power frequency withstand voltage (dry and wet) (kV rms)	275
(d)	Total creepage distance (min) (mm)	3625

2.5 Insulation Coordination

The highest voltage for equipment shall be selected according to IEC – 71.1:

a) 145 for 132 kV nominal voltage

Corresponding lightning impulse withstand voltage shall be selected in accordance with IEC – 71 – 1. IEC – 71.1 specifies several withstand voltages for each level. As a general rule, the higher levels shall be selected for systems not protected by lightning arresters.

2.6 Major Technical Parameters

The major technical parameters of the equipment are given below. For other parameters and features respective technical chapters should be referred.

(A) Equipment at Dhungesaghu 132 kV AIS type substation

2.6.1 145 kV Circuit Breakers and Isolators

Table 2.5: Major technical particulars of 145 kV CB and DS

Sl. No.	Description of Parameters	Technical Requirement
1	Rated Voltage kV rms	145
2	Rated Frequency	50 Hz
3	No. of poles	3
4	Design ambient temperature (°C)	50
5	Rated Insulation levels	
5.1	Full wave impulse withstand Voltage (1.2/50 microsec.)	
a)	Between line terminals and ground	± 650 kVp
b)	Between terminals and circuit breaker open	± 650 kVp
c)	Between terminals and isolator open	± 750 kVp
5.2	One minute power frequency dry and wet withstand voltage	
a)	Between line terminals and ground	275 kV rms
b)	Between terminals and circuit breaker open	275 kV rms
c)	Between terminals and isolator open	315 kV rms
6	Minimum creepage distance	
a)	Phase to ground (mm)	3625
b)	Between CB terminals (mm)	3625
7	System neutral earthing	Effectively earthed
8	Horizontal seismic coefficient	0.15g
9	Rating of auxiliary contacts	10 A at 110 V DC (as applicable)
10	Breaking capacity of auxiliary contacts	2 A DC with current time constant of not less than 20 ms
11	Phase to phase spacing (mm)	3000 or 2700

2.6.2 145 kV CT/CVT/LA (SA)

Table 2.6: Major technical particulars of 145 kV CT, CVT and LA (SA)

Sl. No.	Description of Parameters	Technical Requirement
1	Rated Voltage kV rms	145
2	Rated Frequency	50 Hz
3	No. of poles	1
4	Design ambient temperature (°C)	50
5	Rated Insulation levels	
5.1	Full wave impulse withstand Voltage (1.2/50 microsec.)	
a)	Between line terminals and ground for CT and CVT	± 650 kVp
b)	For arrester housing	± 650 kVp
5.2	One-minute power frequency dry and wet withstand voltage	
a)	Between line terminals and ground for CT and CVT	275 kV rms
b)	For arrester housing	275 kV rms
6	Minimum creepage distance	
a)	Phase to ground (mm)	3625
7	Partial discharge for	
a)	Surge arrester at 1.5 COV	Not exceeding 50 pc
b)	For CT/CVT	Not exceeding 10 pc

2.7 Engineering Data and Drawings

The list of drawings/documents which are to be submitted to the Employer shall be discussed and finalized by the Employer at the time of award.

The Contractor shall necessarily submit all the drawings/ documents unless anything is waived.

The Contractor shall submit 3 (three) sets of drawings/ design documents/data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Employer. The contractor shall also submit the softcopy of the above documents in addition to hardcopy. ***The hardcopy of design/ drawings submitted for employer's approval shall be in A3 size banded hard or spirally. The loose or stitched drawing/ design submitted for Employer's approval shall not be entertained.***

2.7.1 Drawings and Documents for Approval

Prior to commencement of the work, the Contractor shall submit detailed design drawings and data to the Employer for approval. Should the Employer direct that modifications be made in order to satisfy

the requirements of the Specifications, the Contractor shall submit revised drawings for approval. Alteration in the Contract price shall not be allowed by reason of the drawing modifications.

The Contractor shall prepare and furnish to the Employer such drawings, calculations, and data on materials and equipment (hereinafter in this provision called data) as are required for the proper control and completion of the work. This shall include but not be limited to those drawings, data and calculations specifically required elsewhere in the Technical Specifications.

The Contractor shall submit detailed drawings, instructions and maintenance books, and parts lists with recommended stock quantities for the equipment furnished, prepare and submit detailed engineering, design and construction drawings pertaining to all civil, structural, architectural, mechanical and electrical equipment and installations in substations. The drawings to be furnished by the Contractor shall include, but not be limited, to the following:

a) Electrical System Design
    i) Design Basis Report
    ii) Single line and three-line diagrams for AC and DC station service power supply
    iii) Relay and Metering Single Line Diagram.
    iv) CT & PT Sizing calculation.
    v) Calculation of protection setting parameters of relay for every protection scheme adopted for various components in substation.
    vi) Insulation Co-ordination
    vii) Substation grounding calculation
    viii) Direct Stroke Lightning Protection (DSLP) Calculation.
    ix) Sizing calculation of Battery & Battery-Charger.
    x) Design Calculation for indoor and outdoor Illumination System.
    xi) Design of solar PV street lighting system.
    xii) Sag, tension and short circuit force calculation.
    xiii) Cable Sizing Calculation
    xiv) Calculation and coordination for selecting operation of protection relays
    xv) Detailed material list

b) Plot Plan of Substation Premises.

c) Substation Layout
    i) Electrical layout (Plan and section) of substations
    ii) Electrical Clearance diagram.
    iii) Erection key diagram for substations
    iv) Cabling Layout including cable trench, cable tray, wire gutters, conduits, and specifying location.

v) Line Bay Expansion grounding Layout, plans, elevations and details
vi) Cable trench, duct and conduit layout plan, elevation and details.
vii) Substation lighting and convenience outlet plan, elevation, and details
viii) Installation details for equipment
ix) Cable schedule, specifying cable identification number, routing and length of the cable for the substation and cable summary.
x) Detailed interconnection diagram for all substation equipment, AC and DC station service equipment and all building equipment.

d) Equipment drawings

i) Dimensioned General arrangement drawings showing front and rear elevations and identification of each device and complete nameplate schedule
ii) Foundation Loading Details
iii) AC and DC diagram for control, metering, relaying, communication, alarm, etc. required to describe in detail the operation of all systems in the substation. Wire numbers and terminal numbers for each device shall be clearly marked on all AC and DC elementary and schematic diagram
iv) Communication system drawings
v) Technical Catalogues
vi) Instruction Manuals for Erection, Testing and Commissioning
vii) Operation and Maintenance Manuals.
viii) Instruction books, spare parts lists, material lists and any other documents pertaining to the substation and required for construction, operation, maintenance and repair

e) Civil, Structural and Architectural Works

i) Geo technical Investigation report
ii) Details of veiling and grading of substation area.
iii) Design Basis report
iv) Design/calculation of all Civil structural works
v) Foundation Layout of Substations, plans and elevations indicating top of foundations, details for anchor bolt installation, plus all data required for civil works
vi) Structural erection and fabrication drawings and Bar Bending schedule for RCC structures and foundations.
vii) Details of slope protection and retaining walls
viii) Civil, Structural and architectural drawings for all buildings.

ix) Details of Road and Drains.

x) Details of fences and gates.

xi) Details of stone spreading within substation area.

f) General Documentations

i) Monthly Progress Report

ii) QA/QC Documentation including MQP and FQP for all Equipment & systems

iii) Testing and commissioning procedure of each equipment

iv) Design (Type) Test Reports as specified

v) Routine Test Reports of all Equipment

vi) Field Test Reports

2.7.2 Drawings and Documents Submission Schedule

The Contractor shall submit the drawings and data to the Employer for approval in the following manner and designated deadlines.

Table 2.15: For Supply of Equipment and/or Installation Works

Item	No. of Copies	Deadline & Remarks
Proposed work program	3	Within 30 days from the Effective date of the Contract.
Principal equipment drawings for approval	3	Within 90 days from the Effective date of the Contract.
Principal installation drawings for approval	3	Within 30 days from the Effective date of the Contract.
Revised drawings for approval	3	Within 14 days after receiving drawing for revision.
Final drawings with reproducible copies	5	Within 14 days after receiving approval
AutoCAD files of Final Drawings in USB flash drive	2	Within 14 days after receiving approval
Schedule of manufacturing and transportation	2	Within 45 days from the Effective date of the Contract.

Item	No. of Copies	Deadline & Remarks
Plan for shop tests	2	Not less than 30 days before testing
Results of shop tests for approval	4	Upon completion of tests
Records of shop tests	4	Upon approval of results of shop tests
Plan for field-tests	2	Not less than 14 days before testing
Report for field tests	4	Within 14 days after completion of each test
As-built drawings	5	Within 30 days after completion of installation work
AutoCAD file of as-built drawings in USB flash drive	3	Within 30 days after completion of installation work
Instruction manuals and drawings with reproducible copies for installation	5	30 days after shipment of Equipment

Table 2.16: For Civil Works

Item	No. of Copies	Deadline & Remarks
Detail construction schedule & method	3	Within 45 days from the Effective date of the Contract.
Drawing for approval (principal drawings for construction)	3	Within 90 days from the Effective date of the Contract.
Revised drawings for approval	3	Within 14 days after receiving drawings for revision
AutoCAD file of approved drawings in USB flash drive	2	Within 14 days after receiving drawings for revision
Reports of Field Tests	4	Within 14 days after completion of each test
As-built drawings	5	Within 30 days after completion of construction works

Item	No. of Copies	Deadline & Remarks
AutoCAD files of as-built drawings in USB flash drive	3	Within 30 days after completion of construction works

Table 2.17: Others

Item	No. of Copies	Deadline & Remarks
Drawing and Deliverable Schedule	3	Within 30 days from the Effective date of the Contract.
QA/QC Documentation	3	Within 30 days from the Effective date of the Contract.
Monthly Progress Reports with photographs	3	By 7th of following month
Packing list (copy)	5	At each shipment
Invoice (copy)	5	At each shipment
Bill of lading (copy)	5	At each shipment
Certificate of origin (copy)	1	At each shipment

2.7.3 Drawings: Titles, scales and Sizes

The title of the drawing, Contract Number, the signature of the Contractor's engineer and the date shall appear in the bottom right-hand corner of each drawing in the following format:

Rastriya Prasaran Grid Company Limited
(Government of Nepal Undertaking)
Mewa Changhe (Dhungesaghu) 132kV Transmission Line Project

Contract No…….
Name of the Substation: Dhungesaghu Substation
Item No…….
Brief Description ……

In general, the scales of the drawings shall be 1:200. The Contractor, however, can prepare and submit drawing in any other appropriate scales with the prior approval of the Employer. The Contractor shall use any one of the following sizes for the preparation of drawings as appropriate:

A0	841 x 1189 mm	(33.11 x 46.81 in)
A1	594 x 841 mm	(33.39 x 33.11 in)
A2	420 x 594 mm	(16.54 x 23.39 in)
A3	297 x 420 mm	(11.69 x 16.54 in)
A4	210 x 297 mm	(8.27 x 11.69 in)

2.7.4 Employer's Approval

The Employer will send comment/ approval each drawing/design/document within twenty-one (21) days after receipt at his office. One print of each of the drawings submitted for approval will be returned by the Employer or Employer's Representative, marked either "APPROVED", "APPROVED EXCEPT AS NOTED", or "RETURNED FOR CORRECTION".

a) The notations "APPROVED" or "APPROVED EXCEPT AS NOTED" will authorize the Contractor to proceed with the manufacturing drawings, subject to the corrections, if any indicated thereon. The notation "RETURNED FOR CORRECTION" shall require the Contractor to make the necessary revisions on the drawings and submit for approval complying with timeline mentioned in Table 2.15.

   Approval of the Contractor's drawings shall not in any way relieve the Contractor of any part of his obligation to meet all the requirements of the Contract or of the responsibility for the correction of the drawings.

b) Reproducible: Reproducible of all final approved drawings shall be made on USB flash drive.

Neither the review nor lack of review of any drawing, calculation or data shall waive any of the Specifications or Contract drawings, or responsibility for correctness of the drawings, calculations or data. Defective work, materials, and equipment may be rejected notwithstanding conformance with drawings, calculation and data reviewed by the Employer/the Employer's representative. The Employer shall have the right to require the Contractor to make any changes in the design which may be necessary, to make the apparatus/works conform to the requirements and intent of the Specifications, with no additional cost to the Employer.

Approval of the Contractor's drawings (including cases of un-noticed/un-known deviations) shall not in any way relieve the Contractor of any part of his obligation to meet all the requirements of the Contract or of the responsibility for the correction of the drawings. The ultimate responsibility of meeting all the requirements of the technical specifications and fulfill contractual obligations shall rest on the Contractor.

Any drawings changed by the Contractor during the development of his design after review by the Employer shall be submitted for approval.

Within 30 days from the effective date of the Contract, the Contractor shall prepare and furnish to the Employer a schedule for submission of all drawings and data. Each drawing to be submitted for the work of the Contract shall be listed in the Schedule, and the Schedule shall contain separate columns for scheduled submitted dates and actual submitted dates. The schedule will be reviewed by the Employer/ the Employer's representative and the Contractor shall correct any defects noted therein. The schedule shall at all times present a complete plan for orderly submission of such drawings and data and shall be updated and resubmitted monthly showing actual submittal dates and revised scheduling. The Contractor shall promptly notify the Employer of any occurrence requiring substantial revision of the schedule giving a detailed explanation of the cause of the revision. Revised schedules will be revised and corrected in the same manner as the original schedule.

2.8 Quality Control

The Contractor shall provide and maintain a quality control program to ensure compliance with quality standards of the Technical Specifications. Within 30 days from the effective date of the Contract, the Contractor shall furnish to the Employer three (3) copies of his complete quality control procedures, manual, and a description of the quality control organization.

The Employer/ the Employer's representative will monitor the Contractor's methods, procedures and processes for compliance with the quality control program and the quality standards of these Specifications. Failure of the Contractor to effectively maintain the quality control program throughout all phases of the work will be considered a failure to execute the work with the diligence required by the Contract documents.

2.9 Material/ Workmanship

2.9.1 General Requirement

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Employer shall decide upon the question of similarity. When required by the specification or when required by the Employer the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Employer.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.

2.9.2 Provisions for Exposure to Hot and Humid Climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipment located in non-air-conditioned areas shall also be of same type.

2.10 Tools and Appliances

All the Bidder shall propose complete, new and unused sets of all special tools or gauges and testing kits, which will be required for normal operation and maintenance. The Bidder shall furnish the list of tools and appliances and their prices under Price Schedule of this Tender

Document. To the greatest extent possible, the tools for each specific operation shall be stored in a single, locked, portable, steel box suitably and clearly marked for convenient identification. In the event that such a box must be too large for convenient carrying by one man, it shall be provided with rubber-tired wheels of substantial construction.

2.11 Spare Parts

The Bidder shall propose spare required for three years' maintenance for trouble free operation and shall include a price list of these parts. Sufficient information shall be provided to permit the Employer to estimate spare parts requirements. This information shall be furnished under Price Schedule of this Tender Document.

All spare parts supplied under the Contract shall be strictly interchangeable with the parts for which they are intended to replace. They shall be treated and packed for long storage under the climatic conditions prevailing at the site. Each spare part shall be clearly marked or labeled on the outside of its packing with its description and purpose. When more than one spare part is packed in a single case or other container, a general description of its contents is to be shown on the outside of such cases or container and a detailed list enclosed inside. All case containers and other packages must be suitably marked and numbered for purposes of identification.

All cases, containers or other packages are liable to be opened at the site for such examinations as the Employer may consider necessary and all such opening and subsequent repackaging shall be at the expense of the Contractor.

All spare parts must be delivered to Site in advance of the trial operation. Contractor shall ultimately prepare and deliver five (5) copies of the final consolidated spare parts list, arranged specification-wise, with unit prices and quantities supplied.

It shall be in the interest of the Contractor to organize the delivery and systematic storage of spare parts before the trial operation to obviate post erection difficulties and delays. Any spare part consumed by the Contractor before final acceptance shall be replaced without any cost to the Employer.

2.12 Technical Requirements

2.12.1 Design ambient temperature

All equipment of Dhungesaghu Substation shall be designed based on 50^0C design Ambient Temperature.

2.12.2 Type Test Certificate

The bidders must offer type tested equipment only.

Bidders shall submit reports of type tests of the following equipment performed on identical* equipment or of higher rating of each type in accordance with latest revision of IEC Publications / International Standards.

a) 132 kV SF6 Circuit Breakers
b) 132 kV Disconnect Switches
c) 132 kV Instrument Transformers
d) 132 kV Lightning Arrestors
e) 132 kV Control and Relay Panels
f) Substation Automation System
g) Fiber Optic Based Communication System
h) Battery and Battery Charger
i) 132 kV XLPE cable.
j) As per respective chapter requirements for specific components.

Note: "*" Identical equipment shall mean having same voltage rating, current / MVA rating, and construction.

For all type test reports following criteria shall apply.

a) Type Test must have been carried out within five (5) years prior to the date of opening of the bid.
b) Type Test must have been carried out in any laboratory owned by the Government or an Government Undertaking or the test was witnessed by any Government Utilities.

A) The Employer, his duly authorized representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times free access to the Contractor's/sub-vendors premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Employer and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

B) The Contractor shall give the Employer /Inspector fifteen (15) days written notice for on-shore and six (6) weeks' notice for off-shore material being ready for joint testing including contractor and ***Employer.*** Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Employer /inspector, unless witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed alone with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.

C) The Employer or Inspector shall, within fifteen (15) days from the date of inspection as defined herein 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.

D) The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Employer /Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

E) When the factory tests have been completed at the Contractor's or Sub- Contractor's works, the Employer/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 /Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the

F) Engineer/Inspector. Failure of the Employer /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Employer to accept the equipment should, it, on further tests after erection, is found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of CIP by the Employer.

G) In all cases where the Contract provides for tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labor, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Employer /Inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer /Inspector or to his authorized representative to accomplish testing.

H) 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 program forming a part of the Contract.

I) The Employer will have the right of having at his own expenses any other test (s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material complies with the specification.

J) The Employer reserves the right for getting any field tests not specified in respective chapters of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Employer.

K) The contractor has to involve a reputed independent third-party inspection agency for the Factory tests as per the specification (Chapter 23, Clause 23.4.1) and IEC standard at the testing laboratory of Transformer Manufacturer before dispatch of the power transformers supplied under this Contract. <u>The factory tests shall be carried out in presence of reputed independent third party inspector and NEA personnel. The involvement days of third-party inspector/s shall not be less than 10 days.</u>

L) Bidders have to propose the name of reputed independent third-party inspection agency along with their bid. All the cost of Factory tests as per the specification and IEC standard and the cost of independent third-party inspector/s shall be borne by the contractor.

2.12.3 Material for outdoor panels

A) All outdoor panels such as motor operated mechanism (MOM) box of disconnect switch, operating mechanism box of circuit breakers, CT & VT junction boxes shall be made of aluminium / aluminium alloy of suitable thickness.

B) A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.

C) Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.

D) All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, BS:4255/ Equivalent International Standard. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

E) All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel-plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS: 6121.

F) A 230V, single phase, 50 Hz, 15-amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

G) For illumination, a fluorescent tube or LED (low power consumption) of approximately 9 to 15 watts shall be provided. The switching of the fittings shall be controlled by the door switch.

H) For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

I) All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.

J) Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of self-etching washer. Earthing of hinged door shall be done by using a separate earth wire.

K) The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.

2.12.4 Degree of Protection of Enclosures

Following degree of protection as per relevant IEC shall be provided for all equipment of Dhungesaghu Substation:

S No.	Description of Panel/Equipment	Degree of Protection
1	Control and Relay Panel	IP43
2	Battery Charger	IP42
3	All other Indoor Panels	IP43
4	All outdoor Equipment:	
	a) Operating Mechanism Box for Circuit Breaker and Disconnecting switches.	IP55W (Weather Proof)
	b) CT/VT Junction Boxes	
	c) Bay Marshalling Boxes.	
	d) Outdoor Lighting Panels	

2.12.5 Relays

a) All relays to be used for main and backup protection shall be numerical type only.

b) All main protection relays shall have the features like fault recorder and event logging functions etc. as mentioned in Chapter – 12 (Control and Relay Panels). These functions shall be supplied and activated at no extra cost to the Employer. Necessary hardware and software for automotive uploading/downloading data from the relay to station Laptop Computer and vice versa shall be supplied.

c) The relay shall have communication facility for connectivity to SCADA. Communication protocol shall be IEC 61850.

2.12.6 Fuses and Links

A) Fuse and link carriers and bases shall be of such forms and materials that they protect personnel from shock and burns in normal service and maintenance. Furthermore, fuse links, fuse contacts and fixed contacts shall be shielded to prevent inadvertent contact with live metal whilst the fuse is being inserted or withdrawn.

B) Fuses shall be of the non-deteriorating HRC cartridge type complying with IEC 269 and fuse bridges shall be so designed as to permit detection of fuse rupturing without removing the bridge. 'Zed' and screw-in type fuses shall not be permitted except with the specific approval of the Employer.

C) Test links in current transformer circuits shall be of the bolted or plug-in type.

D) The labeling of fuses, carriers and bases shall comply with IEC 269. Identification labels fixed to panels, boards and desks for fuses and links shall describe their duty, voltage and rating.

E) Fuse and link carriers and bases shall be colored to the approval of the Employer. Fuses shall be used only for DC circuits. For AC circuits MCCB/MCB's of appropriate ratings shall be used.

2.12.7 Wiring

The equipment to be provided as part of this Contract shall be fully wired in accordance with the following general requirement.

a) All wiring shall be carried out with general-purpose 1.1 kV grade PVC copper wire complying with the requirements of IEC. The wire core size shall not be less than 2.5 Sq. mm for current & voltage circuit. The wire core size for control circuits shall be less than 1.5 Sq. mm. All wire cores shall be multi-stranded and flexible.

b) Wires shall be neatly bunched and adequately supported so as to prevent sagging and strain on termination.

c) All inter panel wiring between panels that directly adjoin one another shall be made through the cable duct underneath the panels. All inter panel wiring shall start and terminate on terminal blocks; direct wiring between other items of equipment will not be acceptable.

d) Joints or splices in panel and inter panel wiring will not be acceptable.

e) The wiring of like panels, cubicles or kiosks shall be identical.

f) All wire termination shall be made with compression type connectors. Wires shall not be spliced or tapped between terminal points.

g) Not more than two wires shall be connected to any terminal at each end. If necessary, a number of terminals shall be jumpered together to provide additional wiring points.

h) Wiring leads and cable cores shall be permanently marked at both ends with an approved type of marking device having black letters and numbers impressed on a white background.

2.12.8 Terminal Blocks

a) Multi-way terminal blocks complete with screws, nuts, washers and marking strips for terminal identification shall be furnished for terminating the internal wiring and outgoing cables.

b) Control terminals shall be washers head screw type, each suitable for connection of at least two numbers of copper conductor cables of requisite cross-section at each end through compression type (solder less) lugs. Screw type terminals with screw directly impinging on conductor or any other type of terminal, which does not accept compression type lugs, are not acceptable. The successful Bidder shall have to take prior approval of the terminals to be used in the block from the Employer/ the Employer's representative.

c) Each terminal shall be marked with designations obtained from schematic diagrams.

At least 20% spare terminals shall be provided in the terminal blocks.

2.12.9 Nameplate

a) Nameplates or rating plates shall be stainless steel and shall be engraved in English language. Instruction plates, warning signs and anti-marking whatever on the equipment and parts and accessories thereof shall be both in the English and the Nepali language.

b) The switch handles shall be carved with the function number or work colored in white.

c) The details of the matters to be shown on the nameplates, etc. shall be indicated in the drawings for approval.

d) The Contractor shall provide nomenclature for all equipment installed in the substation. Such nomenclatures shall be as approved by the Employer.

2.12.10 Painting

All sheet steel works shall be phosphate in accordance with the following procedure and in accordance with BS 2569 and BS 5493.

a) Oil, grease, dirt shall be thoroughly removed by emulsion cleaning.

b) Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

c) After phosphating, thorough rinsing shall be carried out with clean water, followed by final rinsing with dilute dichromate solution and even drying.

d) The phosphate coating shall be sealed by the application of two coats of stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

e) After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. Touch up shall be applied after completion of tests. The color for the finishing paint shall be light gray or as approved by Employer.

f) The final finished thickness of paint film on steel shall not be less than 100 microns.

g) Finished painted surface of panels shall present aesthetically pleasing appearance free from runs and drips.

h) A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panels.

2.12.11 Compatibility

All equipment, structures, etc. offered by the Contractor shall be compatible with existing systems.

The Contractor shall pay utmost attention towards compatibility in design, supply, installation, interfacing and integration of the new SCADA system with the existing one. The Contractor shall be responsible for establishing data and voice communication along with other necessary requirements with remote end substations as well as LDC, Kathmandu. The Contractor shall be fully responsible for compatibilities and complete interfacing of the signal system, integration in the SINAUT Spectrum, located at Kathmandu etc.

The Contractor shall undertake a detailed study of the existing relay and protective schemes and propose a suitable scheme along with relay settings of the proposed relays as well as for the existing relays in Dhungesaghu substations to ensure proper coordination of the relays in the system. If required, the Contractor shall also be responsible for undertaking necessary adjustments in the settings of the relays in neighboring substations. If necessary, the Contractor shall also be responsible for design / supplying / executing all necessary works for the proper functioning of the protection and communication schemes without additional cost to the Employer.

2.12.12 Technical Requirements of Equipment

2.12.12.1 Power and Control Cables (1.1 kV Grade)

Applicable for PVC Control Cable

The manufacturers, whose PVC control cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 km of 1.1 KV grade PVC insulated control cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 17C x 2.5 Sq. mm or higher size as on the originally Scheduled date of bid opening.

Applicable for PVC Power Cable

The manufacturer, whose PVC Power Cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 km of 1.1 KV or higher-grade PVC insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 150 Sq. mm or higher size as on the originally Scheduled date of bid opening.

Applicable for XLPE Power Cable

The Manufacturer, whose XLPE Power cables are offered should have designed manufactured, tested and supplied in a single contract at least 25 km of 1.1 KV or higher grade XLPE insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 630 Sq. mm or higher size as on the originally Scheduled date of bid opening.

2.12.12.2 LT Switchgear

The Manufacturer whose LT Switchgear is offered should be a manufacturer of LT Switchboards of the type and rating being offered. He should have designed, manufactured, tested and supplied at least 50 nos. draw out circuit breaker panels, out of which at least 5 nos. should have been with relay and protection schemes with current transformer. He should have also manufactured at least 50 nos. MCC panels comprising of MCCBs (i.e. Molded Case Circuit Breakers) modules of the type offered which should be in successful operation as on originally Scheduled date of bid opening.

The Switchgear items (such as circuit breakers, fuse switch units, contactors etc.), may be of his own make or shall be procured from reputed manufacturers and of proven design. At least one hundred circuit breakers of the make and type being offered shall be operating satisfactory as on originally Scheduled date of bid opening.

2.13 Quality Assurance Program

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's Works or at his Sub-contractor's premises or at the Employer's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points necessary. Such program shall be broadly outlined by the contractor and finalized after discussions

before the award of contract. The detailed program shall be submitted by the contractor after the award for reference. A quality assurance program of the contractor shall generally cover the following:

a) His organization structure for the management and implementation of the proposed quality assurance program:
b) Documentation control system;
c) Qualification data for bidder's key personnel;
d) The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
f) Control of non-conforming items and system for corrective actions;
g) Inspection and test procedure both for manufacture and field activities.
h) Control of calibration and testing of measuring instruments and field activities;
i) System for indication and appraisal of inspection status;
j) System for quality audits;
k) System for authorizing release of manufactured product to the Purchaser.
l) System for maintenance of records;
m) System for handling storage and delivery; and
n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The Employer or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his vendor's quality management and control activities.

Quality Assurance Documents

The contractor would 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.

2.14 Tests

2.14.1 Pre – Commissioning Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial recommissioning tests at Site. The lists of pre-commissioning tests to be performed are given in respective chapters and shall be included in the Contractor's quality assurance program.

2.14.2 Commissioning Tests

The available instrumentation and control equipment will to be used during such tests and the Employer will calibrate all such measuring equipment and devices as far as practicable.

Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.

The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed on production of requisite documents.

2.15 Packaging & Protection

All the equipment 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. On request of the Employer, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Employer to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes should be taken into account. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Employer takes no responsibility of the availability of the wagons.

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and piping's and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

2.16 Handling, Storage and Installation

A. In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Employer or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract.

B. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energization at rated voltage.

C. Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.

D. The contractor shall have to ensure that the hard and flat indoor and outdoor storage areas are in place prior to commencement of delivery of material at site. Contractor shall also ensure availability of proper unloading and material handling equipment like cranes etc. and polyester/nylon ropes of suitable capacity to avoid damage during unloading and handling of material at site. All indoor equipment shall be stored indoors. Outdoor equipment may be stored outdoors but on a hard and flat raised area properly covered with waterproof and dustproof covers to protect them from water seepage and moisture ingress. However, all associated control panels, marshalling boxes operating boxes etc. of outdoor equipment are to be stored indoors only.

E. Storage of equipment on top of another one is not permitted if the wooden packing is used. Material opened for joint inspection shall be repacked properly as per manufacturer's recommendations.

F. During storage of material regular periodic monitoring of important parameters like oil level / leakage, SF6 / Nitrogen pressure etc. shall be ensured by the contractor.

G. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Employer. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

H. Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

I. Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

J. The Contractor shall be fully responsible for the equipment/material until\ the same is handed over to the Employer in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Employer, as well as protection of the same against theft, element of nature, corrosion, damages etc.

K. Where material / equipment is unloaded by Employer before the Contractor arrives at site or even when he is at site, Employer by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor to store the material in an orderly and proper manner.

L. The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment which requires indoor storage.

M. The words 'erection' and 'installation' used in the specification are synonymous.

N. Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

O. The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances as given in clause 4.7.1 the Contractor shall immediately proceed to correct the discrepancy at his risks and cost.

2.17 Environment Mitigation Measures

2.17.1 Physical Environment

The following mitigation measures shall be undertaken to reduce the adverse impacts on the physical environment during construction of the substation.

a) Discharge of cement slurry, garbage and other solid wastes generated by the construction activities and workforce should be avoided where possible.
b) Chemical and other hazardous materials should be dumped safely far away from the water bodies.
c) Disposal material of substation should be carried out within the acquired land for substation. The waste materials of the substation shall be minimized to avoid for separate land for disposal.

2.17.2 Biological Environment

None

2.17.3 Socio-economic and cultural environment

In the construction phase following mitigation measures shall be adopted to minimize the impacts:

a) Control of adverse socio interactions between local communities and construction work force.
b) Awareness program regarding health and safety of substation.
c) Awareness program for workforce.
d) Insurance against health and safety.

2.17.4 Employment

Priority shall be given to the local project affected people while hiring workers and labors during construction of the project. Nepal being a signatory to the International Convention against Child Labor, the Contractor shall not employ child Labor in construction.

ANNEXURE - A

LIST OF SPECIFICATIONS

GENERAL STANDARDS AND CODES

IEC-60060 (Part 1 to P4)	-	High Voltage Test Techniques
IEC 60068	-	Environmental Test
IEC-60117	-	Graphical Symbols
IEC-60156,	-	Method for the Determination of the Electrical Strength of Insulation Oils.
IEC-60270,	-	Partial Discharge Measurements.
IEC-60376	-	Specification and Acceptance of New Sulphur Hexafluoride
IEC-60437	-	Radio Interference Test on High Voltage Insulators.
IEC-60507	-	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems.
IEC-62271-1	-	Common Specification for High Voltage Switchgear & Control gear Standards.
IEC-60815	-	Guide for the Selection of Insulators in respect of Polluted Conditions.
IEC-60865 (P1 & P2)	-	Short Circuit Current - Calculation of effects.
ANSI-C.1/NFPA.70	-	National Electrical Code
ANSI-C37.90A	-	Guide for Surge Withstand Capability (SWC) Tests
ANSI-C63.21,	-	Specification for Electromagnetic Noise and
C63.3	-	Field Strength Instrumentation 10 KHz to 1 GHZ
C36.4ANSI-C68.1	-	Techniques for Dielectric Tests
ANSI-C76.1/EEE21	-	Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings.
ANSI-SI-4	-	Specification for Sound Level Meters
ANSI-Y32-2/C337.2	-	Drawing Symbols
ANSI-Z55.11	-	Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray
NEMA-107T	-	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-II	-	General Standards for Industrial Control and Systems Part ICSI-109
CISPR-1	-	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz

CSA-Z299.1-1978h	-	Quality Assurance Program Requirements
CSA-Z299.2-1979h	-	Quality Control Program Requirements
CSA-Z299.3-1979h	-	Quality Verification Program Requirements
CSA-Z299.4-1979h	-	Inspection Program Requirements

CIRCUIT BREAKERS

IEC-62271-100	-	High-voltage switchgear and control gear - Part 100: Alternating current circuit-breakers
IEC-62271-101	-	High-voltage switchgear and control gear - Part 101: Synthetic testing
IEC-62155	-	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC-62271-110	-	High-voltage switchgear and control gear - Part 110: Inductive load switching
IEC-62271-109	-	High-voltage switchgear and control gear - Part 110: Inductive load switching

CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS

IEC-60044-1	-	Current Transformers.
IEC-60044-2	-	Inductive Voltage Transformers.
IEC-60044-5	-	Instrument Transformers - Part 5: Capacitor Voltage Transformers
IEC-60358	-	Coupling Capacitors and Capacitor Dividers.
IEC-60044-4	-	Instrument Transformers : Measurement of Partial Discharges
IEC-60481	-	Coupling Devices for power Line Carrier Systems.
ANSI-C5713	-	Requirements for Instrument transformers
ANSIC92.2	-	Power Line Coupling voltage Transformers
ANSI-C93.1	-	Requirements for Power Line Carrier Coupling Capacitors

BUSHING

IEC-60137	-	Insulated Bushings for Alternating Voltages above 1000V

SURGE ARRESTERS

IEC-60099-4	-	Metal oxide surge arrestors without gaps

IEC-60099-5	-	Selection and application recommendation
ANSI-C62.1	-	IEE Standards for S A for AC Power Circuits
NEMA-LA 1	-	Surge Arresters

CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS

IEC-60068.2.2	-	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-60529	-	Degree of Protection provided by enclosures.
IEC-60947-4-1	-	Low voltage switchgear and control gear.
IEC-61095	-	Electromechanical Contactors for household and similar purposes.
IEC-60439 (P1 & 2)	-	Low Voltage Switchgear and control gear assemblies
ANSI-C37.19	-	Switchgear Assemblies, including metal enclosed bus.
ANSI-C37.50	-	Test Procedures for Low Voltage Alternating Current Power Circuit Breakers
ANSI-C39	-	Electric Measuring instrument
ANSI-C83	-	Components for Electric Equipment
NEMA-AB	-	Moulded Case Circuit and Systems
NEMA-CS	-	Industrial Controls and Systems
NEMA-PB-1	-	Panel Boards
NEMA-SG-5	-	Low voltage Power Circuit breakers
NEMA-SG-3	-	Power Switchgear Assemblies
NEMA-SG-6	-	Power switching Equipment
NEMA-5E-3	-	Motor Control Centers
1248 (P1 to P9)	-	Direct acting indicating analogue electrical measuring instruments & their accessories.

Disconnecting switches

IEC-62271-102	-	High-voltage switchgear and control gear - Part 102: Alternating current disconnectors and earthing switches
IEC-60265 (Part 1 & 2)	-	High Voltage switches
ANSI-C37.32	-	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories

ANSI-C37.34	-	Test Code for high voltage air switches
NEMA-SG6	-	Power switching equipment

Protection and control equipment

IEC-60051: (P1 to P9)	-	Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories.
IEC-60255 (Part 1 to 23)	-	Electrical relays.
IEC-60297		
(P1 to P4)	-	Dimensions of mechanical structures of the 482.6mm (19 inches) series.
IEC-60359	-	Expression of the performance of electrical & electronic measuring equipment.
IEC-60387	-	Symbols for Alternating-Current Electricity meters.
IEC-60447	-	Man machine interface (MMI) - Actuating principles.
IEC-60521	-	Class 0.5, 1 and 2 alternating current watt hour metres
IEC-60547	-	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)
ANSI-81	-	Screw threads
ANSI-B18	-	Bolts and Nuts
ANSI-C37.1	-	Relays, Station Controls etc.
ANSI-C37.2	-	Manual and automatic station control, supervisory and associated telemetering equipment
ANSI-C37.2	-	Relays and relay systems associated with electric power apparatus
ANSI-C39.1	-	Requirements for electrical analog indicating instruments

Electronic equipment and components

MIL-21B, MIL-833 & MIL-2750		
IEC-60068 (P1 to P5)	-	Environmental testing
IEC-60326 (P1 to P2)	-	Printed boards
		Material and workmanship standards
ASTM	-	Specification and tests for materials

Clamps & connectors

NEMA-CC1	-	Electric Power connectors for sub station
NEMA-CC 3	-	Connectors for Use between aluminum or aluminum-Copper Overhead Conductors

Bus hardware and insulators

IEC-60120	-	Dimensions of Ball and Socket Couplings of string insulator units.
IEC-60137	-	Insulated bushings for alternating voltages above 1000 V.
IEC-60168	-	Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V.
IEC-62155	-	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC-60273	-	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
IEC-61462	-	Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than 1000V – Definitions, Test methods, acceptance criteria and design recommendations
IEC-60305	-	Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for a.c. systems Characteristics of String Insulator Units of the cap and pin-type.
IEC-60372 (1984)	-	Locking devices for ball and socket couplings of string insulator units: dimensions and tests.
IEC-60383 (P1 and P2)	-	Insulators for overhead lines with a nominal voltage above 1000 V.
IEC-60433	-	Characteristics of string insulator units of the long rod type.
IEC-60471	-	Dimensions of Clevis and tongue couplings of string insulator units.
ANSI-C29	-	Wet process porcelain insulators
ANSI-C29.1	-	Test methods for electrical power insulators
ANSI-C92.2	-	For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8	-	For wet-process porcelain insulators apparatus, post-type
ANSI-G.8	-	Iron and steel hardware

CISPR-7B	-	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153	-	Zinc Coating (Hot-Dip) on iron and steel hardware

Strain and rigid bus-conductor

ASTM-B 230-82	-	Aluminum 1350 H19 Wire for electrical purposes
ASTM-B 231-81	-	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	-	Aluminum - Alloy extruded bar, road, wire, shape
ASTM-B 236-83	-	Aluminum bars for electrical purpose (Bus-bars)
ASTM-B 317-83	-	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)

Batteries and batteries charger

Battery

IEC:60896-21&22	-	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC: 60623	-	Vented type nickel Cadmium Batteries
IEC:60622	-	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC:60623	-	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC:60896-11	-	Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests
IEEE-485	-	Recommended practices for sizing of Lead Acid Batteries
IEEE-1115	-	Sizing of Ni-Cd Batteries
IEEE-1187	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	-	Guide for selection of VRLA Batteries

Battery Charger

IEEE-484	-	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations.
IEEE-485	-	Sizing large lead storage batteries for generating stations and substations

Wires and cables

ASTMD-2863	-	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IEC-60096 (part 0 to p4)	-	Radio Frequency cables.
IEC-60183	-	Guide to the Selection of High Voltage Cables.
IEC-60189 (P1 to P7)	-	Low frequency cables and wires with PVC insulation and PVC sheath.
IEC-60227 (P1 to P7)	-	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V.
IEC-60228	-	Conductors of insulated cables
IEC-60230	-	Impulse tests on cables and their accessories.
IEC-60287 (P1 to P3)	-	Calculation of the continuous current rating of cables (100% load factor).
IEC-60304	-	Standard colors for insulation for low-frequency cables and wires.
IEC-60331	-	Fire resisting characteristics of Electric cables.
IEC-60332 (P1 to P3)	-	Tests on electric cables under fire conditions.
IEC-60502	-	Extruded solid dielectric insulated power cables for rated voltages from 1 kV up to 30 kV
IEC-754 (P1 and P2)	-	Tests on gases evolved during combustion of electric cables.

Painting

ANSI-Z551	-	Gray finishes for industrial apparatus and equipment
SSPEC	-	Steel structure painting council

Steel structures

ANSI-B18.2.1	-	Inch series square and Hexagonal bolts and screws

ANSI-B18.2.2	-	Square and hexagonal nuts
ANSI-G8.14	-	Round head bolts
ASTM-A6	-	Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use
ASTM-A36	-	Specifications of structural steel
ASTM-A47	-	Specification for malleable iron castings
ASTM-A143	-	Practice for safeguarding against emblement of Hot Galvanized structural steel products and procedure for detaching embroilment
ASTM-A242	-	Specification for high strength low alloy structural steel
ASTM-A283	-	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	-	Specification for Galvanized steel transmission tower bolts and nuts
ASTM-441	-	Specification for High strength low alloy structural manganese vanadium steel.
ASTM-A572	-	Specification for High strength low alloy columbium-Vanadium steel of structural quality
AWS D1-0	-	Code for welding in building construction welding inspection
AWS D1-1	-	Structural welding code
AISC	-	American institute of steel construction
NEMA-CG1	-	Manufactured graphite electrodes

ACSR CARDINAL CONDUCTOR

IEC:437-1973	Test on High Voltage Insulators NEMA:107-1964 CISPR
Part - V	Overhead Transmission Purposes
BS:215(Part-II)	Aluminum Conductors galvanized IEC:209-1966 steel reinforced extra high
BS:215(Part-II)	voltage (400 kV and above)

GALVANISED STEEL EARTHWIRE

P5:1992)	overhead transmission purposes.

Chapter 3: Outdoor Circuit Breaker

3.1 General

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation, field test and commissioning of outdoor circuit breaker complete with all accessories for efficient and trouble free operation as specified herein under. All necessary parts to provide a complete and operable circuit breaker installation such as main equipment, terminals, control parts, connectors and other devices whether specifically called for herein or not shall be provided.

The equipment specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular:

IEC 60056	High-voltage alternating switchgear
IEC 62271	High-voltage alternating switchgear and control gear
IEC 60376	Specification and acceptance of new sulphur hexafluoride
IEC 60529	Degree of protection provided by enclosures
IEC 60694	Common specifications for high-voltage switchgear and control gear standards

3.2 Design Requirements

The circuit breakers shall be suitable for 3 phase, 50 Hz. and shall be installed outdoor in the vicinity of industries.

All equipment and accessories shall be provided with sub-tropical finish to prevent fungus growth.

The maximum temperature rise in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in relevant standards.

The support structure of circuit breaker shall be hot dip galvanized. Exposed hardware items shall be hot dip galvanized or Electro-galvanized.

The rated peak short circuit current or the rated short time current carried by the equipment shall not cause:

a) mechanical damage to any part of the equipment
b) separation of contacts
c) Insulation damage of "Current Carrying Part"

Technical particulars of the circuit breaker shall be as specified in the appendix.

All auxiliary equipment shall be suitable for 3 phase-4 wires, 400V or single phase 230 V, 50 Hz system. All controls shall be suitable for 110V DC.

3.3 Construction Features

The circuit breaker shall be outdoor, three-phase, (single-throw or), spring charged motor operated, trip free in any position, complete with operating mechanism and supporting structure.

The 145kV circuit breaker shall be SF6 gas type.

The circuit breaker shall be capable of interrupting the steady state and transient magnetizing current corresponding of power transformers.

The circuit breaker shall also be capable of:

a) Interrupting line/cable charging current as per IEC without use of opening resistors.
b) Clearing short line fault (Kilometric faults) with source impedance behind the bus equivalent to symmetrical fault current specified.

The Breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energization of lines with trapped charges. The breaker shall also withstand the voltages specified under Appendix 2.1 of this Section.

3.3.1 Reclosing operation

The circuit breaker for outgoing/incoming line for voltage level 66 kV and above shall be capable of making reclosing operation.

3.3.2 Contacts

The contacts shall be designed to have adequate thermal and current carrying capacity for carrying full-rated current without exceeding the allowable temperature rise as specified by IEC standards. They shall be designed to have long life so that frequent replacement or maintenance will be unnecessary. The surfaces of either of both moving and stationary arcing-contacts that are exposed directly to the arc shall be faced with suitable arc resisting material.

The gap between the open contacts shall be such that it can withstand at least the rated phase to ground voltage for 8 hours at zero-gauge pressure of SF6 gas due to the leakage. The breaker should be able to withstand all dielectric stresses imposed on it in open condition at lock out pressure continuously (i.e. 2 p.u. across the breaker continuously, for validation of which a power frequency dielectric with stand test conducted for a duration of at least 15 minutes is acceptable).

3.3.3 Gas Density Detector for SF6 circuit breaker

The circuit breaker shall be provided with gas density detector, responding to the gas temperature and pressure, which shall have two different functions according to the gas condition: the first step gives alarm and the second step locks the operating mechanism. A gauge shall also be provided to indicate the gas-pressure.

3.3.4 Vacuum Interrupter for vacuum circuit breaker

Vacuum interrupter, which makes use of the excellent dielectric properties, should confirm to obtain a highly reliable extinguishing device such as to quench the arc as soon as possible without causing the visible formation of the arc. There should not be any deterioration of the quenching medium. The design and manufacturing technology of the interrupter should ensure the vacuum integrity. The recovery should be faster and hence the arc quenching should be accomplished within the adequate contact gap to support the

required rating. The contact surface should be free of impurities and pollution layers. Materials of high conductivity should be used such that the contact resistance will be very low. During switching, the Breaker should be re-strikes free.

3.3.5 Local Test Switch

Each mechanism shall be equipped with a local test switch for electrically testing the closing and tripping operations of the circuit breaker. A separate manually operated cut-out device to disconnect the circuits from remote closing, reclosing and tripping devices shall be provided on each circuit breaker. A warning nameplate requiring operation of this device before operation of the local test switch shall be mounted adjacent to the local test switch.

3.3.6 Emergency Trip

Each circuit breaker shall be provided with an emergency hand trip device. This device shall be provided with mechanically interlocked contacts to disconnect circuits from remote closing and reclosing devices. The trip button shall be mounted in such a way that it can be operated from outside of the operating box.

3.3.7 Position Indicator

A mechanical indicator shall be provided to show open and close position of the breaker. It shall be located in a position where it will be visible to a man standing on the ground level with the mechanism housing closed. An operation counter shall also be provided in the central control cabinet. The indicator shall be provided for each pole.

3.3.8 Tripping Circuit

Two (2) sets of tripping coils shall be provided in two separate current and magnetic circuits in order to make possible primary and backup tripping of circuit breaker. Provision for trip circuit supervision shall be provided.

The tripping circuit mechanism and the closing control circuit mechanism shall each have a nominal voltage rating of 110 volts DC. The tripping circuit shall operate satisfactorily for a tripping operation over a voltage range of 70-110%. The closing control circuit shall operate satisfactorily over a voltage range of 85-110%.

3.3.9 Motor-operated Spring-Charged Mechanism

A complete and separate spring-operating system shall be furnished and installed to operate the circuit breaker. The mechanism shall be housed in a weather proof and dust proof control cabinet. The closing action of breaker shall charge the opening spring for tripping.

The operating mechanism shall be strong, rigid, not subject to rebound.

The mechanism shall be anti-pumping and trip free (as per IEC definition) under every method of closing.

As long as power is available to the motor, a continuous sequence of the closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty.

After failure of power supply to the motor one close open operation shall be possible with the energy contained in the operating mechanism.

Breaker operation shall be independent of the motor which shall be used solely for charging the closing spring.

Each operating mechanism shall be provided with a spring charging motor with a common control cabinet.

- The time required to charge the closing spring after the closing operation shall not exceed 30 seconds.
- Under voltage alarm relay suitable for operation on DC circuit to permit remote indication of loss of potential on the AC to the control gear.
- Spring charged indicator shall indicate the state of energy store in the spring. Indication for fully charged spring shall be provided both at local and remote control panel.
- When closing springs are discharged after closing a breaker, closing springs shall be automatically charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.
- Means shall be provided to prevent the operation of the mechanism when maintenance work is being done. The mechanism shall be so arranged that emergency manual charging and release of the spring is possible without electrical means. One (1) CO-operation shall be possible after failure of supply.

Working parts of the mechanism shall be corrosion resisting material, bearings which require grease shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker.

The bidder shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker. The instruction manuals shall contain exploded diagrams with complete storage, handling, erection, commissioning, troubleshooting, servicing and overhauling instructions.

3.3.10 Operating Cubicle

Circuit breaker operating mechanisms, auxiliary switches and associated relays, control switches, control cable terminations, and other ancillary equipment shall be housed in sheet steel vermin-proof and weatherproof cubicles. The enclosure protection of the cubicle shall be IP55W. Where appropriate, the cubicles may be free standing with front and rear access.

Cubicles shall be of rigid construction, preferably folded but alternatively formed on a framework of standard rolled steel sections and shall include any supporting steel work necessary for mounting on the circuit breaker or on concrete foundations. The thickness of the sheet steel shall be at least 2 mm. All fastenings shall be integral with the panel or door and provision made for locking. Doors shall be rigid and fitted with weatherproof sealing materials suitable for the climatic conditions specified. The structure design shall be such that during operation of circuit breaker vibrations are reduced to minimum.

Cubicles shall be well ventilated thorough vermin-proof louvers comprising a brass gauze-screen attached to a frame and secured to the inside of the cubicle. Divisions between compartments within the cubicle shall be perforated to assist air circulation. In addition, thermostat- controlled space heater with ON-OFF switches rated 230 V, 1 phase, 50 Hz shall be provided to prevent condensations within the cubicle.

A local control switch connected with a remote-local selector switch shall be furnished and wired in the control circuits of the breaker. The local control switch shall be operative from within the operating cubicle only when the selector switch is in local position.

3.3.11 Terminal Connector Pad

The circuit breaker terminal pads shall be made up of high quality electrolytic copper or aluminum the terminal pad shall have protective covers which shall be removed before interconnections.

3.3.12 Bushings

The bushings shall be of the porcelain gas filled, designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

3.4 Accessories

The Contractor shall furnish following accessories as an integral part of each circuit breaker:

a) Padlocks and duplicate keys.
b) Cable glands (Double compression type), Lugs, Ferrules etc.
c) Space heaters equipped with thermostatic controls.
d) Local/remote control switch.
e) Fuses as required.
f) Operation counter.
g) Earthing pad (two) for each pole.
h) Terminal boards with six spare terminals.
i) Two earthing terminals for each mechanism box.
j) Auxiliary relays.
k) Motor contactor with thermal release for spring charging motor.
l) Rating and diagram plate in accordance with IEC incorporating year of manufacture. .
m) Special tools and tackle for operation and maintenance of equipment including gas leakage detector and gas filling device for the circuit breaker supplied.
n) Other necessary accessories.

3.5 Spare Parts

For each type of circuit breaker, the spare parts shall be provided in required quantities as listed in Price Schedule. Further spare parts as recommended by the manufacturer shall also be included in the Price Schedule.

3.6 Tests

3.6.1 Routine Tests

On completion, each circuit breaker shall be subjected to following routine tests. As far as practical, the procedure of IEC shall be followed:

a) Construction Inspection
b) Leakage Test (for SF6 circuit breaker)

c) Operating Speed Check
d) Dielectric test
e) Control and secondary wiring check test
f) Mechanical operation test
g) Operating mechanism system check
h) Voltage withstand test on auxiliary circuits
i) Measurement of resistance of main circuit of each pole
j) Power frequency voltage withstand test on main circuit of each pole and the combination of poles and breaker frame.

3.6.2 Design Tests

Following design tests shall be performed on the offered model.

The circuit breaker design tests shall include following:

a) Dielectric withstand test
b) Temperature rise test
c) Radio interference voltage test
d) Short-time withstand current and peak withstand current tests
e) Verification of the protection
f) Electromagnetic compatibility tests

The Bidder shall submit type test report as specified in section-2 of this specification for the circuit breaker of the offered model along with the bid.

3.6.3 Field Tests

After installation at Site, the circuit breaker shall be subjected to the following field tests:

a) Insulation resistance of each pole.
b) Check adjustments, if any suggested by manufacturer.
c) Breaker closing and opening time.
d) Slow and Power closing operation and opening.
e) Trip free and anti-pumping operation.
f) Minimum pick-up voltage of coils.
g) Dynamic Contact resistance measurement.
h) Functional checking of compressed air plant and all accessories.
i) Functional checking of control circuits interlocks, tripping through protective relays and auto reclose operation.
j) Insulation resistance of control circuits, motor etc.
k) Resistance of closing and tripping coils.
l) SF6 gas leakage check.
m) Dew Point Measurement
n) Operation check of pressure switches and gas density monitor during gas filling.
o) Checking of mechanical 'CLOSE' interlock, wherever applicable.
p) Testing of grading capacitor.
q) Resistance measurement of main circuit.

r) Checking of operating mechanisms
s) Check for annunciations in control room.
t) Point of wave switching test (wherever applicable)

The contractor shall ensure that erection, testing and commissioning of circuit breaker shall be carried out under the supervision of the circuit breaker manufacturer's representative. The commissioning report shall be signed by the manufacturer's representative.

3.7 Performance Guarantee

The performance guarantee figures quoted on the schedule of Technical Data shall be guaranteed within the tolerances permitted by relevant standard and will become a part of successful Bidder's Contract.

3.8 Drawings, Data and Manual

The outline drawings of the breaker and control cubicle with accessories shall be furnished along with the Bid.

After award of Contract the successful Bidder shall submit the required number of copies (hard and soft copies) of the following drawings and data for approval of the Employer.

a) General equipment layout
b) Outline drawings of the breaker and control cubicle with accessories
c) Loading data and foundation detail
d) Elementary control wiring diagrams
e) Internal wiring diagrams
f) External connection diagrams, showing terminal boards and other external Connection points for each assembly and the required interconnecting wiring
g) Drawings showing typical cross-sections of the operating mechanism and the breaker mechanism
h) Drawings showing typical cross-section and assembly of interrupting device
i) Drawings showing assembly of principal component parts and accessories
j) Drawings showing details of bushings or porcelain supporting columns, including dimension details of flanges and outline dimensions
k) Drawing to show details at all points where adjustments may be made to operating dimension mechanism, breaker mechanism and contact
l) Any other drawings and data required for design and installation of circuit breaker.
m) Instruction manual for storage, installation, operation and maintenance of circuit breaker and operating mechanism.

3.9 Nameplate

Circuit breaker shall be provided with a nameplate of stainless steel material fitted in a visible position. It shall show the following items as a minimum.

a) Circuit Breaker (Note: Circuit breaker and operating cubicle nameplates may be combined)

- Manufacturer's name
- Manufacturer's serial number and type designation
- Year of manufacture

- Rated voltage, kV
- Rated insulation level, kV
- Rated frequency, Hz
- Rated nominal current, A
- Rated short-circuit breaking current, kA
- Rated short circuit making current, kA
- Rated operating cycle (duty cycles)
- Rated short time current & duration, kA/s
- Rated operating sequence (duty cycles)
- Type of operating mechanism
- First pole to clear factor
- Rated interrupting time, cycles
- Rated operating pressure (SF6), kg/cm2
- Weight of circuit breaker, kg
- Parts list number

b) Operating cubicle (Note: Operating cubicles and circuit breaker nameplates may be combined.)

- Manufacturer's name
- Manufacturer's serial number and type designation
- Year of manufacture
- Rated supply-voltage of closing and opening devices, V
- Rated supply-frequency of closing and opening devices, Hz
- Closing current, A
- Tripping current, A
- Rated supply-voltage of auxiliary circuits, V
- Rated supply-frequency of auxiliary circuits, Hz
- Parts list number

3.10 Special Tools

In addition to the tools, which are regularly furnished with such breakers, the Contractor shall also supply all necessary special tools or equipment for assembling and disassembling the breaker. The Contractor shall submit an itemized list of such equipment in the Price Schedule.

APPENDIX 3-1: Technical Particulars of 132 kV SF6 Circuit Breaker

1.	Type	SF6, outdoor type
2.	Voltage rating:	
	a) Nominal system voltage	132 kV
	b) Rated maximum voltage	145 kV
3.	Insulation level	
	a) Impulse withstand voltage	650 kV (crest)
	b) Power-frequency withstand voltage (1 min.)	275 kV (rms)
4.	Frequency	50 Hz
5.	Current rating	
	a) Rated continuous current at 40 degree C ambient	1250/2000 A
	b) Short circuit breaking current	40 kA
	c) Short circuit making current	102 kA
6.	Creepage distance	3625 mm (min)
7.	Auxiliary supply	
	a) Control circuit	110 V DC
	b) Space heater and auxiliary equipment.	AC, 230/400V, 50 Hz
8.	Operation	3 phase with Autorecloser (3 Nos. Single Phase Electrical Gang Operated Circuit breaker)
9.	Number of possible operations without maintenance:	
	For breaker contact with:	Not less than 10
	-Rated short circuit breaking current (31.5 kA)	Not less than 2000
	- Rated normal current (1250/2000 A)	Not less than 2000
	For mechanism	
10.	Reclosing duty cycle	O-0.3 sec-CO-3 min-CO
11.	Total maximum break time	60 ms
12.	First pole to clear factor	1.3
13.	Additional Auxiliary Contacts	8 NO, 8 NC
14.	Maximum make time	120 ms
15.	Spring charging motor	110 V DC

Chapter 4: Disconnecting Switch (Isolator)

4.1 General

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation works, field test and commissioning of outdoor type disconnecting switches complete with all accessories for efficient and trouble-free operation as specified herein under.

The Bidder shall submit type test reports, valid ISO 9001 certificates, necessary technical brochures, as well as detailed drawings showing layout, section, various clearances in conformity with relevant standards with this tender to verify compliance with the requirement of these specifications.

The equipment specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular:

IEC 60129 High-voltage alternating current disconnectors and earthing switches
IEC 60529 Degree of protection provided by enclosures

4.2 Design Requirements

The disconnecting switches shall be used for the 50Hz, 3 phase system. Earth switches shall be provided on disconnecting switches wherever called for.

Complete disconnecting switches with all the necessary items for successful operation shall be supplied.

The equipment shall be installed outdoor. All equipment, accessories and wiring shall be provided with sub-tropical finish to prevent fungus growth.

The maximum temperature rise in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in relevant standards.

The rated peak short circuit current or the rated short time current carried by the disconnecting switches & earth switches shall not cause;

a) Mechanical damage to any part of the equipment
b) Separation of Contacts
c) Insulation damage of "Current Carrying Part".

The disconnecting switches shall be center break for 132kV with contact blades moving through horizontal plane.

The rating, the accessories to be furnished and the schedule of equipment are detailed in Appendix.

The disconnecting switch shall be able to carry the rated current continuously and rated short circuit current for one second without exceeding the temperature.

The disconnecting switches shall be capable of withstanding the dynamic and thermal effects of maximum possible short circuit current.

In case of disconnecting switch with grounding switch, the grounding switch shall be capable of making to a dead short circuit without damage of the equipment or endangering operator. It shall be provided with and interlocking with the corresponding disconnecting switch so that the earth switches can be operated only when the disconnecting switches is open and vice versa.

The earthing switches shall be capable of discharging trapped charges of the associated lines. Disconnecting switches and earth switches shall be able to bear on the terminals the total forces including wind loading and electro-dynamic forces on the attached conductor without impairing reliability or current carrying capacity.

4.3 Construction Features

The 3-pole disconnecting switches shall be gang-operated type so that all the poles make and break simultaneously.

The disconnecting switches shall be designed for upright/vertical mounting on steel structure. The disconnecting switches shall be provided with a galvanized steel base provided with holes and designed for mounting on a lattice/pipe support structure. Disconnecting switches to be mounted on gantry structure shall include necessary steel channels, bolts, nuts, etc. The position of movable contact system (main blades) of each of the disconnecting switches and earthing switch shall be indicated by a mechanical indicator at the lower end of the vertical rod of shaft for the disconnecting switches and earthing switch. The indicator shall be of metal and shall be visible from operating level. The disconnecting switches shall have padlocking arrangement in both "open" and "closed" positions.

All current carrying parts shall be of non-ferrous metal or alloy. Bolts, screws and pins shall be provided with lock washers. Keys or equivalent locking facilities, if provided on current carrying parts, shall be made of copper silicon alloy or equivalent. The live parts shall be designed to eliminate sharp joints, edges and other corona producing surfaces.

All metal parts shall be of such material and treated in such a way as to avoid rust, corrosion and deterioration due to atmospheric conditions. Ferrous parts shall be hot-dip galvanized.

Bolts, nuts, pins, etc. shall be provided with appropriate locking arrangement such as lock nuts, spring washers, key, etc.

Bearing housing shall be weatherproof with provision for lubrication. The design, however, shall be such as not to require frequent lubrication.

All bearings in the current path shall be shorted by flexible copper conductor of adequate size (minimum – 150 mm2) to allow the specified fault current through it without injury.

The design of linkages and gears be such so as to allow one man to operate the handle with ease for disconnecting switches and earth switch.

4.3.1 Main contacts

The disconnecting switches shall be provided with high pressure current carrying contacts on the hinge/ jaw ends and all contact surfaces shall be silver plated and controlled by powerful springs designed for floating and pressure point contact. The thickness of silver plating should not be less than 25 microns. The contacts shall be accurately machined and self-aligned.

The contacts shall have sufficient area and pressure to withstand the electromagnetic stresses developed during short circuit without excessive heating liable to pitting or welding.

Contacts shall be adjustable to allow for wear, shall be easily replaceable and shall have minimum movable parts and adjustments.

The moving blade shall be made of electrolytic-copper/aluminum tube for center rotating type disconnecting switch. Rotating feature of the blade at the end of tube travel for contact wiping shall be provided.

Arcing horns shall be provided to divert the arc from main contacts to the separating horns after the main contacts have opened. Arcing horns shall be renewable type.

4.3.2 Insulators and Terminals

Insulators shall be post type, brown glazed and solid core single stage type.
The porcelain used for insulators shall be manufactured by wet process and shall be homogenous and free from cavities and other flaws.

Caps and pins shall be of the highest quality malleable iron or forged steel and smoothly galvanized.

Arcing horns as required shall be furnished.

All insulators of identical ratings shall be interchangeable.

The terminals of the disconnecting switch shall be provided with terminal connectors.

4.4 Operating Mechanism

4.4.1 Disconnecting Switches

The operating mechanism for 132 kV disconnecting switches shall be motor operated as well as manual operated. The driving motor of the motor operated disconnecting switch shall be suitable for operating on 400/230 V AC supply. The mechanism shall also be equipped with dependable manual operating device for emergency operation when the power operating mechanism is inoperative.

The control shall be such that the disconnecting switch can be opened or closed from local as well as remote. LOCAL/REMOTE selector switch and OPEN/STOP/CLOSE push buttons shall be provided at the local "Mechanism Box" for local electrical operation. The LOCAL/REMOTE selector switch shall be lockable type.

Starters, relays and limit switches shall be provided as required for operation, indication and interlocks. All electrical controls shall be suitable for 110V DC.

The disconnecting switch shall be provided with a minimum number of eight (8) normally closed and eight (8) normally open electrically separated (Voltage free) auxiliary contacts for system interlock in addition to the auxiliary contacts required for its own indication and operational requirements so as to have a trouble free operation of the system. The contacts shall be convertible type so that normally open contact may be converted to normally closed contact and vice-versa at site. The auxiliary contacts shall be suitable for 0.5A, 110V DC inductive breaking duty.

All auxiliary contacts shall be wired up to terminal block in local mechanism box. All auxiliary contacts shall be silver plated and shall have positive wiping action when closing.

The auxiliary contacts shall be adjustable type to suit the following requirements.

a) Signaling of "closed position" shall not take place unless main power contacts have reached a position so that rated normal and short time current can be carried safely.
b) Signaling of "open position" shall not take place unless the main power contacts are at a safe isolating distance.

The operating device, auxiliary switches and all other devices shall be housed in a weatherproof box of sheet steel / aluminum alloy construction. The enclosure protection of the mechanism box shall be IP-55W as per IEC. The thickness of the sheet steel shall be at least 2mm. In the case of aluminum alloy, the operating box shall be of robust design. The box shall have gasket-hinged door with lock and key. The box shall be suitable for fixing on disconnecting switch steel structure. A 4mm thick removable gland plate shall be provided at the bottom of the box for cable entry. The box shall be mounted at a safe working clearance from the live parts of switches. Thermostat-controlled space heater with ON-OFF switches rated 230V, 1 phase, 50Hz shall be provided to prevent condensation within the mechanism box.

4.4.2 Grounding Switches

The grounding switch shall be triple pole manually and gang operated. The mechanism shall be such that one operator alone shall be able to operate without undue effort. Electrical and mechanical interlocking shall be provided for the safe operation of grounding switch.

Where grounding Switches are specified these shall include the complete operating mechanism and auxiliary contacts. The grounding Switches shall form an integral part of the disconnecting switches and shall be mounted on the base frame of the disconnecting switches. Grounding Switches shall be suitable for local operation only. The grounding Switches shall be constructional interlocked with the disconnecting switches so that the grounding Switches can be operated only when disconnecting switches is open and vice versa.

The grounding switch shall be capable of withstanding the electrical and mechanical stresses developed by a short circuit current specified in Appendix. The cross-section of the flexible copper connection between rotating shaft and structure shall be capable to allow specified fault through it without injury but of minimum size 150 mm2.

Arrangement shall be provided to padlock the grounding switch in open and closed positions.

The operating handle shall be such that it can be operated easily from standing height from ground level. Grounding of handle through copper flexible conductor of adequate size shall be provided.

Each grounding switch shall be provided with four (4) normally closed and four (4) normally open contacts for remote indication and interlocking purpose.

All the auxiliary contacts and interlocking coils shall be housed in a mechanism box. The box shall be suitable for fixing on grounding switch steel structure. A 4mm thick removable gland plate shall be provided at the bottom of the box for cable entry.

Auxiliary contacts shall be suitable for 0.5A, 110V DC inductive breaking duty.

The auxiliary coils shall be suitable for 110V DC supply.

4.5 Tests

4.5.1 Routine Tests

On completion each disconnecting switch shall be subjected to following routine tests. As far as practical, the procedure of IEC shall be followed:

a) Construction Inspection
b) Power frequency voltage dry test
c) Measurement of resistance of main circuit
d) Control and secondary wiring check tests
e) Mechanical operation test
f)

4.5.2 Design Tests

The disconnecting switch design tests shall include following:

a) Dielectric tests, including impulse withstand tests
a) Radio interference tests
b) Temperature rise tests
c) Short-time withstand current tests
d) Operating and mechanism endurance test
e) Voltage drop test.

The voltage drop across one complete phase of a switch shall be measured when carrying rated current.

The Bidder shall submit type test report as specified in section-2 of this specification for the disconnecting switch of the offered model along with the bid.

4.5.3 Field Tests

After installation at Site, the disconnecting switches shall be subjected to the following field tests:

a) Construction inspection
b) Measurement of insulation resistance of main and auxiliary circuits
c) Mechanical operation test
d) Measurement of resistance of main contact

4.6 Drawings, Data and Manuals

The General arrangement drawing with Technical leaflets shall be furnished with the Bid.

After award of Contract the successful Bidder shall submit the required number of copies (hard and soft copies) of the following drawings and data for approval of the Employer.

a) Outline dimensional drawings of the equipment showing general arrangement and location of fittings.
b) Transport/shipping dimensions with weights.
c) Foundation and anchor bolt details including loading condition.
d) Assembly drawings for erection at site with part numbers and schedule of materials.
e) Electrical schematic and wiring diagram.
f) Any other relevant drawings and data necessary for erection, operation and maintenance.
g) Instruction manual and data sheets.
h) Any other relevant data, drawing and information necessary for review of the items stated above.
i)

4.7 Spare Parts

For each type of disconnecting switch, the spare parts shall be provided in required quantities as listed in Price Schedule. Further spare parts as recommended by the manufacturer shall also be included in the Price Schedule.

APPENDIX 4-1: Technical Particulars of Disconnecting Switch With & Without Grounding Switch

S. No.	Description	Disconnecting switch 132 kV
1.	Type	3-poles, center break
2.	Rated Voltage	132 kV
3.	Frequency	50 Hz
4.	Insulation levels	
	a) Basic impulse level (BIL)	650 kV (crest)
	b) Power frequency withstand voltage (For1 minute)	275 kV (rms)
5.	Current ratings	
	a) Continuous current	1250/2000 A
	b) Rated Short Time current (1 sec.)	40 kA
6.	Operating mechanism of disconnecting switch	Motor operated (both local and remote operation) and manual
7.	Auxiliary power supply	
	a) Space heater and cubicle	230V,1-phase, 50Hz
	b) Control circuit	110 V DC
	c) Operating motor	230/400 V, 50 Hz
8.	Applicable standard	IEC
9.	Enclosure Protection	IP-55W
10.	Creepage distance	3625mm (min)

Chapter 5: Instrument transformer

5.1 General

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation, field test and commissioning of outdoor and indoor instrument transformers as specified herein under.

The equipment specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular:

IEC 60044	Voltage transformers
IEC 60044	Instrument transformers
IEC 60529	Degree of protection provided by enclosures
IEC 60186	Capacitive Voltage transformers

5.2 Design Requirements

Instrument transformers shall be suitable for 50Hz, 3 phases with solidly grounded neutral system.

Instrument transformers shall be installed outdoor/indoor in a hot and humid climate. All equipment and accessories shall be provided with tropical finish to prevent fungus growth.

Capacitor voltage transformers shall be provided with accessories suitable for carrier equipment.

Technical particulars of instrument transformers shall be as per Appendices.

Burden of the instrument transformers stated herein is the minimum value required. Where higher burden is required to suit the designs, the Contractor shall supply the same without additional cost.

The instrument transformers shall be complete with its terminal box and a common marshalling box for a set of 3 instrument transformers. The common marshalling box shall be supplied along with instrument transformer.

The external surface of instrument transformer, if made of steel, shall be hot dip galvanized or painted.

5.3 Construction Features

5.3.1 General

The instrument transformers of 132 kV voltage level shall be oil-filled construction and shall be designed for outdoor service and suitable for outdoor service and vertical mounting on steel structures.

The core and coils of current transformer shall be mounted in a steel tank on the top of the unit with the primary coil leads extending through insulated bushings for series or multiple connections. A steel base shall support the high voltage bushing and tank. The high voltage bushing shall be sealed to the tank and the base with oil-tight joints.

Instruments transformers shall be hermetically sealed units. Bidder/ Manufacturer shall furnish details of the arrangements made for the sealing of instrument transformers during detailed engineering.

The capacitor voltage transformers shall be of high Capacitance with two nominal voltage outputs of $110/\sqrt{3}$ volts each. They must be suitable for revenue metering and protection system.

The primary terminals of instruments shall include provisions for externally connecting the primary winding. The secondary terminals shall be enclosed in a weatherproof terminal box.

Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.

Porcelain bushings shall have adequate mechanical and electrical strength. The color of porcelain shall be brown. It shall be in one piece without any metallic flange joint.

5.3.2 Junction Boxes

Junction boxes shall be rigid weatherproof type complete with terminal blocks suitable for cable size having the range up to 2 x 6 mm^2 for termination of the secondary connections (such as delta or wye connection). They shall be made of metal, which will resist corrosion on both inside, and outside surfaces, otherwise galvanizing shall suitably protect them. Cover of the junction box shall be of hinge door type complete with door handle. Two drainage holes shall be provided at the bottom of the junction box. In case the junction boxes are steel sheet, the thickness of such steel sheet shall be at least 1.2 mm. Junction boxes shall be sized and arranged to provide easy access for external cables and adequate space for internal wiring and installed equipment. Enclosure protection class of the junction boxes shall be IP55W.

5.3.3 Insulating Oil

Insulating oil to be used for instrument transformers shall be of EHV grade and shall conform to IS-335 / IEC - 60296 (required for first filling).

5.3.4 Terminations

a) Current Transformers

All current transformer secondary-winding terminals for each ratio shall be connected to terminals on terminal blocks located in the junction boxes.

b) Capacitive Voltage Transformer/ Voltage Transformer

All CVTs' secondary terminals (for each core) shall be connected to terminals for each ratio on terminal blocks located in the junction boxes.

5.3.5 Accessories

The following items shall be provided for each instrument transformer:

a) Nameplate
b) Oil level gauge

c) Oil valves or plugs
d) Power factor test terminals
e) Necessary terminal connections
f) Grounding terminals
g) Other necessary accessories

5.4 Tests

Test shall be performed as specified hereunder.

5.4.1 Current transformer

Routine tests

Each current transformer shall be subjected to following routine tests. As far as practical, the procedure of IEC shall be followed:

- Construction Inspection
- Verification of terminal markings
- Power frequency withstand test (primary & secondary)
- Partial discharge measurement
- Power frequency withstand test between sections of primary & secondary windings
- Inter turn over voltage test
- Determination of errors
- Ratio Test
- Accuracy Test

Design tests

The current transformer design tests shall include following:

- Short time current tests
- Temperature rise test
- Power frequency withstand voltage (wet) tests
- Lightning impulse withstand tests
- Switching impulse withstand tests
- Radio interference voltage measurement test

5.4.2 Capacitor Voltage Transformer

Routine Tests

Each capacitive voltage transformer shall be subjected to following routine tests. As far as practical, the procedure of IEC shall be followed:

- Construction Inspection
- Capacitance and dissipation factor measurement of the capacitor divider before and after power frequency withstand voltage (dry) test
- Power frequency withstand voltage (dry) test for capacitor divider
- Dielectric tests for electromagnetic unit
- Ratio Test
- Accuracy tests

- Polarity check
- Applied and Induced over voltage test, etc.

Design Tests

The capacitive voltage transformer design tests shall include following:

- Lightning Impulse tests
- Switching Impulse test
- Ferro-resonance tests
- Temperature rise tests
- Measurement of radio interference voltage

5.4.3 Inductive Voltage Transformer

Routine Tests

Each voltage transformer shall be subjected to following routine tests. As far as practical, the procedure of IEC shall be followed:

- Construction Inspection
- Verification of terminal marking
- Power frequency withstand test on primary winding
- Partial discharge measurement
- Power frequency withstand test on secondary winding
- Power frequency withstand test on between sections
- Ratio Test
- Determination of error

Design Tests

The inductive voltage transformer design tests shall include following:

- Temperature rise test
- Short circuit withstand capability test
- Lightning impulse test
- Switching impulse test
- Measurement of the radio interference voltage

5.4.4 Field Tests

After installation at site, all instrument transformers shall be subjected but not limited to the following tests:

a. Construction inspection
b. Polarity check
c. Ratio test
d. Measurement of insulation resistance

The Bidder shall submit type test report as specified in section-2 of this specification for the instrument transformers of the offered model along with the bid.

5.5 Drawings, Data and Manuals

The outline dimensional drawings of the equipment shall be furnished with the Bid.

After award of Contract the successful Bidder shall submit the required number of copies (hard and soft) of the following drawings for approval of the Employer/ the Employer's representative.

a) Outline dimensional drawings of the equipment
b) Transport/shipping dimensions with weights
c) Foundation and anchor bolt details
d) Characteristic and performance data including ratings, ratio and phase angle curves, accuracy for standard burdens, and thermal burden ratings
e) Instruction books including technical description and complete information for installation, testing, operation and maintenance with renewal parts data
f) Any other relevant drawings and data necessary for review of the items stated above.

APPENDIX 5-1: Technical Particulars of Capacitor Voltage Transformers for 132 kV

S.N.	Type	Outdoor, oil immersed for protection and metering.
1.	Rated primary voltage	132kV
2.	Max. system voltage	145 kV
3.	Impulse withstand voltage	650 kV (crest)
4.	Power frequency withstand voltage (1min,rms)	275kV(rms)
5.	Rated frequency	50Hz
6.	Connection	Line to ground
7.	Number of secondary winding	3
8.	Voltage ratio	132/√3/0.11/√3/0.11/√3 kV
9.	Rated burden	50 VA
10.	Accuracy class	3P and 0.2 for metering
11.	Rated voltage factor	1.1 Continuous
12.	Creepage distance	3,625 mm (min)
13.	Applicable standard	IEC 60186

APPENDIX 5-2: Technical Particulars of 132 kV Current Transformer

S.N.	Type	Outdoor, oil immersed for protection and metering.
1. 2.	Rated primary voltage	132 kV
2. 3.	Maximum system voltage	145 kV
3. 4.	Impulse withstand voltage	650 kV (crest)
4.	Power frequency withstand voltage (1min,rms)	275kV(rms)
5.	Rated frequency	50 Hz
6. 6.	Number of core	5
7. 7.	Short time thermal ratings	40 kA
8. 8.	Current ratio	*1200-600-300/1A*
9. 9.	Rated burden for each core	30 VA
10. 10.	Accuracy class	Class PS for protection and 0.2 for metering
11. 11.	Creepage distance	3,625 mm (min)
12. 12.	Applicable standard	IEC 60044-1

Chapter 6: Lightning Arrester

6.1 General

This specification covers the design, manufacture, factory test, delivery, installation, field test and commissioning of lightning arresters, complete with all accessories. The equipment specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular:

IEC 60099-4	Metal-oxide Surge arrester without gap for a.c. system
IEC 60099-5	Surge arrester - Selection and application recommendations
IEC 60529	Degree of protection provided by enclosures

6.2 Design Requirements

The lightning arresters shall be of heavy duty station class and gapless type without any series or shunt gaps.

The lightning arresters shall be suitable for a nominal system of 3 phase, 50Hz solidly grounded system. Lightning arresters shall be provided at entry points of the overhead transmission lines and both HV & LV sides of the transformers.

The lightning arresters shall be capable of discharging over-voltages occurring during switching of unloaded transformers, reactors and long lines.

The lightning arresters shall be station type / transformer-tank-mounted, gap less metal oxide type of rated voltage of 120 kV for 132 kV systems. The nominal discharge current shall not be less than 10 kA. The selection of Lightning arrester shall be done by the contractor based on insulation co-ordination study without any additional cost to the Employer.

145 kV class arrester shall be capable for discharging energy equivalent to class 3 of IEC for 145 kV systems on two successive operations.

The active part of the lightning arresters shall be accommodated in single stacked porcelain insulators, which are suitably reinforced to prevent explosion of an arrester.

The lightning arresters shall be preferably mounted on galvanized steel structure. Terminal connectors for both line and ground terminals shall be furnished.

Surge monitoring device consisting of surge counter, leakage current measuring instrument etc., along with insulating bases for mounting at the bottom of the arrester, shall be furnished.

The duty cycle of CB installed in 132 kV System shall be O-0.3 sec-CO-3 min-CO. The lightning Arrester shall be suitable for such circuit breaker duties in the system.

The technical features of the lightning arresters are given in Appendix.

6.3 Constructional Features

The features and constructional details of surge arresters shall be in accordance with requirement stipulated hereunder:

a) The non-linear blocks shall be of sintered metal oxide material. These shall be provided in such a way as to obtain robust construction, with excellent mechanical and electrical properties even after repeated operations.

b) The surge arresters shall be fitted with pressure relief devices suitable for preventing shattering of porcelain housing and providing path for flow of rated fault currents in the event of arrester failure. Details shall be furnished in the bids along with quality checks.

c) The outer insulator housing shall be so coordinated that external flashover will not occur due to application of any impulse or switching surge voltage up-to the maximum design value for arrester.

d) The end fittings shall be made of corrosion proof material and preferably be nonmagnetic.

e) The name plate shall conform to the requirements of IEC incorporating the year of manufacture.

f) The manufacturer will submit Data for rejection rate of ZnO blocks during manufacturing/operation for the past three years.

g) The arrester shall not fail due to arrester porcelain contamination.

h) Seals shall be provided in such a way that these are always effectively maintained even when discharging rated lightning current.

6.4 Fittings and Accessories

120 kV Arresters shall be complete with insulating base having provision for bolting to flat surface of structure.

Self-contained discharge counters, suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation shall be provided for each single pole unit along with necessary connection. Suitable leakage current meters should also be provided. The reading of milli ammeter and counters shall be visible through an inspection glass panel. The terminals shall be robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends.

Surge monitor consisting of discharge counters and milli ammeters should be suitable to be mounted on support structure of the arrester and should be tested for IP66 degree of protection. The standard supporting structure for Lightning arrester should be provided with a mounting pad, for fixing the surge monitor. The surge monitor should be suitable for mounting on this standard mounting pad. Also all nuts, bolts, washers etc. required for fixing the surge monitor shall have to be supplied by the Contractor.

The arrangement for Surge Monitor enclosure fixing to the structure shall be at its rear/bottom. Connection between the Surge Arrester base and Surge Monitor shall be through a 2.0 m (minimum) long insulated copper rod/strip of at least 75 sq.mm cross sectional area. The cable shall be terminated at rear/bottom side of the Surge Monitor. The gaskets of the surge monitors shall be of Neoprene, Butyl or equivalent material.

Grading/corona rings shall be provided on each complete arrester unit as required. Suitable terminal connectors shall be supplied by the Contractor.

6.5 Tests

6.5.1 Routine Test

Each lightning arrester switch shall be subjected to following routine tests. As far as practical, the procedure of IEC shall be followed:

c) Construction inspection
d) Measurement of reference voltage
e) Residual voltage test
f) Internal partial discharge test.

6.5.2 Design Test

The lightning arrester design tests shall include following:

a) Insulation withstand test
b) Residual voltage test
c) Long duration current impulse test
d) Operating duty cycle test
e) Artificial pollution test

The Bidder shall submit type test report as specified in section-2 of this specification for the Lightning arrester of the offered model along with the bid.

6.5.3 Pre-Commissioning Tests

An indicative list of tests is given below.

a) Operation checks of LA counter.
b) Insulation resistance measurement
c) Capacitance and Tan delta measurement of individual stacks.

Contractor shall perform any additional test based on specialties of the items as per the field Q.P./Instructions of the equipment Supplier or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

6.6 Drawings and Data

The following documents shall be furnished along with the bid:

a) Standard catalogue identifying the models and ratings being furnished
b) Outline drawings including dimensions

The following drawings and data shall be furnished in required number of copies after award of Contract for approval of Employer:

a) Outline drawings including dimensions

b) Foundation and anchor details including dead load
c) Transport/shipping dimensions with weight
d) Any other relevant data, drawings and information

6.7 Name Plate

Each lightning arrester shall be provided with a nameplate of weather resistant material fitted in a visible position showing the following items as a minimum:

a) Manufacturer's name
b) Manufacturer's serial number and type designation
c) Year of manufacture
d) Rated voltage
e) Nominal discharge current

APPENDIX 6-1: Technical Particulars of 132 kV Lightning Arrester

S. No.	Description	Technical Particulars
1.	Type	Gap less, Metal –oxide, Outdoor
2.	Mounting	Pedestal mounted
3.	Rated frequency	50Hz
4.	System voltage	132 kV
5.	Rated voltage	120 kV
6.	Impulse withstand voltage (BIL)	650 kV (crest)
7.	Power frequency withstand voltage	275 kV (rms)
8.	Nominal discharge current of 8/20 micro second wave shape	10 kA
9.	Degree of Protection	IP 55
10.	Line discharge class	Class-3
11.	Max. Steep current impulse residual voltage at 10 kA (kVp)	380
12.	Max. Lightening Impulse residual voltage at 10 kA (kVp)	330
13.	Max. switching surge residual voltage at 1 kA (kVp)	280
14.	Partial discharge at 1.05 COV not greater than	50pC
15.	Max. discharge capability corresponding to rated voltage	5Kj/kV
16.	Low current long duration test value	2400µs
17.	High current short duration test value (4/10 µ second wave)	100kA
18.	Minimum Corona Extinction Voltage (kVrms)	105
19.	. Creepage distance (mm)	3625
20.	Prospective symmetrical fault current for pressure relief test for (0.2 sec) kA	40
21.	Applicable Standard	IEC 60099-4

Chapter 7: Battery and Battery Charger

7.1 General

This specification covers design; manufacture, assembly factory test, supply, delivery, installation, field test and commissioning of a stationary battery or batteries each complete with battery charger, distribution board and control gear.

One set of batteries and one set of battery charger shall be provided for the following voltage level. Regarding Battery and Battery Charger of 48V DC will be shared with existing Battery Charger and Batteries installed in the Substation. The operation shall be such that each set of battery shall be connected with two sets of chargers, out of which one set shall be for main supply and the other as a backup.

- 110 V DC shall be used for protection and control
- 48 V DC shall be used for communication/SCADA system.

It shall be ensured that the 110 V power supply system operates with both battery terminals free of earth, whilst that for communications, 48 V DC system with positive earthed, to detect faults on both the positive and negative poles.

7.2 Batteries

The Contractor shall offer maintenance free valve regulated lead-acid 110 V batteries. The batteries shall be assembled in heavy-duty-steel structure designed for easy stack ability.

The battery cells shall be hermetically sealed, sturdy, weather proof and long lasting. The safety valves, if provided shall be explosion free. All the cells shall be mounted on racks of plastic-covered steel. More than 2 levels shall not be permitted. If the batteries are located together in two rows, provide enough space for maintenance access along the two long sides.

The arrangement of the rack shall be such as to allow easy access and adequate space for normal maintenance in battery room.

All battery stands shall be suitably protected against corrosion and attack by the battery electrolyte. Inter-cell connections shall be made of low resistance in a clean condition when bolted and protected against corrosion.

Battery banks shall be protected by appropriate fuses.
The lowest rack for accommodating battery cells shall be at a minimum of 30 cm above ground level.

Bidder shall select number of cells, float and Boost voltage to achieve following system requirement:

System Voltage	Maximum Voltage during Float operation	Minimum voltage available when no charger working and battery fully discharged up to 1.85V per cell.	Minimum Nos of cell
110 Volt	121 Volt	99 Volt	54

7.3 Battery Capacity Sizing

7.3.1 110V DC Battery

Battery nominal capacity shall be not less than 600/2 AH. The nominal voltage of the battery at its terminal shall be 110 V. At the end of the rated discharge period of 10 hours, the voltage available at the battery terminals shall be not less than the minimum 94 V. Batteries shall be suitable for operation on a floating charge system and capable of providing the guaranteed output throughout the range of ambient conditions specified. The battery rated output shall be available at the outgoing terminals, after making due allowance for the resistance of inter cell connections.

7.4 Battery Charging Equipment

The chargers shall be of the automatic constant voltage output type designed for float charge operation. They shall be suitable for operation from the 400 V ± 10% ac supply, 50 Hz.

The chargers for communications batteries shall be such that the phosphometric noise level does not exceed the equivalent of 2 milli-volts at a frequency of 800 Hz after weighing in accordance with CCIF, the charger output being at any point within its rating with the battery connected.

The DC output of each main charger unit shall remain within the limits of +3% and -2% under any of the following conditions:

a) System frequency between ±5% of the nominal value;
b) System rated voltage input ± 10%
c) Output of charger between 5% and 100% of rated output.

The constant voltage charge level on a cell shall be 2.25 V or any other value recommended by the offered battery manufacturer. The Battery charger output rating shall be 80 A for 110 V charger.

The equalizing and float voltage levels shall be adjustable and suitable for the range of operating conditions recommended by the battery manufacturer.

The static direct voltage variation shall be maintained as specified over an ambient temperature range of 0-40^{o}C.

The end switching / dropper diodes, if required, to limit equipment over voltage during equalizing charge shall be provided.

A voltmeter and charge and load ammeters on the front of the charger panels shall be provided. Provisions of AC and DC, under voltage and DC earth fault alarms with local indication (LED type indicator lamp) and separate electrically isolated contacts shall be made in the control panel.

The charger shall be equipped with automatic switch to transfer from the floating voltage to the equalizing voltage under the following conditions:

- When the voltage of the connected battery reaches the minimum prescribed value for a time longer than one minute.
- Every 30 days.

A manual override switch for selection of float charge and equalizing charge for test purposes shall also be provided.
An adjustable timer (6-24 hours) to determine the length of time the equalizing voltage shall be provided.

The AC component through the battery of the delivered DC shall not exceed 1 A rms per 50 Ah of battery capacity. The superimposed alternating voltage component shall not exceed 2% of the peak values during continuous charge operation. This applies for the entire frequency range.

The connection blocks for the connection of cables shall be of a minimum of 16 sq. mm. or as required as per voltage drop calculation.

The float charging voltage shall be between 2.1 to 2.25 volts per cell or at any other voltage recommended by the battery manufacturer. The battery charger shall have boost facility.

The boost-charging voltage shall be about 2.3 to 2.4 volts/cell or at any other voltage recommended by the battery manufacturer.

The equipment shall be designed to facilitate cable entry from bottom. Removable plates shall be furnished with compression type cable glands to make entry dust tight and no weight is transferred on the terminal. The glands shall be suitable for terminating cable armor. Compression type cable lugs as required shall be furnished for termination of power and control cables.

Sufficient space shall be provided to avoid sharp bending and for easy connection. A minimum space of 200 mm from the gland plate to the nearest terminal block shall be provided.

Terminal blocks shall be as specified in General Technical Requirements. A copper ground bus of 25mm x 6mm cross section shall be furnished near the bottom of panels and shall be connected to the station earthing mat with appropriate copper conductor. All devices shall be grounded to this ground bus.

All indicating instruments, control switches and indicating lamps shall be mounted on the front side of the Charger.

Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks and ready for external connections. The control wiring shall be carried out with PVC insulated, 1.5 sq.mm. stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5 sq.mm stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 20% spare terminals shall be provided for control circuits.

The insulation of all circuits, except the low voltage electronic circuits shall withstand test voltage of 2 KV AC for one minute.

The following accessories shall be furnished for the batteries:

a) one (1) connector bolt wrench
b) one (1) cell testing voltmeter with leads
c) Battery racks.

The charger shall be complete with the standard accessories including but not limited to the following.

a) Solid state surge protectors on the AC and DC sides.
b) AC failure alarm relay.
c) DC time delay low voltage relay.
d) Ground detection alarm for positive and negative leads.
e) Manual voltage adjust switch.
f) DC ammeter and voltmeter.

7.5 Annunciation System

Audio-visual indications through bright LEDs shall be provided in all Chargers for the following abnormalities:

a) AC power failure
b) Rectifier/chargers fuse blown.
c) Over voltage across the battery when boost charging.
d) Abnormal voltage (High/Low)

Any other annunciation if required. Potential free NO Contacts of above abnormal conditions shall also be provided for common remote indication "CHARGER TROUBLE" in for future use. Indication for charger in float mode and boost mode through indication lamps shall be provided for chargers. A potential free contact for float/boost mode shall be provided for external interlocks.

7.6 Tests

Type and routine tests at manufacturers' works and acceptance test at site shall be carried out on the battery/battery chargers as per stipulations of latest standard of IEC.

The tests shall include the following:

a) General inspection.
b) Leakage test and internal short test for each cell.

After initial charging, the following tests shall be performed at site:

a) Capacity test.
b) Efficiency test, etc.

The battery charger shall be subjected to the following tests at manufacturer's works:

a) Construction Inspection
b) Measurement on insulation resistance.
c) High voltage test.
d) Performance test.
e) Temperature rise test.

Test certificates shall be submitted to the Employer for approval.

7.7 Drawing, Data and Manuals

Technical leaflets on battery and battery charger shall be furnished with the Bid:

The following drawings and manuals shall be submitted by the successful Bidder for approval:

a) Dimensional layout arrangement of battery and battery charger.
b) Dimensional outline drawing of battery charger panel clearly showing the location of meters, switches etc.
c) Schematic and wiring diagram of battery charger panel.
d) Instruction manuals of battery and battery charger.
e) Battery and battery charger sizing calculation.
f) Discharge data for 10 hour, 8 hour, 3 hour, 2 hour, 1 hour, 15 minute and one minute indicating capacity factors for end cell voltage of 1.75V & 1.85V.

Chapter 8: Grounding and Lightning Protection System

8.1 General

This specification covers the design, supply, delivery, installation and testing of the complete grounding system as described below.

The complete station grounding work shall be in accordance with the recommendation in the "Guide for Safety in Substation Grounding" IEEE No. 80 and the requirements of this section.

8.2 Design Requirements

Dhugesaghu substation lies in hilly terrain at an altitude of and 1355 m above Mean Sea Level respectively. It seems stable. After award of contract the Contractor shall conduct necessary soil investigation including soil resistivity on his own and calculate the total length of buried ground conductor, number of grounding electrode and their depth and spacing to achieve a grounding system resistance of less than 1.0 (One) Ohm.

The Contractor shall calculate the cross-section considering the maximum fault level of 40 kA.

The Contractor shall submit the details of calculations of the grounding system for the Employer's approval.

8.3 Grounding Conductor

8.3.1 Main Ground Grid

The main ground system shall consist of a grounding grid buried minimum 0.8 meter below grade level. The grounding grid shall consist of minimum 25 x 4 mm copper flat conductor cable or minimum 120 sq.mm stranded copper wire.

8.3.2 Ground Electrodes

The ground electrodes shall be of minimum 16 mm diameter and 3.0-meter-long (min.) copper clad steel. These shall be driven into ground and connected to the main ground grid.

8.3.3 Risers

The risers shall consist of copper conductor of adequate size (but not less than 120 $mm^{2)}$ connected at one end to the main ground mat and at the other end to the equipment.

8.4 Grounding Installation Features

The grounding installation shall be complete in all respects for efficient and trouble free service. All work shall be carried out in a good quality neat workman like manner. Grounding conductors shall be handled carefully to avoid kinking and cutting of the conductors during laying and installation. All exposed ground conductors runs shall be taken in a neat manner, horizontal, vertical and parallel to building walls, foundations or columns and shall not be laid haphazardly.

For all connections made to equipment or to the structures, the grounding conductor, connectors and equipment enclosures shall have good clean contact surfaces. Grounding conductor connection to all electrical equipment, switchgear, transformers, motors, panels, conduit system, equipment enclosures, cable trays, distribution boards, equipment frames, bases, steel structure, etc. shall be by pressure type or bolting type connectors.

All lap, cross and tee connections between two grounding conductors shall be made by thermo-welding process or compression type connector. The various joints shall have adequate mechanical strength as well as necessary electrical conductivity not less than that of the parent conductors of the joints. All accessories for grounding installation shall be of quality and design approved by the Employer.

Ground conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 300mm below the bottom elevation of such trenches/pipes.

The maximum size of each grid of grounding mat shall not exceed 4X4 meters. The terminals for connecting ground mat and equipment shall be terminated whenever necessary.

Neutral points of systems of different voltages, metallic enclosures and frame works associated with all equipments and extraneous metal works associated with electric system shall be connected to a single earthing system.

Earthing conductors or leads along their run on cable trench, ladder, walls etc. shall be supported by suitable welding/cleating at intervals of 750 mm. Wherever it passes through walls, floors etc., galvanized iron sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.

Earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500 mm away from such location.

Earthing conductors crossing the road shall be laid 300 mm below road or at greater depth to suit the site conditions.

Earthing conductors embedded in the concrete shall have approximately 50 mm concrete cover

8.4.1 Equipment and Structure Earthing

Earthing pads shall be provided for the apparatus/equipment at accessible position. The connection between earthing pads and the earthing grid shall be made by two short earthing leads (one direct and another through the support structure) free from kinks and splices.

Whether specifically shown in drawings or not, steel/RCC columns, metallic stairs etc. shall be connected to the nearby earthing grid conductor by two earthing leads. Electrical continuity shall be ensured by bonding different sections of hand-rails and metallic stairs.

Metallic pipes, conduits and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections,

beginning points shall also be connected to earthing system. Metallic conduits shall not be used as earth continuity conductor.

Light poles, junction boxes on the poles, cable and cable boxes/glands, lockout switches etc. shall be connected to the earthing conductor running along with the supply cable which in turn shall be connected to earthing grid conductor at a minimum two points whether specifically shown or not.

Earthing conductor shall be buried 2000 mm outside the switchyard fence. All the gates and every alternate post of the fence shall be connected to earthing grid.

Flexible earthing connectors shall be provided for the moving parts.

All lighting panels, junction boxes, receptacles fixtures, conduits etc. shall be grounded.

8.4.2 Jointing

Earthing connections with equipment earthing pads shall be bolted type. Contact surfaces shall be free from scale, paint, enamel, grease, rust or dirt wherever possible. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint/compound.

Connection between equipment earthing lead and main earthing conductors and between main earthing conductors shall be welded type.

Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingression.

Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.

8.4.3 Power Cable Earthing

Metallic sheaths and armor of all multi core power cables shall be earthed at both equipment and switchgear end. Sheath and armor of single core power cables shall be earthed at switchgear end only.

8.4.4 Specific Requirement for Earthing Systems

Each earthing lead from the neutral of the transformer shall be directly connected to two pipe electrodes in treated earth pit (as per IS) which in turn, shall be buried in Cement Concrete pit with a cast iron cover hinged to a cast iron frame to have an access to the joints. All accessories associated with transformer like cooling banks, radiators etc. shall be connected to the earthing grid at minimum two points.

Earthing terminal of each lightning arrester & capacitor voltage transformer shall be directly connected to rod earth electrode which in turn, shall be connected to station earthing grid.

Auxiliary earthing mat comprising of 16 mm dia copper rods closely spaced (300 mm x 300 mm) conductors shall be provided at depth of 300mm from ground level below the operating handles of the M.O.M. Box of the disconnecting switches. M.O.M. boxes shall be directly connected to the auxiliary earthing mat.

8.5 Lightning Protection

The outdoor equipment of the substation and the buildings shall be protected against direct stroke lightning.

Direct stroke lightning protection (DSLP) shall be provided by lightning masts of adequate number and height. If required separate direct stroke lightning protection system shall be provided for the buildings.

The lightning protection may also be achieved by an overhead lightning shield system of galvanized steel wire of 7/3.35 mm, which shall be connected to the main grounding grid by steel conductor of 7/3.35 mm.

The design of the lightning protection system shall be subject to the approval of the Employer.

The lightning protection system shall not be in direct contact with underground metallic service ducts and cables etc. Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.

Down conductors shall be cleated on the structures at 2000 mm interval

Connection between each down conductor and rod electrodes shall be made via test joint (pad type compression clamp) located approximately 1500 mm above ground level. The rod electrode shall be further joined with the main earth-mat.

Lightning conductors shall not pass through or run inside G.I. conduits.

8.6 Tests

On completion of the installation, either wholly or in sections, it shall be tested in compliance with relevant Code by the Contractor in presence of the Employer. The cost of any test including labor, material and equipment charges shall be borne by the Contractor. If the ground grid resistance cannot be obtained as per his design, then additional grounding conductors shall be buried in the earth, or if necessary, buried in treated soil to obtain the required low ground resistance without any additional cost.

8.7 Drawings

After award of the Contract, the Contractor shall furnish the grounding layout drawing with dimensions showing the location of grounding grids, electrodes, test link chambers and risers, backed up by necessary calculations for Employer's approval. Also calculation for direct stroke lightning protection (DSLP) shall be submitted with required numbers of lightning mast tower of required height for Employer's approval. The work shall have to be started at site only after getting approval from the Employer. If alteration is required for any work done before getting Employer's approval, the same shall have to be done by the Contractor at no extra cost to the Employer.

APPENDIX 8-1: Sizes of Grounding Conductors

Sl. No.	Item	Size	Material
a)	Main Earthing Conductor to be buried in ground	25x4 mm or 120 mm^2	Copper flat Stranded Copper wire
b)	Conductor above ground & earthing leads (for equipment)	≥120 sq.mm	Copper conductor
c)	Conductor above ground& earthing leads (for columns & aux. structures)	≥120 sq.mm	Copper conductor
d)	Earthing of indoor LT panels, Control panels and outdoor marshalling boxes, MOM boxes, Junction boxes& Lighting Panels etc.	≥120 sq.mm	Copper conductor
e)	Rod Earth Electrode	16mm dia, 3000mm long	Copper Clad Steel
f)	Pipe Earth Electrode (in treated earth pit) as per IS.	16mm dia, 3000mm long	Copper Clad Steel
g)	Earthing for motors	16mm dia, 3000mm long	Copper Clad Steel
h)	Earthing conductor along outdoor cable trenches	16mm dia, 3000mm long	Copper Clad Steel
I)	Earthing of Lighting Poles	16 mm dia 3000 mm long	Copper Clad Steel

Chapter 9: Illumination System

9.1 General

This chapter covers the scope and general description of the design, supply, installation, testing and commissioning of illumination system, which shall be incorporated and coordinated during the substation construction works. Illumination system design shall be submitted for approval of the Employer.

The explanations and listings hereinafter are intended to give a general requirement of the illumination design and installation and shall not be construed to be an itemized listing of each element of works required. The Bidder shall be responsible for design and installation of complete facilities, conforming in all respects to the relevant standards and to the details and requirements of the specifications.

9.2 System Description

The lighting system shall comprise of the following:

A. AC Normal Lighting

AC lights will be connected to AC lighting panels. All the lights connected to the AC lighting system in different areas will be connected to the main lighting distribution boards.

B. DC Emergency Lighting

A few DC emergency lighting fixtures operated on the 110 V DC system will be provided in the strategic locations including, outdoor substation, Battery charger room, control room, 11 kV switchgear room, communication room so that the operating personnel can safely find their way even during emergency of a total AC failure. These lights will be normally 'OFF' and will be switched 'ON' automatically when under voltage occurs in the AC lighting panel. Down light fixtures in false ceiling area and Bulkhead fixtures in non-false ceiling area shall be used. Control board shall be equipped with necessary contactors and timers to control number of lighting fixtures in gang. Details shall be worked out to the satisfactory to the employer.

C. Portable Emergency Lighting

Three (3) numbers of self-contained battery operated, portable emergency lights will be provided in the Control Building. These fixtures will be provided at important locations after approval by the Employer.

9.2.1 Illumination Level

Following illumination (lux) levels shall be maintained at different areas:

Sr. No.	Area	Average Lux Level (lx)
1.	11 kV Switchgear Room	200
2.	Control Room / Communication Room / Office Room	350

Sr. No.	Area	Average Lux Level (lx)
3.	Battery Room	150
4.	Street Lighting	20
5.	Outdoor Substation & Transformer Area	50
6.	Store	100

The minimum lux level to average lux level ratio should not be less than 0.6 times of average lux level specified (i.e $E_{min}/E_{av} > 0.6$). The maintenance factor for indoor illumination design shall be considered as 0.8. The surface reflectance for ceiling/wall/floor shall be 50/30/10.

Lighting in all indoor areas shall be done by CFL & fluorescent energy efficient based low power consumption luminaries and HPSV type for outdoor areas to achieve desired lux level specified.

9.3 Description of Works

The illumination works shall consist of outdoor substation lighting, control building lighting and roads lighting, lighting for gate post etc. All lighting fixtures shall energy efficient type.

9.3.1 Outdoor Substation Lighting

The outdoor substation lighting shall consist of lighting of the area covered by substation equipment, access road, and substation compound lighting.

Substation outdoor equipment and area lighting

Lighting fixture shall be of outdoor, flood light type, symmetrical beam spread of not less than 2x30° with built-in ballast. The housing shall be die cast aluminium and the reflector shall be high-grade aluminium. A cast aluminium doorframe shall be designed for easy replacement of lamp. The front glass shall be heat & shock resistance with the gasket for jet proof and dust proof sealing.

The lamps shall be of sodium vapour, 400/250 watts, 230 volts and shall have minimum luminous flux of 20,000 lumens with 16,000-hour service life.

The ballast shall be high efficiency electronic type and shall be used with 400/250 watts lamp, 230 volts, 50 hertz. The ballast shall be electrically designed to ensure very low operating temperature and low wattage losses.

The wiring cable shall be of armoured single core, directly burial and shall be installed underground or laid in the cable trench except those rising along the steel structures shall be run in conduits.

Access Road Lighting

Street lighting of sub-station shall be done by "solar photovoltaic street lighting system (SLS)" to achieve the desired lux level specified. Solar lighting system consists of solar photovoltaic (SPV) module, a luminaire, storage battery, control electronics inter-connecting wires/ cables, module mounted pole including hardware and battery box.

The luminaire is based on CFL or HPSV.

In addition to Solar lighting, all street lighting shall also be connected with normal lighting power supply system. A suitable changeover arrangement shall be provided in each street pole to switchover to normal lighting in case of prolonged outage of solar grid.

Substation Compound Lighting

Lighting Fixtures shall be outdoor, post top, bottom support with built in ballast. The electrical unit shall be made of high-pressure die cast aluminium with non-corrosive finish and shall contain a ballast, capacitor and lamp holder. The diffusing bowl shall be conical and shall consist of spun aluminium canopy and white opal diffuser. The diffuser shall be vandal-proof and shall be ultra violet radiation and heat resistance. The fixture shall be rainproof and insect tight. All metal parts shall be made of non-corrosive material.

The lamp shall be of sodium vapour, 250 watts, 230 volts and shall have minimum luminous flux of 11,000 lumens with 16,000 hour service life.

The ballast shall be of high efficiency electronic type and shall be used with 250 watts lamp, 230 volts, 50 hertz. The ballast shall be electrically designed to ensure very low operating temperature and low wattage losses.

The wiring cable shall be of armored single core, directly buried and shall be installed underground or laid in the cable trench except those rising along the steel structures shall be run in conduits.

Building (Indoor) Lighting

Unless described herein, the control building lighting design shall conform to Illuminating Engineering Society, National Electrical Code and National Electrical Manufactures Association Standard.

All normal lighting fixtures of control building shall be of CFL type with granulated acrylic diffuser complete with all accessories. All lighting fixtures installed on the ceiling covered by false ceiling shall be recessed. Lighting fixtures shall conform to the Standard for Electric Lighting Fixtures or other internationally accepted standards.

9.4 Lighting Panels

The lighting panel shall conform to NEMA Standard requirements. All over-current protective devices shall be Moulded Case Circuit Breaker (MCCB) or Miniature Circuit Breakers (MCB).

The outdoor control panel shall be galvanized or enamel painted steel cabinet, outdoor type. The over current protective devices shall be of MCCB or MCB. The ON-OFF operation of outdoor lighting shall be both manual and automatic control (with photo-switch). The arrangement of lighting branch circuits shall be reliable and easy maintenance.

Constructional Features

i) Panels shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be of thickness not less than 2.00 mm (cold rolled) smoothly finished, leveled and free from

flaws. Stiffeners shall be provided wherever necessary. The indoor lighting panels will be ready made DB of minimum 1.6 mm sheet thickness.

ii) The panels shall be of single front construction, front hinged and front connected, suitable for either floor mounting on channels, sills or on walls/columns by suitable M.S. brackets. Indoor panels in control room shall be flush mounted.

iii) Panels shall have a dead front assembly provided with hinged door(s) and out door panels will be with padlocking arrangement with single key supplied in duplicate.

iv) All out door panels, removable covers, doors and plates shall be gasket all around with neoprene gaskets.

v) The outdoor panels shall be suitable for cable/conduit entry from the top and bottom. Suitable removable cable gland-plate shall be provided on the top and bottom of panels. Necessary number of double compression cable gland shall be supplied, fitted on to this gland plate. The glands shall be screwed on top and made of tinned brass.

vi) The panels shall be so constructed as to permit free access to connection of terminals and easy replacement of parts.

vii) Each panel shall have a caution notice fixed on it.

viii) Each panel will be provided with directory holder in which printed and laminated as built circuit directory would be kept inside a document holder/pasted at site.

Main Bus Bars

Bus bars shall be of aluminium alloy conforming to IEC: 60114/60105 and shall have adequate cross-section to carry the rated continuous and withstand short circuit currents. Maximum operating temperature of the bus bars shall not exceed 85 deg. C. The bus bars shall be able to withstand a fault level of 9 kA for 1 sec. for AC panels and 4 KA for 1 sec. for DC panels. The Indoor lighting panels shall have copper bus bar.

9.5 Junction Boxes

i) The junction boxes shall be concealed type for indoor lighting and suitable for mounting on columns, lighting poles, structures etc., for outdoor lighting.

ii) Junction boxes shall be of square/rectangular type of 1.6 mm sheet steel with minimum 6 mm thick pressure diecast aluminium material LM-6 and shall have bolted cover with good quality gasket lining.

iii) The junction box and cover of sheet steel construction shall be hot dip galvanized.

iv) The junction boxes shall be complete with conduit knockouts/threaded nuts and provided with terminal strips. The junction boxes shall be suitable for termination of Cable glands of dia 20 mm, 25 mm, 32 mm, 40 mm on all sides. The junction boxes shall be provided with 4 way terminals suitable for two numbers 10 sq. mm. wire & for street lighting/switchyard lighting suitable for 2 numbers 4C x 16 Sq.mm Al. cable.

v) The junction boxes shall have the following indelible markings

(i) Circuit Nos. on the top.

(ii) Circuit Nos. with ferrules (inside) as per drawings.

(iii) DANGER sign in case of 400volt junction box.

vi) The junction boxes shall be weather proof type with gaskets conforming to IP 55 as per IEC: 60529.

9.6 Cable and Raceway

All wiring cable shall be of single core and shall run in conduits.

9.6 Grounding

All lighting panels, junction boxes, fixtures conduits etc. shall be grounded in compliance with the provision of relevant standard or local statutory requirements.
All electrical equipment shall be effectively grounded. The ground wire shall not be less than 1.5 mm^2 copper for fixtures and 4 mm^2 copper for Panel.

9.7 Information to be furnished

After award of the contract the contractor shall submit detail design of the illumination system. The fixtures shall be satisfactory to the Employer and shall be energy efficient.

The contractor shall submit detailed indoor and outdoor lighting calculation for reaching the above Lux level including surface illumination diagram at varying equipment surface levels, detailed drawing showing the lighting layout and lighting distribution wiring diagram, receptacles, switches and lighting panels for Employer's approval during detailed engineering.

Bidder shall confirm the Lux levels at different locations by measurement.

Bidder shall provide all necessary foundations and / or supporting structures for all outdoor and indoor areas.

All rectification, repairs or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the bidder, without any extra cost to the Employer.

The Bidder along with the Employer shall measure the actual lux level in all the areas of the substations to prove compliance to the specification.

9.8 Tests

The entire illumination system operation shall be tested on completion of the works in presence of the Employer. The tests shall include but not limited to measurement of intensity of light. During Test, if it is observed that illumination level in any area is lower than the specified value, the contractor will rectify the same at his own cost.

Chapter 10: Power and Control Cables

10.1 General

This specification covers the design, manufacture, factory test, supply, delivery, installation, field-testing and commissioning of all Power, Control, Communication and Instrumentation cables required for the entire project.

10.2 Codes and Standards

HV Cables shall comply as a minimum with the below mentioned standards.

IEC 60059	Recommended current ratings for Cables
IEC 60332	Tests on Electric Cables under fire conditions.
IEC-754 (Part-I)	Test on gases evolved during combustion of Electric Cables.
IEEE-383	Standard for type test of Class IE Electric Cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics.

10.3 Low Voltage Power Cables

10.3.1 General

Low voltage AC power systems will be solidly grounded neutral with phase to phase voltage level of 400 V and phase to neutral voltage of 230V AC and the DC system with 110V, ungrounded and 48 V DC.

The main characteristics of the low-voltage cables shall be as follows:

- Rated voltage : 0.6/1.1 kV
- Conductors : Multi stranded annealed copper
- Insulation : Cross-linked polyethylene (XLPE)
- Inner sheath : PVC
- Armour : Galvanized steel
- Outer sheath : PVC, black colour, FRLS, rodent protected
- Fire behavior : flame retardant category according to IEC 60332.

Power cables will have a minimum cross section of 2.5 mm² for lighting and 4 mm² for power. The main (incomer) cable to AC distribution panel shall be three & half (3.5) core and not less than 150 mm2.

10.3.2 Design Requirement

The cables shall be suitable for laying on racks, in ducts, trenches, conduits.

Conductor shall consist of stranded annealed copper wires. They shall comply with relevant IEC publication.

Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions.

Outer sheath shall be of PVC black in colour. Outer sheath of all the cables shall have the following FRLS properties.

- Oxygen index of min. 29 (to ASTMD 2863)
- Acid gas emission of max. 20% (to IEC-754-I).
- Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTMD-2843.

All cables shall meet the fire resistance requirement with cable installations made in accordance with 'Flammability Test' and as per Category-B of IEC 332 Part -3.

- Selection & sizing of power cables shall be based on the following considerations.
- Rated current of the connected equipment
- The voltage drops in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage
- Short circuit withstand capability
- De-rating Factors: De-rating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:
    a) Variation in ambient temperature for cables laid in air
    b) Grouping of cables
    c) Variation in ground temperature and soil resistivity for buried cables.

Cable lengths shall be considered to ensure that straight through cable joints are avoided.

10.3.3 General Technical Requirements

a) Conductor

Conductor shall consist of stranded annealed copper wires. They shall comply with IEC publication. The cable is intended for use at normal conductor operating temperatures not exceeding 75-degree C.

b) Insulation

The electrically and thermally stable insulation shall be extruded onto the conductor so as to prevent contamination and voids in the insulation.

c) Current Rating

The Contractor shall state the maximum continuous current rating and conditions of installation for low voltage power cables.

d) Jacket

The cable core assembly shall be covered with a flame-retardative and moisture resistant PVC jacket, which is free stripping from the insulation. The overall jacket shall be clean, dry, and free of grease and shall be suitable for ink or paint application.

Anti-termite protection shall be applied to the cable and shall consist of either a non-magnetic metallic barrier or layer of nylon sheathing.

e) Identification

Each cable shall have a printed legend on the overall jacket with the manufacturer's name, voltage class, the number and size of conductors, type of insulation etc.

The colors for core identification and color sequence shall be in accordance with follows.

- Single core : Black
- Twin core : Red and black
- Three core : Red, yellow and blue
- Three & half / Four core : Red, yellow, blue and black

10.4 Control and Instrumentation Cable

a) General

All control and instrumentation cable shall be 600 V grade as per IEC standard, multi conductor, color-coded, PVC insulated armored cable. Each multi-core cable shall have not less than 20 percent or 2 spare cores, whichever is the greater.

b) Conductor

Copper conductor shall be stranded circular non compacted cross section of minimum 2.5 sq.mm. The Contractor shall calculate the load of CT core considering all connected loads and submit to the employer for approval. In case of CT burden constrain, CT circuit cable cross sectional area shall be increased. In this case the Contractor shall supply and install the cable required cross section area without any additional cost to the Employer.

c) Insulation

The electrically and thermally stable PVC insulation shall be extruded onto the conductor so as to prevent contamination and voids in the insulation.

d) Assembly

Multi core conductor cables shall be assembled in accordance with applicable IEC standards.

A flame-retardant binder tape may be used underneath the overall jacket of multi conductor cables, if required, to achieve the desired flame retardant characteristics. Tapes, if used, shall be non-hygroscopic.

e) Jacket

The cable core assembly shall be covered with a flame retardant and resistant jacket, which is free stripping from the insulation.

The overall jacket shall be clean, dry, and free of grease and shall be suitable for ink or paint application.

Cable jacketing and the interstices within the jacket shall be free of water. Evidence of water shall be the ground for rejection of the cable.

Anti-Termite Covering: Anti termite protection shall be applied to the cable and shall consist of either a nonmagnetic metallic barrier or layer of nylon sheathing.

f) Identification

Each cable shall have a printed legend on the overall jacket, with the manufacturer's name, voltage class, the number and size of conductors, and a unique number or code indicating the production run or batch. The identification shall remain legible for the life of the cable.

10.5 Communication Cable

All cables and wiring shall have copper conductors and PVC insulation and shall comply with IEC standards.

Each communication cable shall have not less than 20 percent or 4 spare twisted pairs whichever is the greater. Cabling and wiring installations shall be arranged to minimize the risk of fire and damages, which might be caused in the event of fire.

For telephone type cables, 2 conductor wires of not less than 0.6 mm diameter shall be used. Where twin or quad make up is required in any cable, the cores shall be uniformly twisted and the lays arranged such that cross talk is reduced to a minimum.

No conductor smaller than 32/0.2 mm (1 mm2), or having less than three strands, shall be used for interconnecting the cables except in the case of telephone extensions. All cables shall have insulation, which will withstand the highest temperature to be experienced in service.

Each conductor of a multicore cable shall be readily identified by a numbered marker tape or, in the case of telephone type cables, color coded insulation.

10.6 Cable Tags & Marker

Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

The tag shall be of aluminium with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG Gl wire.

Conforming to IS: 280. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.

Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanized iron plate. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable joints". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.

Cable tags shall be provided on all cables at each end Gust before entering the equipment enclosure), on both sides of a wall or floor crossing, ·on each duct/conduit entry and at each end & turning point in cable tray/trench runs.

10.7 Cable Termination and Connections

The termination and connection of cables shall be done strictly in accordance with cable and termination kit manufacturer's instructions, drawing and or as per instruction of the Employer.

Control cable cores entering control panel/switchgear/MCCB/MCC/Miscellaneous panels shall be neatly bunched, clamped and tied with nylon strap or PVC perforated strap to keep them in position.

The Contractor shall tag/ferrule control cable cores at all terminations, as instructed by the Employer. In panels where a large number of cables are to be terminated and cable identification may be difficult, each core ferrule may include the complete cable number as well.

Spare cores shall be similarly tagged with cable numbers and coiled up.

Double compression type nickel plated (coating thickness not less than 10 microns) brass cable glands shall be provided by the Bidder for all power and control cables to provide dust and weather proof terminations.

The cable glands shall conform to BIS: 6121. They shall comprise of heavy duty brass casting, machine finished and nickel plated, to avoid corrosion and oxidation.

Cable lugs shall be tined copper solder less crimping type conforming to IS-8309 & 8394. Bimetallic lugs shall be used depending upon type of cables used.

10.8 Installation of Cables

In general, all power and control cables shall be in the cable trenches. In addition to the above, for lighting purpose also, cable trench can be used in outdoor area as far as possible.

Cabling in the Switchgear/control room shall also be done on ladder type cable trays.

For cables laid in conduits in outdoor area, conduits of 50 mm nominal outside diameter of class 4 as per IS 4985 shall be used, which shall be buried in the ground at a depth of 250mm below finish formation

level. Separate PVC pipes shall be laid for control and power cables. Cable pull boxes of adequate size shall be provided if required.

Power and control cables in the cable trench shall be laid in separate tiers. The order of laying of various cables shall be as follows, for cables other than directly buried.

- Power cables on top tiers.
- Control instrumentation and other service cables in bottom tiers.

Single core cables in trefoil formation shall be laid with a distance of three times the diameter of cable between trefoil center lines. Power cables from station transformer to main ACDB shall be laid with a minimum center to center distance equal to twice the diameter of the cable.

Power and control cables shall be securely fixed to the trays/supports with self-locking type nylon ties with the interlocking facility at every 5 meter interval for horizontal run. Vertical and inclined cable runs shall be secured with 25 mm wide and 2 mm thick aluminum strip clamp at every 2m.

Cables shall not be bent below the minimum permissible limit.

Where cables cross roads, drains, these shall be laid in reinforced spun concrete or steel pipes buried at not less than one meter depth.

10.9 Cable Trays

Cable trays shall be used in control building and other areas within substation and within cable trenches outside substation area. The cable trays shall be of GS sheet and minimum thickness of sheet shall be 2 mm. cable trays shall have 2.5 meter straight section and 150, 300 mm and 600 mm wide

10.10 Conduits, Pipes and Duct Installation

Bidder shall supply and install all rigid conduits, mild steel pipes, flexible conduits, Hume pipes etc. including all necessary sundry materials such as tees, elbows, check nuts, bushing, reducers, enlargers, coupling cap, nipples, gland sealing fittings, pull boxes etc. The size of the conduit/pipe shall be selected on the basis of 40% fill criterion.

Embedded conduits shall have a minimum concrete cover of 50 mm.

Size of conduit for lighting shall be selected by the Bidder during detailed engineering.

For directly embedding in soil, the conduits shall be coated with an asphalt-base compound. Concrete pier or anchor shall be provided wherever necessary to support the conduit rigidly and to hold it in place.

Conduit shall be installed in such a way as to ensure against trouble from trapped condensation.

FO cables shall be laid in galvanised steel (GS) conduits within cable trenches keeping proper clearance with HV cables

10.11 Special Requirements

The Contractor shall be responsible for estimating and supplying the quantity of various types and sizes of the cables. In course of actual execution, if it is found that additional cross sections, types or quantities of cables are required for the completion of the specified works the same shall be supplied without any additional charge to the employer.

Small cut piece lengths of cables will not be accepted. Cables up to 500 meters in length or as approved by Employer shall be of one length shipped in a drum of adequate size. For higher quantities, multiple lengths/drums may be shipped subject to the approval of Employer.

10.12 Drawings, Data & Manuals

The following information shall be furnished along with the bid.

a) Manufacturer's leaflets giving constructional details, dimensions and characteristics of different cables.

b) Current rating of cables including de-rating factor due to grouping, ambient temperature and type of various installation.

10.13 Tests

Routine and Design Tests

Power cable shall be subjected to following routine tests. As far as practical, the procedure of IEC shall be followed:

a) Measurement of the electrical resistance of conductor

b) Partial discharge test

c) Voltage test

Design Test

The power cable design tests shall include following:

a) Partial discharge test

b) Bending test, followed by a partial discharge test

c) Tan delta measurement

d) Heating cycle test, followed by a partial discharge test

e) Impulse test, followed by voltage test

f) Voltage test for 4 hours.

The Bidder shall submit type test report as specified in section-2 of this specification for the offered power cable along with the bid.

Field Tests

After installation at Site, cables shall be subjected but not limited to the following tests:

a) Continuity test

b) Measurement of insulation resistance

c) DC dielectric test

10.14 11 kV Power Cable

10.14.1 General

The scope shall include the supply, laying, termination and testing of 11 kV power cables between various cubicle/equipment as under clause 1 of this chapter. The cables shall be supplied with necessary terminations/sealing ends/accessories for the both connecting ends of each and every cable.

10.14.2 Design Requirement

The rated voltage of the power cables shall be 12 kV for 11 kV circuits. The power cable shall be cross-linked polyethylene insulated (XLPE), screened and steel tape armored.

The XLPE insulated HV cable shall confirm to the requirements of IEC 60502-2 (applicable clauses only) for construction and IEC 60840/IEC 62067 (as applicable) for testing. The terminating accessories shall conform to IEC 60840/IEC62067 (as applicable). The offered cables and its terminating accessories shall be compatible with each other.

The cable shall be of 11 kV HV grade, single/three core, stranded compacted Copper conductor, core screening by a layer of semiconducting tape followed by a layer of semiconducting compound, cross linked polyethylene (XLPE) dry cured insulation, insulation screening with semiconducting compound extruded directly over the insulation, longitudinal sealing by a layer of non-woven tape with water swellable absorbent over insulation screen, followed by radial sealing (Metal sheath), metallic screening by concentric layer of plain copper wire followed by an open helix of copper & overall HDPE sheathed & graphite coated and conforming to the technical particulars of specification.

The cable shall be suitable for laying underground buried installation with uncontrolled back fill and chances of flooding by water and suitably designed by the addition of chemicals in the outer sheath to be protected against rodent and termite attack.

The conductors screen (non-metallic semi-conductive) shall be extruded in a single one-time process to ensure homogeneity and absence of voids.

They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.

Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of the cable.

The cables shall have outer sheath of HDPE material. Repaired cables shall not be accepted.

Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.

a) Conductor

Conductor for power cable shall consist of stranded annealed copper wires. They shall comply with IEC Publication.

b) Cable Rating

The current rating for the cable and conditions of installation shall be adequate for size of the equipment power transformers, station service transformers and feeders.

The conductor and metallic sheath shall be designed to meet the requirement of the system short circuit rating of 25 kA for 1 sec.

The 11 kV power cables shall be rated as follows:

a) Rated voltage, phase to phase (U_0) 11 kV

b) Highest voltage of three phase system (U_m) 12 kV

c) Rated lightning impulse withstand voltage 28 kV

d) Rated power-frequency short duration withstand voltage for 1 min 75 kV

The maximum temperature for the power cables shall be less than the following values:

SN	Description	Continuous Rating	Short Time Rating	Short Circuit Rating
a)	Conductor	65^0C	90^0C	250^0C
b)	Sheath	-	-	250^0C

c) Anti-termite Covering

Anti-termite protection applied to the cables and shall be black PVC suitable for the operating temperature of cables and shall meet the requirements of IEC standard.

d) Outdoor Covering

The outer covering of the cable shall be extruded, continuous black PVC suitable for the operating temperature of cable and shall meet the requirements of IEC standard.

e) Cable Drum

Cable drum shall be non-returnable and made of steel suitably protected against corrosion.

f) Jointing Accessories

Cables shall be installed in single lengths and straight-through jointing shall not be permitted.

g) Voltage Identification

The plastic covering shall be embossed with the name of the manufacturer, voltage class, number, material and size of conductors, cross sections, types of insulations followed by:

Electric cable - (Corresponding) volts

h) Phase Identification

Phase identification for either triplex or multi-core conductor cable shall be in accordance with the following:

Phase A (R): Red
Phase B (Y): Yellow
Phase C (B): Blue

10.14.3 Installation Requirements

The construction of cable shall generally conform to the IEC standard and description mentioned in this specification. Bidder may offer necessary layers such as separation tape, binder tapes etc additionally as per their manufacturing practices for meeting required performance of the offered cable. The bidder shall enclose with the bid, drawing showing cross section of the cable.

12 kV cable shall be laid in the cable duct/cable trench/cable tray/ladder.

The method of cable laying shall be designed by the Contractor to ensure highest security and reliability during and after the installation. The cable installation shall be carried out by the Contractor in accordance with the procedures approved.

At the opening in the civil structures from where the power cables are passing through in the open, suitable sealing means like lean concreting shall be provided by the Contractor to keep out ingress of water in the powerhouse etc. from outside.

Cable termination/Sealing ends

11 kV cable terminations shall be of the heat-shrinkable type / pre-moulded push-on type. Requisite terminations for 11 kV cables shall be provided for facilitating connections with circuit cubicle, transformers, switchgears, feeders etc. in the substation etc.

The cost of all necessary termination/sealing ends shall be included in the price of the cables.

10.15 Performance Guarantee

The performance figures quoted on schedule of Technical Data shall be guaranteed within the tolerance permitted by relevant standards and shall become part of the Contract. In case of failure of the cables to meet the guarantees, the Employer reserves the right to reject the item. The Contractor shall have to rectify/replace the defect/defective part at no extra cost to the Employer and without delaying the commissioning schedule.

10.16 Cable Laying and Termination

11 kV, XLPE insulated cable shall be laid for connection from transformer to the incoming 11 kV feeder and correspondingly connected to outgoing Bays in Buried cable trench from 11 kV Outgoing feeder. The cable shall be laid in flat formation with 100mm (minimum) spacing. The depth of laying shall be 1.0 m. Single point bonding system shall be employed along with sheath voltage limiters (SVL) if required, to limit the standing voltage to 65V. Laying route along with cable length shall be planned to keep the provision of a future cable joint in all cables by providing S bend. Contractor shall propose his own design of cable trench and submit to owners for approval.

10.17 High Voltage Power Cables (132 kV Power Cable)

10.17.1 CABLE CONSTRUCTION DETAILS

1. The XLPE insulated EHV cable shall conform to the requirements of IEC 60502-2 (applicable clauses only) for construction and IEC 60840/IEC 62067 (as applicable) for testing. The terminating accessories shall conform to IEC 60840/ IEC 62067 (as applicable). The offered cables and its terminating accessories shall be compatible with each other.

2. The EHV grade cable shall be single core, unarmoured, stranded, compacted **Copper (as specified in BPS)** conductor, core screening by a layer of semiconducting tape followed by a layer of semiconducting compound, cross linked polyethylene (XLPE) dry cured insulation, insulation screening with semiconducting compound extruded directly over the insulation, longitudinal sealing by a layer of non woven tape with water swellable absorbent over insulation screen, followed by radial sealing (Metal sheath of Lead alloy 'E'), metallic screening by concentric layer of plain copper wire (if required) to meet short time current requirement, followed by an open helix of copper & overall HDPE sheathed & graphite coated and conforming to the technical particulars of specification. Bidder may offer necessary layers such as separation tape, binder tapes etc additionally as per their manufacturing practices for meeting required performance of the offered cable.

3. The cable shall be suitable for laying under the climate conditions (as specified in Section-Project) and underground buried installation with uncontrolled back fill and chances of flooding by water.

4. Cable shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.

5. Progressive sequential marking of the cable length (in metres), at every one metre, shall be provided on the outer sheath of the cable.

6. Repaired cables shall not be accepted.

7. Allowable tolerance on the overall diameter of the cables shall be $\pm$ 2 mm.

10.2 Conductor

The conductor shall be of **Copper** wires as specified in the Bid Price Schedule **(BPS)**. The shape of conductor shall be compacted segmental having high compactness and smooth surface finish.

10.3 Conductor Screen

The conductor screen shall consist of extruded semi-conducting XLPE. Semi-conducting separator tapes may be applied between conductor and the extruded semi-conductor XLPE. The conductors screen (non-metallic semi-conductive) shall be extruded in a single one-time process to ensure homogeneity and absence of voids.

10.4 Insulation

The extruded XLPE insulation shall be applied over the conductor screen to the desired thickness in a void free manner.

10.5 Insulation Screen

The insulation screen shall consist of extruded semi-conducting XLPE. Suitable bedding tapes shall be applied over the extruded semi-conducting XLPE.

10.6 Moisture Barrier

Longitudinal water barrier:
The longitudinal water barrier shall be applied over insulation screen by a layer of non woven synthetic tape with suitable water swellable absorbent.

Radial Moisture Barrier:
This shall be of extruded Lead alloy "E" sheath.

10.7 Metallic Screen:

The metallic screen shall be of plain copper wires, helically applied over the radial moisture barrier. A binder tape of annealed plain copper shall be applied in the form of an open helix over the copper wire screen. The combination of the metallic sheath (lead sheath) in combination with wire screen shall be designed to meet the requirement of the system short circuit rating as specified in **the bidding documents**.

10.8 Outer Sheath

The outer sheath shall consist of extruded black coloured HDPE with graphite coating. The outer sheath shall be suitably designed by the addition of chemicals in the outer sheath for protection against termite and rodent attack and shall be coated with graphite.

10.9 Rating

The contractor/ manufacturer shall declare current rating of cable for maximum conductor temperature of 90 degree C under continuous operation and 250 degree C during short-circuit condition. The contractor/ manufacturer shall also declare over load curve with duration for conductor temperature of 105 Deg C. A complete set of calculation made in arriving at the current rating shall be furnished, for laying condition envisaged under the project, during detailed engineering for Employer/Owner's reference.

10.10 Cable Jointing Accessories

1. The cable jointing accessories shall include all the straight through joints, Cross bonding, earth continuity cables, Link boxes, Sheath Voltage Limiters (SVLs) etc as required for entire cable route. Bidder shall arrange all special tools and tackles required for making these joints at his own cost. **Unless specified separately** in BPS, **cable end terminating kits** shall be deemed included as part of cable jointing accessories.

2. The straight through joint shall preferably be built up from the same material as the main cable and shall have electrical and mechanical withstand capabilities same as or better than the main cable. The joints shall be suitable for tropical conditions as specified in **Section-Project Specification Requirement and Section-General Technical Requirement**.

3. The straight through joints and cable end terminations shall be of proven design and should have been type tested as per relevant IEC. A list of supply of cable jointing accessories which are in successful operation in projects, shall be furnished.

4. The detailed description on jointing procedure shall be furnished during detailed engineering.

5. The cable end terminations shall be of anti-fog type and shall be of Polymer type/Porcelain type suitable for withstanding the climatic conditions with required Creepage distance as specified in **Chapter GTR**. The cable end terminals for terminating the cables shall be complete with accessories & fully compatible with the cables to be supplied. The terminations shall also be capable to withstand mechanical forces during normal and short circuit operations.

6. The cable end terminations envisaged for **GIS interface,** shall comply to IEC 60840. It will be the responsibility of the contractor to ensure smooth interface with GIS equipment.

10.18 CABLE DRUMS

1. Cables shall be supplied in returnable steel drums of heavy construction of suitable size and packed conforming to applicable standards.

2. Standard drum lengths for manufacturing shall be finalised during detailed engineering. Each drum shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stencilled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

3. Packing shall be sturdy and adequate to protect the cables from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PE/Rubber caps so as to eliminate ingress of water during transportation and erection.

10.19 TESTS ON CABLES

All XLPE insulated EHV cables shall conform to all Type, Routine and Acceptance tests listed in the relevant IEC & shall submit the type test reports for Employer's approval. If specified in Section-Project Specification Requirement or Section-General Technical Requirement, Type tests shall be carried out on the EHV cable as per relevant standard.

10.20 TESTS ON ACCESSORIES

Contractor shall submit type test reports for accessories, as per IEC 60840:1999/ IEC 62067 for Employer's acceptance. Contractor shall submit type test reports as per relevant clause of chapter: GTR for Employer's acceptance.

10.21 TESTS AFTER INSTALLATION

All tests on cable system as prescribed in IEC 60840:1999/IEC 62067 (as applicable) shall be performed after installation.

10.22 CABLE HANDLING

The inspection of cable on receipt, handling of cables, paying out, flaking, cushioning with sand or sieved compacted soil, back-filling, reinstatement of road surfaces, providing and fixing joint markers, route indicators, precautions of joint holes, sump holes and all necessary precautions that are required shall be carefully planned and in accordance with acceptable standard practices/statutory requirements.

10.23 BENDING RADIUS

The minimum bending radius of XLPE insulated cables shall be 20XD where "D" means the Outer diameter of the cable.

10.24 CABLE LAYING & TERMINATIONS

The preparation of the cable end for installing the terminations and the precautions to be taken before fixing the terminations shall be followed as in the case of the cable jointing procedures. The instructions furnished by the termination manufacturer shall be strictly followed.

At cable terminating end, the following provisions for supply and erections are to be included:

(i) A sufficient length of spare cable shall be left in the ground, for future needs.
(ii) The rise of the cable immediately from the ground shall be enclosed in PVC/PE pipe of suitable diameter to protect against direct exposure to the sun.
(iii) The cable shall be properly fastened using non-metallic clamps.
(iv) Appropriate labels shall be fixed identifying the phase circuit, voltage and date of commissioning etc., on the cable supporting structure.
(v) The sealing end shall be mounted on pedestal insulators to isolate them from their supporting steel work.
(vi) Protection from contact with the exposed metal work at the termination shall be provided by resin bonded glass fibre shroud.

(vii) Providing earth stations with all required materials, like leads, connectors etc. Earth pits shall conform to IS–3043:1987 (Code of practice for earthing)/ or equivalent International standards.

10.25 BONDING OF SCREEN/ SHEATH

The screens/sheath shall be cross-bonded under each segment of specified route in accordance with IS-3043 (Code of practice for earthing) or applicable International codes & practices. The bidder shall offer complete cable system in order to limit maximum sheath voltage in accordance with relevant standards and furnish complete set of calculations in support of the same. The screen/sheath shall be connected to the earth stations/ earth pits through disconnecting type link boxes & through Sheath Voltage Limiter (SVL) as required.

All required materials used in the Cross bonding, termination of earth continuity cable, Link box, SVL etc to comply with specification/statutory requirements shall be in the scope of bidder and should be of good quality and compatible with the cable.

10.26 CONNECTION OF RADIAL WATER BARRIER AND CABLE SCREEN

If the metallic radial water barrier is insulated from the metallic wire screen, a connection suitable to carry the currents occurring during operation must be installed between metallic radial water barrier of the cable and metallic wire screen in joints and sealing ends.

10.27 CABLE TERMINATING STRUCTURES

4. The terminating structure being supplied, should be designed as per the project requirement for the cable end terminations i.e. for Standalone Outdoor AIS terminations, GIS end terminations and Transmission line Tower end terminations as per requirement specified in BPS.

5. The mounting structure shall be fixed on the reinforced cement concrete foundation, the design & drawings of which shall be submitted to Employer for review & acceptance during detailed engineering.

6. The mounting structure includes the supports for cable end boxes, link boxes and any other item required for the intent of the contract. All steel sections used shall be free from all imperfections, mill scales, slag intrusions, laminations, fillings, rust etc. that may impair their strength, durability and appearance. All materials shall be of tested quality only unless otherwise permitted by the Employer. The steel for mounting structure shall confirm to IS-2062 (latest).

7. In case of cable terminations on transmission line towers, the cable termination kit, LA, Link Box, SVL etc shall be fixed suitably on the tower for which necessary interface details shall be coordinated for Tower design during detailed engineering. After fixing the end terminations, the cable shall be suitably fixed to the tower members, with non-magnetic material clamps to the required height securely. The cable in air shall be suitably protected using HDPE pipes up to certain height.

8. In case of GIS end terminations, the structure & foundations shall be suitably designed in coordination with GIS terminations during detailed engineering.

10.28 Cable Route Markers/Cable Joint Markers

Permanent means of indicating the position of joints and cable route shall be fabricated supplied and erected as per approved drawings.

Markers provided shall be as per the field requirement, if the route passes through open fields, markers should be conspicuously visible and above ground surface.

The marker should incorporate the relevant information such that the name of the Owner, voltage, circuit and distance of cable from the marker.

10.29 Jointing and Termination of Cables

The cable jointing personnel and his crew shall have good experience in the type of joints and terminations that are used. The jointing work shall commence as soon as two or three lengths of cables have been laid. All care should be taken to protect the factory-plumbed caps/ seals on the cable ends, and the cable end shall be sealed whenever the end is exposed for tests.

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

Sufficient over lap of cables shall be allowed for making the joints.

The joint bay should be of sufficient dimensions to allow the jointers to work with as much freedom of movement and comfort as possible. Sufficient space should be kept below the cable to be jointed.

The joints of different phases shall be staggered in the jointing bay.

10.30 Sump holes

When jointing cables in water logged ground or under unforeseen rainy conditions, a sump hole should be made at one end of the joint bay, in such a position so that the accumulated water can be pumped or bailed out by buckets, without causing interference to the jointing operation.

10.31 Tents/Covers

An enclosure or suitable protection cover shall be used in all circumstances wherever jointing work is carried out in the open, irrespective of the weather conditions. The joint shall be made in dust free, moisture free and clean atmosphere.

10.32 Precautions Before Making A Joint

The cable end seals should not be opened until all necessary precautions have been taken to prevent circumstances arising out of rainy/ inclement weather conditions, which might become uncontrollable.

If the cable end seals or cable ends are found to have suffered damage the cables should not be jointed, without tests and rectification.

10.33 Measurement of Insulation Resistance

Before jointing, the insulation resistance of both sections of cables shall be checked.

10.34 Identification

The identification of each phase, shall be clearly and properly noted. The cables shall be jointed as per the approved design. Each cable shall have identification for phase at joint bays.

10.35 Making A Joint

Comprehensive jointing instructions should be obtained from the manufacture of jointing kits and meticulously followed.

The materials used in the joints like ferrules, screen/sheath continuity bonds, lugs etc., shall be of good quality and conform to standards.

The jointing tools shall be appropriate and as per the requirement of jointing EHV XLPE cables.

Chapter 11: A.C. and D.C. Distribution Panel

11.1 Scope

These specifications are intended to cover the design, engineering, manufacturing, inspection and testing at manufacturer's works, packing, supply & delivery, Testing & commissioning of 400 volts, 3 phase, 4 wire, AC distribution panel, 110V DC and 48V DC distribution panel in-door type complete with all materials, accessories and fittings, erection & maintenance tools & tackles, mandatory spares as detailed in this specification for 132kV substation at Dhungesaghu (Taplejung District).

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life.

Any material and equipments not specifically stated in this specification but which are necessary for satisfactory operation of the equipment shall be deemed to be included unless specifically excluded and shall be supplied without any extra cost.

11.2 Standards

The equipment covered by this specification shall confirm to the provisions of the following IEC/International standards as amended up to date except where specified otherwise in this specification.

The Equipment and material meeting the requirement of any other Indian standards or internationally recognized standards which ensure a quality equal or better than the standard mentioned above shall also be acceptable. Where the equipment confirms to any other standards then salient points of difference between the standards adopted and those prescribed in these specifications shall be clearly brought out in the bid and a copy of the applicable standards shall also be enclosed by the bidder with the bid.

11.3 Description

11.3.1 Main ACDB Panel

The main AC Distribution Panel shall be fed from distribution transformer.

Tentatively the following minimum feeders shall be required from the AC Distribution Panel but not limited to this extent, and each shall be suitably rated as per requirement.

i) 1 (one) number of400 V air circuit breaker (ACB) for 33/0.4 kV station service transformer as INCOMER for main ACDB Panel.
    a. 3 phase, 4 wires supply for oil filtration set.
    b. Single phase supply to various 132 kV Circuit Breakers (separate feeders to each).
    c. 3 phase, 4 wires supply for indoor lighting.
    d. 3 phase, 4 wires supply for outdoor lighting.
    e. 3 phase, 4 wires for transformer Marshalling boxes and Bay Marshalling Kiosk.
    f. Three phase/ Single Phase supply to Main Lighting Distribution Board (MLDB).
    g. 1 phase supply to 132 kV C&R Panels.
    h. 1 phase supply to 132 kV isolator boxes for motor operation.

i. 3 phase, 4 wires feeders for Battery chargers.
j. 1 Phase supply to Substation Automation System, HMI, printers etc.
k. Supply for OPGW Communication Panel.
l. At least 20% (minimum 1) of each rating as spares.
m. Three phase/single phase supply as per requirement with individual MCCB/MCB's to Air conditioning system, Fire detection, alarm and control system, etc.

Incoming from transformer shall be provided with the following:

a. ACB shall be used on upstream (Incomer) side from station transformer whereas suitable rating of MCCBs or MCBs shall be used on load side according to requirement.
b. One No. 100 mm dia. flush mounted digital Ammeter with range 0-400 amp with phase selector switch.
c. One No. 100 mm dia. flush mounting digital voltmeter scale range 0-500 V with fuse and selector switch, along with LED type, indicating lamps before the selector switch.
d. Suitable CTS having burden 25 VA and accuracy class – I
e. One No. 3 phase, 4 wires unbalanced load integrating watt – load meter operable on CT. Each circuit as indicated above shall have switch rating and labeling as mentioned against each and shall include bus-bar connections, terminals cable glands and legs etc.
f. One No. of 3-phase, 4-wire type electronic type energy meter having accuracy class of 0.5 with facility to download data via optical connection.
g. Bus bar shall be of Aluminum and designed for 630 Amps for phases and 400A for neutral.
h. All the protections shall be of numerical type and supported by Test Certificates from Govt. recognized Test house and performance certificates from Govt./Power Utilities.
The relay shall have:

i. Minimum two characteristics, one IDMT of 3 sec. and the other one of definite time characteristic and the same should be site selectable.

ii. Wide range of time and current setting in very small steps without sacrificing the relay characteristics.

iii. Tripping indication for different type of faults until reset by the operator.

iv. Continuous self-supervision along with self-diagnostic feature for faults within the relay and the relay should have potential free 'Change over Contact' for annunciation in the event of internal failure.

v. Output contacts having sufficient current rating to directly energize trip coil of circuit breaker.

vi. LED indication facility for visual annunciation of different type of faults including phase identification.

400VAC switch board cubical type shall consist of feeders as above and shall have MCB of rating and labeling as per system requirement. It shall include bus-bar connections terminals, Cable glands and lugs. The aluminum bus- bar shall be designed for 630 Amps for phases and 400 Amp for neutral based current

density of 85 Amp per sq. cm. The bidder shall design the ratings of ACB, MCB/MCCBs' which shall be approved by Employer. The above details of outgoing feeders are provisional and is subject to change during detailed engineering.

The A.C. Distribution Panel shall be fitted with the following accessories:

1. 230 V, AC space heater with MCB and thermostat.
2. Only ACB, MCB/MCCBs' as appropriate shall be provided. No fuses are allowed.
3. All the feeders shall be provided with single phase ammeters. For three phase supplies an ammeter with selector switch (or in yellow phase only) shall be provided. Typical ammeter size shall be 70 mm x 70 mm. These details shall be finalized during detailed engineering.
4. Necessary CTs wherever required for current measurement shall be provided. The secondary rating of each shall be 1A.
5. Indicating lamps shall be of low wattage typically 2.6 W or less.
6. Energy Meter with provision to download data via optical connection.
7. All the terminals for external cabling shall be suitably rated as per the size of the external cables.
8. All the indicating instruments, lamps, handles, MCCBs', MCB's shall be flush mounted.
9. Panel shall be indoor, single front, fixed type.
10. Base frame shall be of ISMC-100.
11. Phase clearances shall be as per IS/IEC.
12. Panel Paint: will be decided during detailed engineering
13. Interior & mounting plate: Glossy white
14. Bus bars to be color coded and also the circuits taken from it.
15. Earth bus of 50 x 6mm copper strip shall project out of the panel at both ends and shall have two holes for earth connections.
16. Control Wiring: 1.5 mm^2 copper (48 strands), 2.5 mm^2 copper for CTs (48 strands)
17. Power Switch & MCCB shall be door interlocked and shall have pad locking
18. Caution Name Plates for live terminals shall be provided.

11.3.2Main Lighting Distribution Board (MLDB)

Tentatively the following minimum feeders shall be required from the Main Lighting Distribution Board (MLDB) but not limited to this extent, and each shall be suitably rated as per requirement.

i) 1 (one) number of 400 V MCCB from Main ACDB panel as INCOMER for main ACDB Panel.
   a) Feeders for switchyard lighting
   b) Feeders for Street Lighting
   c) Feeders for Utility Portion
   d) Feeders for Control Building
   e) Spare Feeders.

11.3.3 Interchangeability

All similar material and movable parts shall be interchangeable with each other. Such as the breakers, switches, contactors etc. shall be easily removable as a complete unit from the switch boards and shall be capable of being put into similar position in other switch boards for performing identical function.

11.4 Constructional Features

11.4.1 400 V Station Supply LT Board

The supply board shall comprise of:

a. Metal enclosed, indoor /outdoor mounted, dust and vermin proof and self-supporting cubicle type made –up of mild steel sections and cold rolled sheet steel of 2 mm thickness for enclosure and all load bearing members, doors & fitting plate. The Gland Plate shall be 3 mm thick, sheet steel, with double compressions, chromium plated brass glands.

b. The board shall be stiffened properly to be free from vibration, twist and bends. The degree of protection of enclosure to be not less than IP-54 for all indoor type panels and IP-55 for all outdoor mounted panel or boards respectively as stipulated by IS: 2147 or relevant IEC.

c. Requisite number of sheet steel enclosure for mounting circuit breakers, relays, switches, CTs and other components. Light structural members shall be jointed preferably by bolting.

d. Separate cable / bus- bar chambers duly partitioned, removable covers and metals still frames of single front double access type having feeders located in the front and vertical bus bars and cable chamber located in the rear.

e. Detachable or hinged type door with handle and locking arrangements and easy access for inspection and maintenance works.

f. Bottom frame suitable for erection on flush concrete floor by means of evenly spaced grouting bolts projecting through the base channel members.

g. Necessary facilities for entry of cable from the bottom. No access to any live part inside the panel to avoid accident. Separate cable support to avoid load on the thimble of cable as well as on the links.

h. Synthetic rubber Gaskets all-round the perimeter of cover, gland plates, removable covers and doors shall be provided.

i. Eye bolts at the top to facilitate lifting and anti-vibration pads between base frame and panel to prevent vibration.

j. Adequate strength to withstanding all stresses imposed during handling, transportation, installation and operation without distortion or damage. The panels shall be assembled to the extent possible within transporting and handling limitations duly wired up and ready for installation in accordance with this specification.

k. Each MCB to have separate bus –link wired up to terminal block so that by removal of link, the outgoing feeder is isolated without removing cable from the terminals.

l. The minimum component height will be 250 mm form the ground level for case of maintenance.

m. It must be ensured while designing the switch boards that adequate electrical clearance as required under the rules shall be provided for the various components inside the cubical.

11.4.2 Distribution Board

a. The boards shall be fabricated out of best quality cold rolled sheet steel of 2 mm including for doors & sides and shall be fully dust and vermin proof affording a degree of protection of IP – 54 for indoor DBs and IP 55 for outdoor DBs as per IS – 2174.
b. Distribution boards shall be provided both hinged door with handle and looking facility for switch on inter lock facility for switch on interlock of doors. Doors shall be gasketted all round with neoprene gaskets.
c. All accessible live connections / parts shall be shrouded and it shall possible to change /replace individual MCB /Fuse units form the front of the board without danger & coming in to contact with live parts.
d. Adequate interior cabling space and suitable removable type cable entry plates shall be provided for top/ bottom entry of cable gland plate shall be supplied undrilled. Necessary number of glands to suit the specified cable shall be provided. Cable glands shall be screwed on type and made of chromium plated brass.
e. The DB shall have two earthing terminals for connecting to the stations earthing.
f. The ACDBs shall be either floor mounted type. Suitable foundations channels with necessary bolts and nuts shall be provided.
g. The danger board shall be fixed on the front of the door of DBs as per standards.
h. Wiring inside the panel shall be carried out with 1100 V grade PVC insulated stranded copper conductors of adequate size on both ends of each wire engraved identification ferrules shall be provided.
i. Bus bar shall be of copper adequately sized for the specified continuous current rating such that the maximum temperature of the bus bar and links does not exceed 75^0 C.
j. All MCBs /Isolators /switches etc. shall be flush mounted with hinged door provided with locking arrangement and an inner Bakelite sheet /fibre glass sheet shall be provided inside such accidental contact.
k. Equipment mounted inside the panel shall be provided with individual labels with equipment designation /rating. Front of the panel shall be provided with label engraved with designation of the panel as furnished by the purchaser. Label shall be made of 3 ply lamicold /engraved PVC having white letters on black ground. Letter size shall be 4 mm minimum.
l. Terminal blocks shall be 1100 V grade clip on type, moulded in melamine suitable for terminating incoming cable of suitable size of stranded copper conductor and outgoing circuits of approved sizes. All the terminals shall be shrouded, numbered and provided with identification strip for the feeders.
m. MCB's shall be current limiting type magnetic and thermal release suitable for manual closing and automatic tripping under fault condition single pole MCB's shall have interrupting capacity not less than 10 kA. MCB knob shall be marked with ON/OFF indication. A trip free release shall be provided to ensure tripping on fault even if the knob is held in on position to avoid accidental contact. MCCB shall have adjustable setting, O/L & S.C. releases.
n. Fuses if required shall be HRC cartridge type complete with fuses fittings. Fuses fittings shall incorporate fully insulated shrouded contacts. Visible indication of operation of fuses

shall be provided. However, purchaser would not prefer to have fuses instead MCB's should be provided.

o. The indoor panel shall be finalized during detailed engineering. The inside of the panel shall be glossy white.

11.4.3 Power Bus Bars and Insulators

Bus bars shall be of Aluminium alloy, liberally sized for the specified continuous current rating as per approved scheme and short circuit current rating of 31.5/25 KA (rms) for 3 sec. Necessary precaution shall be taken to avoid bimetallic action. Means shall be provided for identifying various phases of bus bars by red, yellow and blue paint. The cross section of the bus bars shall be uniform throughout the length of switch gear

Bus support shall be of arc resistant, non-tracking, low absorption type installations of high impact strength to withstand normal as well as fault condition stresses.

a) **EARTH BUS:** A galvanised steel earthing shall be provided at the bottom of each panel and shall extend throughout the length of switchboard. It shall be welded/bolted to the frame work of each panel and breaker earthing contact bar. Vertical bus shall be provided in each vertical section which shall in turn be bolted/welded to main horizontal ground bus.

b) The earth bus shall have sufficient cross section to carry momentary short circuit and short time fault currents to earth bus without exceeding the allowable temperature rise.

c) The horizontal earth bus shall be projected out of the switch board ends and shall have pre-drilled holes for bolted connection between this bus to sub-station earthing conductor. A joint spaced and taps to earth bus shall be made through at least two bolts.

d) All non-current metal works of the switch board shall be effectively bonded to the earth bus.

11.4.4 Air Circuit Breakers

a) Incoming air circuit breaker shall be four pole air break horizontal draw out type and shall have inherent fault making and breaking capacities as per requirement. All the poles of circuit breakers shall open and close simultaneously. The neutral pole shall be 100% rated.

b) Circuit breakers shall be mounted along with-it operating mechanism on a wheeled carriage. Suitable guides shall be provided to minimize misalignment of the breaker.

c) There shall be 'Service', 'Test' 'ISOLATED' and 'MAINTENANCE' positions for the breakers. In 'Test' position the circuit breaker shall be capable of being tested for operation without energizing the power circuits i.e. the power Contacts shall be disconnected while the Control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the 'SERVICE', 'TEST'. It shall be possible to close the door in 'TEST' position.

d) There should be provision for locking the air circuit breaker in 'ISOLATED' position to achieve mechanical interlocking with Incomer & Bus sectionalizer Air Circuit Breakers.

e) All circuit breakers shall be provided with 4 NO and 4 NC potentially free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be provided in both 'SERVICE' & 'TEST'

position of the breaker. All contacts shall be rated for making continuously carrying and breaking 10 Amps. At 230 V AC and 1 Amp. (Inductive) at 220 V DC.

f) Suitable mechanical indications shall be provided on all circuit breakers to show 'OPEN', 'CLOSE', 'SERVICE', 'TEST' and 'SPRING CHARGED' positions.

g) Movement of a circuit breaker between SERVICE AND TEST positions shall not be possible unless it is in OPEN position. Racking interlock for this shall be provided.

h) Closing of a circuit breaker shall not be possible unless it is in SERVICE, TEST POSITION or in FULL WITHDRAWN POSITION.

i) Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationary isolated contacts when the breaker is withdrawn. It shall however, be possible to open the shutters intentionally, against spring pressure for testing purpose.

j) A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating. The ACB's shall have rating error preventor to achieve this.

k) Circuit breakers shall be provided with electrical anti-pumping and trip free feature even if mechanical anti-pumping feature is provided.

l) Mechanical tripping shall be possible by means of front mounted RED 'Trip' push-button. In case of electrically operated breakers these push-buttons shall be shrouded to prevent accidental operation.

m) Power operated mechanism shall be provided with a universal motor suitable for operation 110V DC Control supply with voltage variation from 85% to 110% rated voltage. Motor insulation shall be class 'E' or better.

n) Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring. The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring.

o) The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.

p) Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.

q) All circuit breakers shall be provided with closing and trip coils. The closing coils shall operate correctly at all values of Voltage between 85% to 110% at rated control voltage. The trip coil shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage Trip circuit supervision shall be provided.

r) The door of the circuit breaker compartment shall be interlocked so that (1) door cannot be opened while the breaker is in closed position and (2) when the door is open the breaker cannot be closed. However, facility to defeat this interlock shall be provided for testing purpose.

s) Provision for mechanical closing of the breaker only in 'TEST' and 'WITHDRAWN' positions shall be made.

t) Air Circuit Breakers shall be from one of the following manufacturer's complying with technical specification & relevant IS & IEC

i) M/s Siemens
ii) M/s L & T
iii) M/s ABB
iv) M/s Schneider
v) M/s GE
vi) Reputed make substantiated by ISO 9001 certificate, test certificates, end user certificate

11.4.5 Switch Fuse Unit (SFU), Moulded Case Circuit Breaker (MCCB) and Miniature Circuit Breaker (MCB)

a) SFU / MCCB shall be 4 pole /2 pole, capable of safely breaking the fault current of the associated feeder. Rating of SFU / MCCB's shall be chosen by the contractor depending upon requirement of outgoing feeders as stipulated in this technical specification and shall be subject to approval of Employer.

b) All the SFU / MCCB shall be flush mounted on AC Distribution boards provided with Rotary operating handle with clear ON-OFF trip indication.

c) MCCBs shall be provided with thermo-magnetic type release for over current and short circuit protection. The o/c setting shall be adjustable type. The s/c settings shall be adjustable type.

d) The setting range of thermal release and breaking capacity of MCCBs are to be specified and shall conform to system requirement. MCCB Knob shall indicate the true position of the equipment. MCCBs shall conform to relevant Indian Standard IS: 13947 Part 2 and shall be of P2 duty.

e) For tripping of any of the outgoing feeder, visual and audible alarm arrangement shall be provided in the AC Board. However, arrangement has to be made for getting audible alarm at the control room for the knowledge of the operator regarding tripping of the outgoing feeders. Necessary arrangement shall also be provided for acceptance and resetting of the audible alarm. In case of tripping of Incoming feeder breaker, arrangement of both audible and visual annunciation shall be made both at AC Board as well in Control room. Acceptance and resetting arrangement are to be provided.

f) Interlocks shall be provided such that it is possible to open the cubicle door only when the SFU / MCCB is in 'OFF' position and to close the SFU / MCCB when the door is closed.

g) Miniature Circuit Breaker (MCB) shall conform to IEC:898-1987 and IS:8828.

h) SFU, MCCB & MCB shall be from one of the following manufacturer's complying with technical specification & relevant IS & IEC

i. M/s Siemens
ii. M/s L & T
iii. M/s ABB
iv. M/s Schneider
v. M/s GE
vi. Reputed make substantiated by ISO 9001 certificate, test certificates, end user certificate.

11.4.6Control and Selector Switch

a) Control and Selector switches shall be rotary type with escutcheon plates clearly marked to show the junction and positions. Switches shall be of sturdy construction suitable for making on panel front.

b) Voltmeter selector switches shall have four stay put position with adequate no. of contacts for 3-phase 4-wire system. These shall be oval handles. .

c) Contacts of the switches shall be spring assisted and shall be of suitable material for giving long trouble-free services.

d) Contact ratings shall be at least the following:

(i) Make and carry continuously: 10 Amp.

(ii) Breaking current at 230 V AC: 5 Amp. (at 0.3 p.f. lagging)

11.4.7 Air Break Switches

a) Air breaker switch shall be of heavy duty, single throw group operated, load break, fault make type complying IS:4046.

b) Switch operating handles shall be provided with pad locking facilities to lock them in 'OFF' position.

c) All switches shall be adequately rated so as to be fully protected by the associated fuses during all abnormal conditions such as over load, locked motor, short circuit etc.

d) Interlock shall be provided so that cubicle door can only be opened when the switch is in 'OFF' position and to close the switch only when the door is closed. However, suitable means shall also be provided to intentionally defeat the interlocks as mentioned above.

e) Switches and fuses MCCB/MCB for AC control supply and heater supply wherever required shall be mounted inside the cubicles.

11.4.8 Indicating Lamps of Control Switches

a) Indicating lamps shall be of the panel mounting cluster LED type. The lamps shall have suitable size plates marked with its function, wherever necessary.

b) Lamps shall have translucent lamp covers of the following colours.

RED	:	Breaker Closed.
GREEN	:	Breaker Open
WHITE	:	Breaker Auto-Trip
BLUE	:	For all healthy condition. (e.g. Control supply and also for "SPRING CHARGED" and "TRIP CIRCUIT HEALTHY")
AMBER	:	For all alarm conditions (e.g. overload). Also, for 'SERVICE' and 'TEST' positions indicators.

11.4.9 Space Heaters

Space heaters shall be provided for preventing harmful moisture condensation in all the AC Boards. The space heaters shall be suitable for continuous operation on 230 V AC, 50 HZ, 1-phase supply and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.

11.4.10 Internal Wiring and Terminal Blocks

a) All switch boards shall be supplied completely wired internally up to the terminal blocks.

b) All inter cubicle and inter panel wiring and connections between panel of same switch board including all bus wiring for AC and DC supplies shall be provided by the contractor.

c) All internal wiring shall be carried out with PVC insulated, stranded copper conductor, single core, 2.5 sq. mm. or larger stranded copper wires. CT circuits. shall be wired with 4 sq. mm. voltage grade and insulation of copper wires shall be same as above. Voltage drop shall be allowed only in the tune of 5% at the remote end of the longest outgoing feeder from the AC Panel board and 15% drop in case of starting of motor of the remote end.

d) All wiring shall be properly supported, neatly bunched, readily accessible and securely connected to equipment terminals and terminal blocks.

e) Each wire shall be identified at both ends and shall be properly tagged and ferruled in compliance with approved drawings. Wires shall not be spliced or tapped between terminal points.

f) Terminal blocks shall be of 1100 V grade 'Elmex/connect well' make and have continuous rating to carry the maximum expected current on the terminals. The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barrier shall be provided between the terminal. The terminal blocks shall have locking arrangement to prevent its escape from the rails. 20% spare terminals are to be provided. These spare terminals shall be uniformly distributed on all terminal blocks.

g) Terminal blocks for CT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided with short circuiting and earthing facilities. Jam nut should be provided with shorting link.

h) All terminal blocks shall be normally suitable for terminating on each side, two (2) nos. of 2.5 mm. sq. size stranded copper conductor. However, terminal blocks to be used in conjunctive with CT shall be suitable for terminating 4 sq. mm. single core Copper wires.

i) All terminals shall be numbered for identification and grouped according to the function. Engraved white on-black labels shall be provided on the terminal blocks.

j) Terminal blocks shall be arranged with at least 100 mm. clearance between two sets of terminal blocks. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250 mm.

11.4.11 Power Cable Terminations

a) Cable termination compartment and arrangement for power cables shall be suitable for stranded Aluminium Conductor, armoured PVC insulated and sheathed 4 / 3.5 -core, 1100V grade.

b) All necessary cable terminating accessories such as Gland plates, supporting clamps and brackets, power cable lugs, hardware etc. shall be provided by the contractor to suit the final cable sizes.

c) The gland plate shall be of removable type and shall cover the entire cable alley. Bidder shall also ensure that sufficient space is provided for all cable termination.

11.4.12 Residual Current – Operated Circuit Breakers (RCCB) / Earth Leakage Circuit Breakers (ELCB)

a) The RCCB/ELCB offered shall be suitable for particular application in conjunction with MCB and arranged for manual closing and opening and automatic tripping on earth fault condition. In case of multi-pole circuit breakers, the indication shall represent the position of all the poles. The metallic portions of the mechanism shall be either inherently resistant to or treated so as to make them resistant to atmospheric corrosion. The operating mechanism shall be trip free. The operation mechanism case shall be effectively sealed by the manufacturer to prevent access to the mechanism. The case shall be of insulating material.

b) The RCCB shall be provided with test device for testing automatic opening of the circuit breaker by an integral test device. The test device shall be arranged for external operation in such a way that the protection afforded by the cover or enclosure is not impaired.

c) The product of rated residual current (rated tripping current) in amperes and the earth loop impedance in ohm should not exceed the value 50. The RCCB shall be so chosen that the same has lowest suitable tripping current.

11.4.13 Grounding

a) A copper strip ground bus rated to carry maximum fault current for the specified duration shall be provided along the entire length of the distribution board.

b) Each casing of the equipments, relays, instruments provided in the board shall be connected directly to the ground bus by independent stranded copper wires of not less than 2.5 sq. mm. The earth bus shall have sufficient cross-section to carry the momentary short circuit and short time fault currents to earth without exceeding the allowable temperature rise. The ground bus shall be brought out to two terminals at the two ends of the switch board for connecting to120 sq.mm stranded copper for all voltage classes. CT & PT secondary neutral point shall be at one place only on the terminal block. Such earthing shall be made through links.

11.4.14 Distribution Board supplied from main ACDB Panel

These shall be provided whenever required to further distribute the three-phase supply taken from the ACDB. The bus bars of distribution boards shall be of electrolytic copper having 99.9 % purity as per IS-440 unless otherwise specified. The size of the Bus bars be got approved form the purchaser during detailed engineering.

a) All bus bars, MCBs, Switch fuse units, fuses and connection shall be of sufficient size to limit the temperature not to exceed the specified value in the relevant standard inside the enclosure while carrying full load current. All main bus bars connections and bus bar outgoing taps be tin plated and tightly clamped with through bolts to ensure maximum conductivity. All bus bars shall be rigid type. All bus bars connections shall be accessible for inspection and maintenance purpose.

b) Bus bars supports shall be made of suitable insulating material such as sheet moulding compound, glass reinforced moulded plastic material, or cast resin etc., of thickness not

less than 6 mm. Separate supports shall be provided for all three phases, anti – tracking barriers shall be incorporated.

c) The bus bars shall be protected from Accidental contact by using highly not less than 6 mm thick.

d) The size of neutral bus of the wall mounted type 3 phase 4 wire distribution board shall be rated as the phase bus-bars. The neutral bus should have sufficient terminals and detachable links for all the single-phase outgoing and supports shall have sufficient strength to with stand thermal and electromechanical stresses for a short circuit level of 10 kA of the system.

11.4.15 Tropical Finish

All electrical equipment, accessories and insulation of wiring shall have fungus protection involving special treatment on insulation and metal against fungus, insect and corrosion.

11.5 Associated Equipments and Accessories

11.5.1 Cable Glands

a) All feeders shall be provided with suitable dust tight screwed brass cable glands conforming to the relevant IS standard.

b) Gland shall project above the gland plate. Terminating cables shall be armoured and the armour rods shall be connected to earth bar.

11.5.2 Meters

The accuracy class of Electronic type KWH meter shall be 0.5. One KWH meter of 3-phase, 4-wire type shall be flush mounted on each of the incoming breaker compartments, Ammeter and voltmeter shall be of 72* 144 sq.mm and of flush mounting digital type with accuracy +/- 1% of full scale. The meters shall conform to the appropriate IS specification. All circuits of the meters shall be capable of withstanding 20% overload for a period of at least 8 hours. Three no. digital Ammeter and one no digital Voltmeter shall be provided for each incoming CB's with voltmeter selector switch.

11.5.3 Numerical Relays

All the protections shall be of numerical type (shall be as per make list) and supported by Test Certificates from Govt. recognized Test house and performance certificates from Govt./Power Utilities.
The relay shall have –

a) Minimum two characteristics, one IDMT of 3 sec. and the other one of definite time characteristic and the same should be site selectable.

b) Wide range of time and current setting in very small steps without sacrificing the relay characteristics.

c) Tripping indication for different type of faults until reset by the operator.

d) Continuous self-supervision along with self-diagnostic feature for faults within the relay and the relay should have potential free 'Change over Contact' for annunciation in the event of internal failure.

e) Output contacts having sufficient current rating to directly energize trip coil of circuit breaker.

f) LED indication facility for visual annunciation of different type of faults including phase identification.

g) Individually site selectable binary Output and Input and latching option for binary Output.

11.5.4 Instrument Transformer

a) All current transformers shall be completely encapsulated cast resin insulated wound type suitable for continuous operation at the temperature prevailing inside the switch gear enclosures, when the switch board is operating at its rated condition and the outside ambient temperature is 50°C.

b) All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit.

c) All instrument transformers shall have clear indelible polarity markings.

d) Accuracy class of current transformer shall be of 5P and 1 for protection and metering. The insulation level of the CT shall be suitable for 1.1KV grade service.

e) The CT ratio associated with 250KVA station service transformer shall be 650/1A or ratio shall be decided by contractor depending upon the requirement and availability subject to approval of the Employer.

11.5.6 Nameplates and Labels

f) ACDB shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

g) All name plates shall be non-rusting metal or 3-ply lamicold with white engraved lettering on black base ground. Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel / module. These labels shall be positioned so as to be clearly visible and shall give device number as mentioned in the module wiring drawings.

11.6 Painting

a. All sheet work shall be phosphate in accordance with following procedure and in accordance with IS/IEC, code of practice for phosphating iron and steel, with seven tank process.
b. Oil, grease and dirt shall be thoroughly removed by emulsion cleaning.
c. Rust and scale shall be thoroughly removed by emulsion cleaning.
d. Rust and scale shall be removed by pickling with dilute acid followed by washing and running water rinsing with slightly alkaline hot water and drying.
e. After phosphating, through rinsing shall be carried out by clean water followed by final rinsing with dilute solution and oven drying.
f. The phosphate coating shall be sealed by the application of two coats of red mixed stoving type Zinc chromate primer. The coat may be 'flash dried' while the second coat shall be stove dried.
g. After the application of the primer, two coats of finishing synthetic enamel shall be applied, each coat followed by stoving. The second finishing coat shall be applied after

completion of tests. The color of the finishing paint on the exterior should be got approved form the purchasers before painting. All the panels and DBs shall be painted white in the interior.

h. Each coat of primer and furnishing paint shall be of a slightly different shade to enable inspection of painting.

i. The final finished film thickness of paint on sheet steel shall not be less than 100 microns and shall not be more than 150 microns.

j. Finished painted appearance shall present an aesthetically pleasing appearance free from dents and uneven surface.

k. Adequacy quantity of finishing paint shall be supplied for minor touchup required at site after the installation of the L.T., AC station board and distribution boards.

11.7 D.C. Distribution Panel

The board shall be metal clad, totally enclosed indoor floor mounted, and free-standing cubicle type. Entry for incoming and outgoing cables shall be from bottom. Bus-bars shall be made of tinned copper and insulated. **The construction feature, pre-treatment, painting and other aspects shall comply with specification covered in clause 12.4 (Constructional Features) which is applicable to DC distribution panel**. The frame shall be fabricated using suitable mild steel structural section or pressed and shaped cold rolled sheet steel of thickness not less than 2.0 mm. The panel shall be provided with circuits and components such as meters, relays, etc. as per the 110 V DC single line diagram subject to approval of Employer. Components such as MCCBs, MCBs etc. shall be of reputed make with proven performance record and suitable for DC application. The bus bars shall be insulated.

The DC distribution panel shall be complete with bus bars, input/output terminals, interpanel connections, internal wiring, name and rating plates, mimic diagram (at the front ofthe switchboard), earthing bus and space heaters etc. The terminals shall be of reputedmake and will be subject to approval of Employer.

11.7.1 Technical Requirement of DC Distribution Board Panel

a) Main bus bar shall be of high conductivity tinned copper of uniform rectangular cross section provided with positive and negative bus bars of adequate size.

b) Aux. Relay and contactor for alarm as well as visual indication against tripping of incoming MCCB as well as outgoing feeder MCCB shall be provided. However, indication will not go off till the restoration of failure.

c) 'ON', 'OFF' and 'TRIP' indicating lamps for both the incoming MCCB along with required number of push button shall be within the scope of supply.

d) One no. digital D.C. voltmeter having a scale range of 0-150 V.D.C. with 72*144 sq. mm. dia flush mounted, type having accuracy. +/- 1% of full scale, shall be provided. The meters shall conform to the appropriate IS specification.

e) Two nos. digital D.C. ammeter with 72*144 mm. sq. dia flush mounted, having range of 0-100 Amps. and accuracy +/- 1% of full scale, shall be provided for measurement of load current flowing to the D.C. switchboard.

f) The ampere rating of MCCB for feeder protection shall be as per requirement of the feeder current but shall not be less than 16 Amps.

g) Doors at the back of the panel shall be provided for inspection with door switch for illumination of the lamp to be provided inside the panel with separate switch fuse unit for controlling the lamp.

h) All the indicating lamps shall be of panel mounting cluster LED type. The lamps shall have suitable size plates marked with its function, wherever necessary. Lamps shall have translucent lamp covers of 'RED', 'GREEN' & 'WHITE' colour for indicating, 'ON', 'OFF' and 'AUTO-TRIP' indication of incoming MCCB's. One no. Indicating lamp is to be provided for tripping of outgoing feeder & DC supervision.

i) Space heater shall be provided for preventing harmful moisture condensation in all the D.C. Boards. The space heaters shall be suitable for continuous operation of 240V AC, 50HZ single switches and HRC fuses shall be provided.

j) All the D.C. and A.C. HRC fuses, D.C. Aux. Relays, isolating copper links, D.C. emergency fuse, D.C. emergency & A.C. emergency contactor, A.C. bell, indicating lamp for indicating D.C. fail of main bus, D.C. contactor etc. shall be within the scope of supply of the contractor. Three nos. Push Button for testing annunciation scheme, resetting annunciation scheme and accept of fault and bell cancellation shall be provided.

k) Moulded case circuit breaker for both incomer circuit shall be of 100 Amp. rating and double pole type. Each MCCB shall be provided with trip coil. MCCB shall be capable of safely breaking the fault current of the associated incoming feeder.

   i. All the MCCB shall be flush mounted on D.C. Distribution boards.

   ii. MCCB's shall be provided with thermo-magnetic type release for over current and short circuit protection.

   iii. The setting range of thermal release and breaking capacity of MCCB's are to be specified and shall conform to circuit requirement.

   iv. MCCB shall have Mechanical Anti-reclosing and facilities for over load and short circuit setting adjustment. MCCB knob shall indicate the true position of the equipment. MCCB's shall conform to relevant IEC Standard.

   v. **Interlocks shall be provided such that it is possible to open the cubicle door only when the MCCB is in 'OFF' position and to close the MCCB when the door is closed.**

11.7.2 Emergency Lighting

In case of AC failure, DC board shall supply emergency light in the Control Room building. Necessary devices for automatic change over for emergency lighting from AC to DC supply complete with necessary relays, interlocking and indications etc. shall be provided. Details shall be approved during engineering stage.

11.7.3 Earthing

An earth bus bar of 25 mm Copper Flat (to be got approved from Employer during detailed engineering) shall be provided along the entire length of the switchboard at the bottom. Two number earthing terminals connected to the earth bus bar shall be provided on the external face of the board for connection to the earthing grid at the sub-station.

11.7.4 Circuit Breakers

All outgoing & incoming feeders shall be through MCCB/MCB's the isolating links shallbe provided before MCCB/MCB.

11.7.5 Name Plate

Name plate shall be made of non-rusting metal or engraved on PVC shall be of size 50 mm x 20 mm indicating the feeder details and shall be provided for all feeders for easy identification DB No. etc. shall be provided.

11.8 Drawings & Literature

After receipts of the order, the contractor shall be required to furnish 5 prints of the following drawings for approval: -

a) General arrangements drawing of AC/DC distribution panel.
b) Typical schematic diagram of AC/DC distribution panel.
c) Complete assembly drawing of AC/DC distribution panel showing plan, elevation. sectional views and location of terminal blocks cable entry details
d) Control and wiring diagram for each module of AC/DC distribution board including spare terminals and inter modular and inter panel wiring.
e) Foundation plan showing location, channels, foundation bolts etc.
f) Schematic control diagram for control interlocks, relays, instruments and space heaters.
g) Protective relay characteristics of each type of relay
h) Fuse characteristics curve for each type of rating
i) Technical and descriptive literature giving details of the equipment offered.

APPENDIX 11-1: Typical Feeder Distribution of Substation

General

Exact quantity will be finalised at the time of detailed engineering. Thus, this table tentatively indicates the following minimum feeders shall be required from the AC Distribution Panel but not limited to this extent, and each shall be suitably rated as per requirement other than listed below in this table. Generally, MCCB shall be considered for feeders for three phase distribution whereas MCB could be considered for single phase distribution subject to approval of Employer.

S. No:	Name of the Feeder	MCCB Rating (10 kA for 1sec)	Cable Size
1	33/11 kV, 6/8 MVA Power Transformer Marshalling Box	4P 32A	4C x 10 sq.mm Cu PVC
2	132 kV Line Bay Marshalling Kiosk	4P 32A	4C x 10 sq.mm Cu PVC
3	Duplex control and relay panel	2P 25A	2C x 4 sq.mm Cu PVC (two feeders for each 132 kV class panel and four feeders for 33 kV class panel)
4	110 V Battery Charger	4P 32A	4C x 10 sq.mm Cu PVC (one feeder for each charger)
5	110 V Battery Charger	4P 32A	4C x 10 sq.mm Cu PVC (one feeder for each charger)
6	DCDB Supply	2P 16A	2C x 2.5 sq.mm Cu PVC (one for each panel)
7	11 kV Indoor Switchgear	2P 25A	2C x 4 sq.mm Cu PVC (two feeders)
8	Substation Automation System	2P 16A	2C x 2.5 sq.mm Cu PVC
9	Communication Equipments	2P 16A	2C x 2.5 sq.mm Cu PVC
10	Main Lighting Distribution Board (MLDB)	4P 63A	4C x 16 sq.mm Cu PVC
11	Air Conditioning for Control Building	2P 63A	2C x 16 sq.mm Cu PVC
12	Control Building Power	2P 32A	2C x 4 sq.mm Cu PVC
13	Smoke and Fire Detection Panel	2P 25A	2C x 4 sq.mm Cu PVC
14	Spare	4P 125A	
15	Spare	4P 32A	-
16	Spare	4P 32A	-
17	Spare	2P 25A	-

18	Spare	2P 16A	-

Note:

1) **These above listed feeders shall be decided in details during detail engineering depending upon the requirement.**
2) **The contractor shall furnish the details of all sub-distribution outgoing feeders from above listed incomers from Main ACDB which shall be approved by Employer.**

APPENDIX 11-2: Technical Particulars of Main ACDB and MLDB

S. No:	Location	Name of the Feeder	ACB/MCCB Rating	Cable Size
1	Main Lighting Distribution Board (MLDB)	Incomer from Main ACDB Panel	4P 63A	4C x 16 sq.mm Cu PVC
2	Other Distribution Board as per requirement	Incomer from Main ACDB Panel	Rating shall be decided during detail engineering as per requirement	Cable size shall be decided during detail engineering as per requirement

NOTE: The price for MLDB along with other distribution board meant to supply AC feeders shall quoted in unit rate of 440 V AC distribution board panel mentioned in S.No: 8.2 of Price Schedule – I.

APPENDIX 11-3: Technical Particulars of AC Distribution Board

S. No:	Description	Technical Parameters
1)	Dimensions	
	a) Height of complete panel (mm)	2200 (max)
	b) Working height (mm)	450 (min) to 1800 (max)
	c) Width (mm)	As per requirement
2)	Sheet steel thickness of panel (mm)	3 (min)
3)	Grade of insulation level for equipments and wiring (kV)	1.1
4)	Minimum rating of fuses	Not less than 16A
5)	Spring operated Air Circuit Breaker/ SFU/ MCCB/ fault current breaking capacity	31.5/25 kA for ACB 10 kA for others
6)	Voltmeter range/ Rating (volts)	0 to 500
7)	Ammeter range (Amps)	

8)	LT AIR CIRCUIT BREAKERS	
a)	System Voltage	400 V AC ± 10%
b)	Insulation voltage	1.1 kV
c)	Rated impulse withstand voltage of main circuit	8 kV
d)	Rated impulse withstand voltage of auxiliary circuit	4 kV
e)	Ambient Temperature	50ºC
f)	Rated frequency	50 Hz
g)	Rated continuous current at 40 ºC	630A
h)	Ultimate short circuit breaking capacity	31.5/25 kA
i)	Withstand short circuit breaking capacity	1 sec
j)	Utilization Category	B
k)	Suitable Isolation	Yes
l)	No. of poles	4
m)	Opening time	40-60 ms
n)	Closing time	60-80 ms
o)	Type of Breaker	Electrical draw out
p)	Spring Charging voltage	230 V AC/ 110 V DC
q)	Permissible variation in voltage	85-110 %
r)	Spring charging time	7-10 sec
s)	Closing coil voltage	110 V DC
t)	Permissible variation in voltage	85-110 %
u)	Tripping coil voltage	110 V DC
v)	Permissible variation in voltage	70-120 %
w)	Maximum temperature rise above ambient at rated current	40ºC
x)	Rated operating duty	O – 0.3 s – CO – 3 Min – CO
9)		

Note:

The outgoing feeders are meant for A.C supply to different control panel, protection panel, Battery charger, SAS and Communication equipment, etc and Transformer auxiliary supply, CB/Isolator auxiliary supply, switchyard lighting, water supply, air conditioning system at control room building, firefighting system, oil filtration and other auxiliary supply related to 132 kV sub-station.

The contractor is to supply AC distribution board to be finalized as per requirement during detailed engineering and as per approved drawings, which shall be within the scope of contractor.

APPENDIX 11-4: Technical Particulars of DC Distribution Board

S. No:	Description	Technical Parameters
1)	Dimensions	
	d) Height of complete panel (mm)	1800 (max)
	e) Working height (mm)	450 (min) to 1650 (max)
	f) Width (mm)	As per requirement
	g) Depth (mm)	750 (max)
2)	Sheet steel thickness of panel (mm)	3 (min)
3)	Grade of insulation level for equipments and wiring (kV)	1.1
4)	Annunciation for blowing of fuse or tripping of breaker	Alarm and visual indication
5)	Ammeter range	0 to 100
6)	Voltmeter range	0 to 150
7)	Wiring for annunciation scheme shall be done with copper of cross-section area (sq., mm)	1.5 (stranded)
8)	Ingress Protection	IP 42
9)	Metering	Digital DC Voltmeter and Ammeter
10)	Cable Entry	From bottom
11)	Applicable Standard	IEC 61439

Chapter 12: Control and Relay Panels

12.1 General

12.1.1 This specification covers study, design, manufacture, assembly, factory test, supply, delivery, installation, field test and commissioning of control and relay panels as specified herein under.

12.1.2 It is not the intent to specify completely herein all details of design and construction of equipment to be supplied. The major equipment to be supplied is specified in Appendix, Bill of Material. However, the equipment supplied shall conform, in all respects, to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to Manufacturers' guarantee.

12.1.3 The equipment shall be designed to be fail-safe for the possible failure of any major circuit during the operation and shall provide a safeguard against possible surges, fail-safe against disrupted signals due to outside interference that would normally be associated with the cable communication lines and any other provisions necessary for the different operation of the equipment.

12.1.4 The relays specified in the following articles are based on standard protection schemes generally adopted in 132 kV substations of Employer's Integrated Power System. However, the Contractor shall carry out detail system study of protection system of Integrated Power System with special regard to existing substations in the vicinity of the proposed works. Based on this study, the Contractor shall design a relaying scheme for the substations, prepare a detail relay schedule and recommend relay-setting values for relay co-ordination with existing ones and make all necessary adjustments in the relay settings of neighboring substations as well.

12.1.5 The indication and annunciation schemes intended for existing substations shall be compatible with the existing system as far as possible.

12.1.6 All major protection relays shall be of static/numeric type. Relays and energy meters supplied under this package shall be only from reputed short-listed manufacturers. **The main numerical protective relays shall be of Panel manufacturer's own make or their principal company's make.**

12.1.7 The complete panel shall incorporate all necessary instruments, meters, relays, auxiliary relays, control switches, indicating lamps, mimic, annunciators, audible alarms, horizontal and vertical wiring trough, wiring supports, interior lighting system, terminal blocks fuses and links etc.

12.1.8 Equipment to be furnished

132 kV Line Control and Relay Panel

Type of Panels

<u>Duplex Panel</u>

Duplex panel shall be walk-in tunnel type comprising two vertical front and rear panel sections connected back-on-back by formed sheet steel roof tie members and a central corridor in between. The corridor shall facilitate access to internal wiring and external cable connections. In case of number of duplex panels located in a row side by side, the central corridor shall be aligned to form a continuous passage. Both ends

of the corridor shall be provided with double leaf doors with lift off hinges. Doors shall have handles either with built-in locking facility or shall be provided with padlocks. Separate cable entries shall be provided for the front and rear panels. However, inter-connections between front and back panels shall be by means of inter panel wiring at the top of the panel.

The front and rear parts of duplex type C&R panel shall be detachable and all interconnection between front and rear panels shall be through terminal connector and preferably underneath the top cover. The interconnection between the simplex type control and relay panel and duplex type respective C&R panels where applicable will be made through cables to be laid in the cable trenches under those panels.

12.2 Constructional Features

12.2.1 Control and Relay Board shall be of panels of duplex type design as indicated in bill of quantity. It is the responsibility of the Contractor to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control schemes be properly accommodated in the panels without congestion and if necessary, **either add more number of panels or** provide panels with larger dimensions. No price increase at a later date on this account shall be allowed. However, the width of panels that are being offered to be placed in existing switchyard control rooms, should be in conformity with the space availability in the control room.

12.2.2 Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-31 in accordance with IEC 60529 (Part-1).

12.2.3 Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation.

12.2.4 All doors, removable covers of panels shall be gasketed all around with synthetic gaskets Neoprene/EPDM. However, XLPE gaskets can also be used for fixing protective glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh

12.2.5 Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces tune and smooth.

12.2.6 Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Anti-vibration strips made of shock absorbing materials that shall be supplied by the contractor, which shall be placed between panel & base frame.

12.2.7 Cable entries to the panels shall be from the bottom. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the panel/station through a flexible braided copper conductor rigidly.

12.2.8 Relay/protection panels of modern modular construction would also be acceptable.

12.2.9 Control/Relay panels, if required to incorporate the provisions for SCADA/SAS as specified in the relevant chapter, shall be completely equipped and wired with necessary devices/equipment for control and other signals to be used for such systems. The detail requirements for SCADA/SAS system are furnished in the relevant chapters of these

Specifications.

12.3 Mounting

12.3.1 All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panel shall be mounted flush.

12.3.2 Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible.

12.3.3 The Contractor shall carry out cut out, mounting and wiring of the free issue items supplied by others which are to be mounted in his panel in accordance with the corresponding equipment manufacturer's drawings. Cut outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.

12.3.4 The centre lines of switches, push buttons and indicating lamps shall not be less than 750mm from the bottom of the panel. The centre lines of relays, meters and recorders shall not be less than 450mm from the bottom of the panel.

12.3.5 The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise the top lines of all meters, relays and recorders etc. shall be matched.

12.3.6 No equipment shall be mounted on the doors.

12.3.7 At existing station, panels shall be matched with other panels in the control room in respect of dimensions, colour, appearance and arrangement of equipment (centre lines of switches, push buttons and other equipment) on the front of the panel.

12.4 Panel Internal Wiring

12.4.1 Panels shall be supplied complete with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be carried out internally

12.4.2 All wiring shall be carried out with 1100V grade, single core, stranded copper conductor wires with PVC insulation. The minimum size of the multi-stranded copper conductor used for internal wiring shall be as follows:

- All circuits except current transformer circuits and voltage transfer circuits meant for energy metering - one 1.5mm sq. per lead.
- All current transformer circuits - one 2.5 sq.mm per lead.
- Voltage transformer circuit (for energy meters): Two 2.5 mm sq. per lead.

12.4.3 The following color scheme shall be used for the wiring:

Circuit where used	Colour of the wire
Red, Yellow and Blue phase of instrument	Red, Yellow and Blue for

transformer circuit	respective phases
Neutral connections earthed or not earthed in the instrument transformer circuit	Black
Earthing Connection	Green
AC control wiring circuit for auxiliary AC supply	Black
DC control wiring circuit using DC battery supply	Grey

12.4.4 All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & troughs shall be used for this purpose.

12.4.5 Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels.

12.4.6 Wire termination shall be made with solderless crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule.

12.4.7 Longitudinal troughs extending throughout the full length of the panel shall be preferred for inter panel wiring. Inter-connections to adjacent panel shall be brought out to a separate set of terminal blocks located near the slots of holes meant for taking the inter-connecting wires.

12.4.8 Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipments.

12.4.9 All spare contact of relays shall be wired up to terminal blocks.

12.5 Terminal Blocks

12.4.1 All internal wiring to be connected to external equipment shall terminate on terminal blocks. Terminal blocks shall be 1100 V grade and have 10 Amps. continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.

12.4.2 Disconnecting type terminal blocks for current transformer and voltage transformer secondary leads shall be provided. Also, current transformer secondary leads shall be provided with short circuiting and earthing facilities.

12.4.3 At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

12.4.4 Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of external cable on each side

- All CT circuits: minimum of two of 4mm Sq. copper.
- All PT circuits: Four of 2.5 mm sq. copper
- AC/DC Power Supply Circuits: Four of 2.5mm Sq. copper.
- All other circuits: Four of 1.5mm Sq. Copper.

12.4.5 There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate or panel side wall. Also, the clearance between two rows of terminal blocks edges shall be minimum of 150mm.

12.4.6 Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side of the wiring-duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.

12.4.7 The number and sizes of the Owner's multi core incoming external cables will be furnished to the Contractor after placement of the order. All necessary cable terminating accessories such as gland plates, supporting clamps & brackets, wiring troughs and gutters etc. (except glands & lugs) for external cables shall be included in the scope of supply.

12.5 Painting

The painting shall be carried out as detailed in Chapter 2 – GTR.

12.6 Mimic Diagram

12.7.1 Coloured mimic diagram and symbols showing the exact representation of the system shall be provided in the front of control panels.

12.7.2 Mimic diagram shall be made preferably of anodised aluminium or plastic of approved fast colour material, which shall be screwed on to the panel and can be easily cleaned. The mimic bus shall be 2mm thick. The width of the mimic bus shall be 10mm for bus bars and 7mm for other connections. Painted overlaid mimic is also acceptable.

12.7.3 Colour scheme for mimic diagram shall be as follows:

kV Class	Colour	Shade Index as per ISS
132 kV	Signal Red	537
Earth	White	-
110 V and 48 V	Canary yellow	-

12.7.4 LED position indicators, round type, for all earth switches and isolators control switches and discrepancy type control switch with flash type built-in indicating lamp for circuit breakers shall be mounted along the mimic diagram at appropriate location in 132 kV duplex type C&R panels.

12.7.5 Indicating lamp, one for each phase, for each bus shall be provided on the mimic to indicate bus charged condition.

12.8 Name Plates and Markings

12.8.1 All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. Also on the top of each panel on front as well as rear side, large and bold nameplates shall be provided for circuit/feeder designation.

12.8.2 All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.

12.8.3 Each instrument and meter shall be prominently marked with the quantity measured e.g. KV, A, MW, etc. All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.

12.8.4 Name Plates shall be made of non-rusting metal or 3 ply lamicoid. Name plates shall be black with white engraving lettering.

12.8.5 Each switch shall bear clear inscription identifying its function e.g. 'BREAKER' '52A', "SYNCHRONISING" etc. Similar inscription shall also be provided on each device whose function is no other-wise identified. If any switch device does not bear this inscription separate name plate giving its function shall be provided for it. Switch shall also have clear inscription for each position indication e.g. "Trip- Neutral-Close", "ON-OFF", "R-Y-B-OFF" etc

12.8.6 All the panels shall be provided with name plate mounted inside the panel bearing LOA No & Date, Name of the Substation & feeder and reference drawing number.

12.9 Miscellaneous Accessories

Plug Point: 230V, Single phase 50Hz, AC socket with switch suitable to accept 5 Amps and 15 Amps pin round standard plug, shall be provided in the interior of each cubicle with ON-OFF switch.

Interior Lighting: Each panel shall be provided with a LED lighting fixture rated for 230 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch. One emergency DC light (LED) shall also be provided for each panel with individual switch with proper identification mark. Corridor of the duplex type control and relay board formation should be illuminated with adequate no. of LEDs, AC operated through door operated push buttons switch provided at both sides.

Switches and Fuses: Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with Fuses. Selection of the main and sub-circuit Fuses rating shall be such as to ensure selective clearance of sub-circuit faults. Voltage transformer circuits for relaying and metering shall be protected by fuses. All fuses shall be HRC cartridge type conforming to relevant international standard. Mounted on plug-in type fuse bases. The short time fuse rating of Fuses shall be not less than 9 KA. Fuse carrier base shall have imprints of the fuse 'rating' and 'voltage'.

Space Heater: Each panel shall be provided with a thermostatically connected space heater rated for 230V, single phase, 50 Hz AC supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit.

The above AC auxiliary supply and DC emergency lamp circuit in each panel shall be HRC fuse and link protected.

12.10 Earthing

12.10.1 All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure

no radiation interference from earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq.mm copper with threaded holes at a gap of 50 mm with provision of bolts and nuts for connection with cable armours and mounted equipment etc. for effective earthing. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of Contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

12.10.2 Provision shall be made on each bus bar of the end panels for connecting Substation earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of Contractor.

12.10.3 All metallic cases of relays, instruments and other panel mounted equipment including gland plate, shall be connected to the earth bus by copper wires of size not less than 2.5 sq. mm. The colour code of earthing wires shall be green.

12.10.4 Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided.

12.10.5 VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

12.10.6 An electrostatic discharge **arrangement** shall be provided in each panel **so as to discharge human body before he handles the equipments inside the panels**.

12.11 Indicating Instruments and Transducers for Control Panel

All instruments, meters and transducers shall be enclosed in dust proof, moisture resistant, black finished cases and shall be suitable for tropical use. All megawatt, megavar, Bus voltage and frequency indicating instruments shall be provided with individual transducers and these shall be calibrated along with transducers to read directly the primary quantities. They shall be accurately adjusted and calibrated at works and shall have means of calibration check and adjustment at site. The supplier shall submit calibration certificates at the time of delivery. However, no separate transducers are envisaged for digital bus voltmeters and digital frequency meters and the indicating meters provided in the synchronising equipment.

12.11.1 Indicating Instruments

Unless otherwise specified, all electrical indicating instruments shall be of digital type suitable for flush mounting.

Instruments shall have 4-digit display; display height being not less than 25 mm

Instrument shall confirm to relevant IEC and shall have an accuracy class of 1.5 or better. Watt and Var meters shall have an indication of (+) and (-) to indicate EXPORT and IMPORT respectively.

Digital voltage and frequency meters shall be of class: 0.5 and shall have digital display of 5 and 4 digits respectively, with display size, not less than 25mm (height).

Indicating lamps shall be of LED type and suitable for being operated on S/S D.C. voltage or AC voltage or P.T. secondary supply as and where applicable. All Lamps shall be interchangeable; panel mounting type with rear terminal connection and shall afford easy replacement from the front of the panel. Lamps shall have translucent lamp covers to diffuse lights and colored Red, green, Amber, clear white or blue as specified. The lamp cover shall be of screwed type, unbreakable and mounded from heat resisting material.

The indicating lamps with resistors shall withstand 120% of rated voltage on a continuous basis.

The colour scheme of the signal lamps shall be as follows:

Function	Colour lens
CB spring charged/compressor healthy indication	Blue
CB trip circuit healthy	White
Alarm Bus and Incoming DC Fail indication	Amber
PT supply healthy indication (Busbar healthy indication)	Red/Yellow/Blue
Isolator ON-OFF Indication	Red/Green

12.11.2 Transducers

Transducers (for use with Indicating Instruments and Telemetry/Data Communication application) shall in general conform to IEC:688-1

The transducers shall be suitable for measurement of active power, reactive power, voltage, current and frequency in three phase four wire unbalanced system.

The input to the transducers will be from sub-station current & potential transformers. The output shall be in milli ampere D.C. proportional to the input & it shall be possible to feed the output current directly to the telemetry terminal or indicating instruments.

The transducer characteristic shall be linear throughout the measuring range.

The transducer output shall be load independent.

The input & output of the transducer shall be galvanically isolated.

Each transducer shall be housed in a separate compact case and have suitable terminals for inputs & outputs.

The transducers shall be suitably protected against transient high peaks of voltage & current.

The transducer shall withstand indefinitely without damage and work satisfactorily at 120% of the rated voltage and 120% of the rated input current as applicable.

All the transducers shall have an output of 4-20 mA.

The response time of the transducers shall be less than 1 second.

The accuracy class of transducers shall be 1.0 or better for voltage/current transducer, 0.5 or better for watt/VAR transducer and 0.2 or better for frequency transducer.

The transducers shall have a low AC ripple on output less than 1%.

The transducer shall have dual output.

12.12 Annunciation System (for Control Panel)

12.12.1 Alarm annunciation system shall be provided in the control board by means of visual and audible alarm in order to draw the attention of the operator to the abnormal operating conditions or the operation of some protective devices. The annunciation equipment shall be suitable for operation on the voltages specified in this specification.

12.12.2 The visual annunciation shall be provided by annunciation facia, mounted flush on the top of

the control panels.

12.12.3 The annunciation facia shall be provided with translucent plastic window for alarm point with approximate size of 35mm x 50mm. The facia plates shall be engraved in black lettering with respective inscriptions. Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall not be less than 5 mm.

12.12.4 Each annunciation window shall be provided with two white lamps in parallel to provide safety against lamp failure. Long life lamps shall be used. The transparency of cover plates and wattage of the lamps provided in the facia windows shall be adequate to ensure clear visibility of the inscriptions in the control room having high illumination intensity (350 Lux), from the location of the operator's desk.

12.12.5 All Trip facia shall have red colour and all Non-trip facia shall have white colour.

12.12.6 The audible alarm shall be provided by Buzzer/ Hooter /Bell having different sounds and shall be used as follows.

- Hooter Alarm Annunciation
- Bell Annunciation DC failure
- Buzzer AC supply failure

12.12.7 Sequence of operation of the annunciator shall be as follows:

Sl. NO.	Alarm Condition	Fault Contact	Visual Annunciation	Audible Annunciation
1.	Normal	Open	OFF	OFF
2.	Abnormal	Close	Flashing	ON
3.	Accept Push Button Pressed	Close Open	Steady On Steady On	OFF OFF
4.	Reset Push Button Pressed	Close Open	On Off	OFF OFF
5.	Lamp Test Push Button Pressed	Open	Steady On	OFF

12.12.8 Audible annunciation for the failure of DC supply to the annunciation system shall be provided and this annunciation shall operate on 230 Volts AC supply. On failure of the DC to the annunciation system for more than 2 or 3 seconds (adjustable setting), a bell shall sound. A separate push button shall be provided for the cancellation of this audible alarm alone but the facia window shall remain steadily lighted till the supply to annunciation system is restored.

12.12.9 A separate voltage check relay shall be provided to monitor the failure of supply (230V AC) to the scheme mentioned in Clause above. If the failure of supply exists for more than 2 to 3 seconds, this relay shall initiate visual and audible annunciation. Visual and audible annunciation for the failure of AC supply to the annunciation system shall be provided and

this annunciation shall operate on Annunciation DC and buzzer shall sound.

12.12.10 The annunciation system described above shall meet the following additional requirements:

a) The annunciation system shall be capable of catering to at least 20 simultaneous signals at a time.

b) One set of the following push buttons shall be provided on each control panel:

- Reset push button for annunciation system
- Accept push button for annunciation system
- Lamp test push button for testing the facia windows

c) One set of the following items shall be provided common for all the control panel (not applicable for extension of substation):

- Flasher relay for annunciation system
- Push button for Flasher test
- Three Push buttons for test of all audible alarm systems

d) These testing circuits shall be so connected that while testing is being done, it shall not prevent the registering of any new annunciation that may land during the test.

e) The annunciation shall be repetitive type and shall be capable of registering the fleeting signal. Minimum duration of the fleeting signal registered by the system shall be 15 milli seconds.

f) In case of static annunciator scheme, special precaution shall be taken to ensure that spurious alarm condition does not appear due to influence of external electromagnetic/ electrostatic interference on the annunciator wiring and switching disturbances from the neighbouring circuits within the panels and the static annunciator shall meet the high voltage susceptibility test , impulse voltage withstand test , high frequency disturbance test– class III and fast transient disturbance test –level III as per IEC 60255.

12.12.11 The annunciation system to be supplied for existing sub-stations shall be engineered as an extension to the existing scheme.

12.13 Switches

12.13.1 Control Switches

Control and instrument switches shall be rotary operated type with escutcheon plates clearly marked to show operating position and circuit designation plates and suitable for flush mounting with only switch front plate and operating handle projecting out.

All Control switches shall be wire connected at the back. The contact mechanism shall be cam operated. The contacts shall be silver faced and designed for liberal rating of the duty involved. The contacts shall be provided with dust and vermin proof removable protection cover. The protection cover shall preferably be of transparent, inflammable material made of moulded dielectric material. Springs to be provided in the switch shall not be used as current carrying parts. The contacts provided in the switch shall be suitable for easy assembly/disassembly during replacement of the contacts. The control switch springs shall be strong to prevent any inadvertent operation due to a light touch on the handle.

Control switches for 132KV circuit breakers shall be of discrepancy type with built in pilot

lamps and having two maintained contact positions for "ON" and "OFF" positions and two momentary contact positions for "ON" and "OFF" impulse. The built-in pilot lamp shall give a steady light when the position of the control switch corresponds to the position of the associated circuit breaker. A flickering light shall be given by the same lamp when due to hand operation or due to automatic tripping of the circuit breaker the position of the control switch does not coincide with that of the corresponding circuit breaker. The arrangement to provide the flickering voltage for the above purpose shall be made by the contractor. In order to avoid continuous burning of the aforesaid built-in lamps associated with the control switches, the said lamp shall be connected through a switch. The circuit should be such that irrespective of the position of the aforesaid switch winking of the lamp shall not be affected by change in respective control switch position. The winking of the control switch pilot lamp shall be followed by an alarm annunciation after a preset time adjustable between 0-10 secs. Switches complete with accessories for the above function shall be supplied.

Control switches for 132 kV isolators shall be with pistol grip type operating handle having "ON & OFF" monetary operating position and an automatic return to normal neutral position on release from operated positions.

At bay level, Bay Control IEDs shall provide all bay level functions regarding control and monitoring, inputs for status indication and outputs for commands.

Clear control priorities shall prevent operation of a single switch at the same time from more than one of the various control levels, i.e. remote-control centre, station HMI, bay level or apparatus level. The priority shall always be on the lowest enabled control level.

12.13.2 Selector Switch and Change Over Switches

Instrument selector switches shall be provided for indicating instruments while change over switches shall be provided for selective operation of controls such as auto/non-auto reclose, trip circuit transfer from main breaker to transfer breaker. Protection selector switches to be provided in the Bus transfer bay shall be used for adopting the bus transfer bay protection during Bay transfer. Condition when line side C.T. operated protection of any bay develops any defect. All these switches shall be stay put type.

Voltmeter selector switch shall be suitable for reading all line to line and line to neutral voltage for effectively earthed system. This selector switch shall be of the rotary oval head or knob type.

Trip circuit transfer switch shall be of 3-position Normal-Inter-Transfer. Operating handle shall be pistol grip, lockable at Normal position and key trapped at transfer position having one common key for all 132KV panels respectively for a particular Sub-station.

One four position selector switch for setting group selection in respect of distance relay in Bus Transfer panel shall be provided.

One three position selector switch for setting group selection in respect of numerical over current & earth fault relay in Bus Transfer panel shall be provided.

12.13.3 Synchronising Switch

Synchronising switch with lock feature two positions, "ON & OFF" shall be provided on all control panels. The switch shall be semi flush mounting type.

The switch shall be wired back connected. It's operation in the "ON" position shall connect the incoming and running bus potentials to the respective synchronising instrument and relay mounted in a trolley, through a synchronising socket having sufficient nos. of ways. The wiring between the synchronising switch, socket and the main breaker control switch shall be such that when the main breaker control switch is operated to close position, the breaker shall not receive a close command unless the synchronising switch is put to the 'ON' position and receives a synchronising command. If the synchronising trolley is not within the scope of supply for a particular sub-station, the terminal of the synchronising socket to be sorted through a plug to be provided to cover the socket.

12.13.4 Push Button Switches

Push button switches, provided where required, shall be of the monetary contact type wired back connected. They shall be semi flush mounted. They shall be provided with integral inscription plates engraved with their functions.

All push buttons shall be with a set of NO/NC contacts as required to fulfill the scheme requirement. The contact faces shall be silver plated and shall able to make/break and carry the rated current appropriate to the duty of the desired function.

The selection of operating handles for the different types of switches shall be as follows:

Breaker, Isolator control switches	:	Pistol grip, black
Synchronising switches	:	Oval, Black, Keyed handle (one common removable handle for a group of switches or locking facility having common key)
synchronising Selector switches	:	Oval or knob, black
Instrument switches	:	Round, knurled, black
Protection Transfer switch	:	Pistol grip, lockable and black.

The contacts of all switches shall preferably open and close with snap action to minimize arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets of pure silver or silver alloy. Springs shall not be used as current carrying parts.

The contact combination and their operation shall be such as to give completeness to the interlock and function of the scheme.

The contact rating of the switches shall be as follows:

Description	**Contact Rating in Amps**		
	110V DC	**50V DC**	**230V AC**
Make and carry Continuously	10	10	10

Make and carry for 0.5 sec.	30	30	30
Break for Resistive load	3	20	7
Break for Inductive load with L/R = 40m sec.	0.2	-	-

12.14 Indicating Lamps

12.14.1 Indicating lamps shall be of cluster LED type suitable for panel mounting with rear terminal connections. Lamps shall be provided with series connected resistors preferably built in the lamp assembly. Lamps shall have translucent lamp covers to diffuse lights coloured red, green, amber, clear white or blue as specified. The lamp cover shall be preferably of screwed type, unbreakable and moulded from heat resisting material.

12.14.2 The lamps shall be provided with suitable resistors.

12.14.3 Lamps and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of the supply.

12.14.4 The indicating lamps with resistors shall withstand 120% of rated voltage on a continuous basis.

12.15 Position Indicators (if Applicable)

12.15.1 Position indicators of "SEMAPHORE" type shall be provided when specified as part of the mimic diagrams on panels for indicating the position of circuit breakers, isolating/earthing switches etc. The indicator shall be suitable for semi-flush mounting with only the front disc projecting out and with terminal connection from the rear. Their strips shall be of the same colour as the associated mimic.

12.15.2 Position indicator shall be suitable for DC Voltage as specified. When the supervised object is in the closed position, the pointer of the indicator shall take up a position in line with the mimic bus bars, and at right angles to them when the object is in the open position. When the supply failure to the indicator occurs, the pointer shall take up an intermediate position to indicate the supply failure.

12.15.3 The rating of the indicator shall not exceed 2.5 W.

12.15.4 The position indicators shall withstand 120% of rated voltage on a continuous basis.

12.16 Synchronising Equipment

12.16.1 For sub-station equipped with sub-station Automation system, the requirement of synchronisation is specified in chapter Sub-station Automation System and the same shall prevail. For other sub-station which is not equipped with Sub-sub-station automation system following shall be applicable as per requirement.

12.16.2 The synchronising instruments shall be mounted either on a synchronising trolley or on a synchronising panel. The panel/ trolley shall be equipped with double analog voltmeters and double analog frequency meters, synchroscope and lamps fully wired. The size of voltmeters and frequency meters provided in the synchronising panel shall not be less than 144 X 144 sq.mm. Suitable auxiliary voltage transformers wherever necessary shall also be provided for

synchronising condition. In case the synchroscope is not continuously rated, a synchroscope cut-off switch shall be provided and an indicating lamp to indicate that the synchroscope is energised, shall also be provided

12.16.3 Synchronising check relay with necessary ancillary equipment's shall be provided which shall permit breakers to close after checking the requirements of synchronising of incoming and running supply. The phase angle setting shall not exceed 35 degree and have voltage difference setting not exceeding 10%. This relay shall have a response time of less than 200 milliseconds when the two system conditions are met within present limits and with the timer disconnected. The relay shall have a frequency difference setting not exceeding 0.45% at rated value and at the minimum time setting. The relay shall have an adjustable time setting range of 0.5-20 seconds. A guard relay shall be provided to prevent the closing attempt by means of synchronising check relay when control switch is kept in closed position long before the two systems are in synchronism

12.16.4 The synchronising panel shall be draw out and swing type which can be swiveled in left and right direction. The synchronising panel shall be placed along with control panels and the number of synchronising panel shall be as indicated in SCHEDULES OF RATES AND PRICES. The incoming and running bus wires of VT secondary shall be connected and run as bus wires in the control panels and will be extended to synchronising panel for synchronisation of circuit breakers. The selector switch provided for each circuit breaker in respective control panels shall be lockable type with a common key so that only one selector switch is kept in synchronising mode at a time.

12.16.5 Alternatively, the trolley shall be of mobile type with four rubber-padding wheels capable of rotating in 360 degree around the vertical axis. Suitable bumpers with rubber padding shall be provided all around the trolley to prevent any accidental damage to any panel in the control room while the trolley is in movement. The trolley shall have two meter long flexible cord fully wired to the instruments and terminated in a plug in order to facilitate connecting the trolley to any of the panels. The receptacle to accept the plug shall be provided on the panel.

12.16.6 At existing sub-stations, the synchronising scheme shall be engineered to be compatible with the existing synchronising scheme and synchronising socket/switch on the panel. In substations, where synchronising panels are available, the bidder shall carry out the shifting of the above panels, if required, to facilitate the extension of control panel placement.

12.17 Relays

General Requirement

The main numerical protective relays shall be of Panel's manufacturer's own make or their principal company's make.

12.17.1 All relays shall conform to the requirements of IEC-60255/IEC 61000 or other applicable standards and shall be suitable for operation within a temperature range 0°C to 55°C and 50% to 95% relative humidity. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear, protected with dust tight cases for tropical use and with transparent cover removable from the front.

12.17.2 All protective relays shall be of numerical type and communication protocol shall be as per IEC 61850. Further, the test levels of EMI as indicated in IEC 61850 shall be applicable to these relays.

12.17.3 All protective relays shall be in draw out or plug-in type/modular cases with proper testing

facilities. Necessary test plugs/test handles shall be supplied loose and shall be included in contractor's scope of supply.

12.17.4 All AC operated relays shall be suitable for operation at 50 Hz AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 1 amp CT secondary. All DC operated relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

12.17.5 The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme; contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts.

12.17.6 Timers shall be of solid state type. Time delay in terms of milliseconds obtained by the external capacitor resistor combination is not preferred and shall be avoided.

12.17.7 No control relay, which shall trip the power circuit breaker when the relay is de-energised, shall be employed in the circuits.

12.17.8 Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

12.17.9 Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured:

a) The operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.

b) Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously.

c) Impedance of the seal-in-unit shall be small enough to permit satisfactory operation of the trip coil on trip relays when the D.C. Supply Voltage is minimum.

d) Trip-circuit seal-in is required for all trip outputs, irrespective of the magnitude of the interrupted current. The trip-circuit seal-in logic shall not only seal-in the trip output(s),but also the relevant initiation signals to other scheme functions, (e.g. initiate signals to the circuit-breaker failure function, reclosing function etc.), and the alarm output signals.

e) Two methods of seal-in are required, one based on the measurement of AC current, catering for those circumstances for which the interrupted current is above a set threshold, and one based on a fixed time duration, catering for those circumstances for which the interrupted current is small (below the set threshold).

f) For the current seal-in method, the seal-in shall be maintained until the circuit-breaker opens, at which time the seal-in shall reset and the seal-in method shall not now revert to the fixed time duration method. For this seal-in method, the seal-in

shall be maintained for the set time duration. For the line protection schemes, this time duration shall be independently settable for single- and three-pole tripping.

g) Seal-in by way of current or by way of the fixed duration timer shall occur irrespective of whether the trip command originates from within the main protection device itself (from any of the internal protection functions), or from an external device with its trip output routed through the main protection device for tripping. Trip-circuit seal-in shall not take place under sub-harmonic conditions (e.g. reactor ring down).

12.17.10 The setting ranges of the relays offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.

12.17.11 Any alternative/additional protections or relays considered necessary for providing complete effective and reliable protection shall also be offered separately. The acceptance of this alternative/ additional equipment shall lie with the OWNER.

12.17.12 All relays and their drawings shall have phase indications as R-Red, Y-yellow, B-blue

12.17.13 For numerical relays, the scope shall include the following:

a) Necessary software and hardware to up/down load the data to/from the relay from/to the personal computer installed in the substation.

b) The relay shall have suitable communication facility for connectivity to SCADA. The relay shall be capable of supporting IEC-61850 protocol.

c) In case of line protection and transformer protection, the features like fault recorder and event logging function as available including available as optional feature in these relays shall be supplied and activated at no extra cost to the owner. Also necessary software/ hardware for automatic uploading to station HMI/DR work station (as applicable) shall be supplied. It is to be clearly understood that these shall be in addition to Fault recorder function as specified at clause no. 28.

12.17.14 All the Numerical Relays should have setting parameter access restriction. All the numerical relay should have provision for setting all the features available in the relay and viewing those setting as well as different other parameters through both built in display unit as well as through PC. The supply of relay should be inclusive of necessary software and hardware for interfacing with a PC., to be supplied by the bidder. The bidder/manufacturer has to make arrangement for communication with all relays, along with supply of cables, connectors, communication port, converters etc. as necessary for downloading the storage data for all microprocessor/ numeric relays, disturbance recorder and fault locator etc. through a centralized PC. The necessary PC, window based Licensed software along with operating system software and all the necessary hardware for establishing the Network in latest IEC 61850 platform to be considered in the scope of supply by the bidder.

12.17.15 The electronic devices on bay shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements. The communication shall be made in fault tolerant ring in redundant mode INCLUDING the links between individual bay IEDs to switch, such that failure of one set of fiber shall not affect the normal operation. However, failure of fiber shall be indicated through alarm/ annunciation. Each fiber optic cable shall have four spare fibers.

12.17.16 The data exchange between the electronic devices on bay and station level shall be realized using fiber optic cables, thereby guaranteeing disturbance free communication. The fiber

optic cables shall be run in suitable, preferably GI, conduit pipes. Data exchange is to be realized using latest IEC 61850 protocol with a external managed switched optical Ethernet communication infrastructure in decentralized ring configuration.

12.17.17 All the protective relays shall be numerical type and communication protocol shall be latest IEC 61850 compatible with the following features:

i) Peer-to-peer communication using GOOSE messages (latest IEC61850) for interlocking.

ii) Interoperability with third party IEC 61850 (latest version) compliant devices

iii) Generate XML file for integration/engineering with vendor independent SCADA systems.

iv) Should be directly connected to the inter bay bus on IEC 61850 (latest version) without the use of any gateways. Connections of bay protection IEDs to the IEC 61850 bus (latest version) through the bay control units are not acceptable.

v) All Numerical relays must be PRP compliant for SAS.

12.17.18 All the numerical relays shall have one front port for direct access with proprietary protocol, rear ports with latest IEC 61850 protocol (One no. mandatory FO port and another FO/RJ 45 port). The main Numerical Protective Relays shall synchronise the internal clock with GPS based time synchronising equipment.

12.17.19 All numerical relays shall be provided with 'Relay Failure Annunciation Contact'. Individual window is to be assigned in annunciator for each Numerical relay.

12.17.20 List of software for local parameterisation, settings, logic configuration, data retrieval, disturbance evaluation, downloading of storage data and no. of license (minim. 3 & one each for other substations involved) shall be supplied by the bidder:

i) Graphical configuration tool having all the functions used in the relay and sufficient numbers different logic gates in the inbuilt library (software)

ii) Basic application licensed software for setting change, service value monitoring etc., one each for every substation where numerical relays shall have to be provided.

iii) Software for disturbance record & event logger collection and evaluation of those records in COM TRADE format.

iv) Latest IEC 61850 software for inter-operability, Goose message etc.

v) Any additional software if required for remote communication and for other facilities available in the relay.

All the above tools/software should be WINDOWS 7/WINDOWS 10/WINDOWS 11 operating system compatible.

12.17.21 Connectivity architecture of Disturbance recorder evaluation station of all numerical relays like numerical distance relay, numerical differential relay etc. with time synchronization unit.

12.17.22 Interface architecture involving multiple nos. of numerical relays of respective make, with the monitoring PC. Interface architecture of the above network with existing/future network of other make numerical relays with monitoring PC, wherever applicable.

12.17.23 The bidder has to furnish the certificate for latest IEC 61850 Compliance from KEMA/CPRI, type test certificate from any Govt. recognized Test House and performance certificate from reputed Power Utilities.

12.17.24 The contractor shall provide one number of laptop computer with latest Intel processor or at least Intel core i7 processor, relay programming software and necessary probes & cables for setting the numeric relays. No separate payment for laptop, software probes, cables etc. shall be made and all cost involved for these items shall be quoted in the unit price and included in the cost of control and relay panels.

12.18 Bay Control Unit

[The IED should be latest IEC 61850 compliant having rear port compatible to latest IEC 61850 protocol].

12.18.1 One no. BCU shall be provided for supervision and control of each bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer).

12.18.2 Communication Port: BCU shall be PRP compliant for SAS with latest 61850 protocol including one front port for direct access with proprietary protocol.

12.18.3 Inputs: Sufficient opto-isolated inputs. Contact bouncing in Digital inputs shall not be assumed as change of state.

12.18.4 Outputs: Sufficient potential free outputs.

12.18.5 All inputs and outputs must be user programmable. The bay control units shall be equipped with sufficient number of programmable I/O modules for interfacing with the process inputs and outputs. Extension should be possible with additional I/Os via fibre-optic communication and process bus.

12.18.6 The BCU shall meet the requirements for withstanding electromagnetic interference as per relevant standard. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

12.18.7 The IEDs should be directly connected to the switchgear without any need for additional interposition or transducers.

12.18.8 A graphic user interface (GUI) display shall be provided in each bay control unit. The GUI display in the BCU shall display the status of the bay devices (breakers, isolators, switches etc) in real time. All alarms related to the respective bay shall be displayed in the BCU through its LED's or in its GUI display as an alarm list/scroll.

12.18.9 Analog inputs for voltage and current measurements shall be connected directly to the voltage transformers and the current transformers without intermediate transducers. The values of active power (MW), reactive power (MVAR), Frequency (Hz) and the RMS values for Voltage and Current shall be calculated.

12.18.10 Each bay control IED shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the other bay control units of the station.

12.18.11 Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

12.18.12 "The bay control unit shall be fed from redundant DC power supplies; this may be implemented with redundant power supply modules in the BCU or with automatic DC source selection with a suitable auxiliary relay."

12.18.13 The BCU must also have redundant processor unit.

12.18.14 Functions of BCU:

a) Control mode selection
b) Selection before execute principle
c) Command supervision
d) Interlocking and blocking
e) Double Command
f) Synchro-check, voltage selection
g) Run Time Command cancellation
h) Transformer Tap Changer Control (Raise & Lower of tap) for power transformer bays
i) Operation counter for circuit breakers
j) Breaker position indicator per phase
k) Alarm annunciation
l) Measurement display of Vrms, Irms, Hz, W, VAR for each phase and for 3 phases
m) Local HMI (local guided, emergency mode) with graphic display
n) Data storage for at least 200 events
o) Capability to implement bay level interlocks

12.19 Event Logger

[The IED should be latest IEC 61850 compliant having rear port compatible to latest IEC 61850 protocol].

12.19.1 Stand-alone type Event logger to be considered with external triggering facility. The event list shall contain events that are important for the control and monitoring of the substation.

12.19.2 The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. It should be possible to get the chronological event list at any time for the whole substation or sections of it. Filters for selection of a certain type or group of events shall be available. The filters shall be designed to enable viewing of events grouped per:

i) Date & Time
ii) Bay
iii) Device
iv) Functions e.g. Trips, Protection operations etc.
v) Alarm class

12.19.3 The chronological event list shall contain:

i) Position changes of Circuit Breakers, Isolators and Earthing devices
ii) Indication of Protective relay operations

iii) Fault signals from the switchgear

iv) Indication when analog measured values exceed upper and lower limits. Suitable provision shall be available to define two level of alarm on either side of the value, which shall be user defined for each measurands.

v) Loss of communication

12.19.4 Event Logger shall fetch events from IEDs (including BCU) through soft signals. It shall also fetch events from potential free contacts through BI (5 inputs per bay + 20% spare).

12.19.5 All recorded/stored events shall be date and time tagged followed by a message describing the points which have been operated. The time resolution shall be 1 milli second.

12.19.6 Number of time tagged events in the event list should be sufficient enough to record/store all possible sorts of events of the switchyard, equipment, relays etc.

12.19.7 Event Recorder buffer memory shall be of non-volatile type and shall not require the use of batteries.

12.19.8 The printout of events shall contain at least the station & feeder identification, date and time (in hour, minute, second and millisecond), event number and event description. The event list and its print out may be available from S/S; PC and its printer to be supplied by the bidder for a complete S/Stn. The timing of each event shall be as per GPS based time synchronising equipment to be supplied by the bidder, wherever applicable & mentioned in the schedule.

12.20 Transmission Line Protection

[The IED should be latest IEC 61850 compliant having rear port compatible to latest IEC 61850 protocol].

12.20.1 All relays shall be suitable for series compensated line.

12.20.2 The line protection relays are required to protect the line and clear the faults on line within shortest possible time with reliability, selectivity and full sensitivity to all type of faults on lines. The general concept is to have main and back up protection for 132 KV transmission lines.

12.20.3 The maximum fault current could be as high as 40 kA but the minimum fault current could be as low as 20% of rated current of CT secondary. The starting & measuring relays characteristics should be satisfactory under these extremely varying conditions.

12.20.4 The protective relays shall be suitable for use with capacitor voltage transformers having non-electronic damping and transient response as per IEC.

12.20.5 Fault Recorder, Distance to fault Locator and Over voltage relay (stage -1/2) functions if offered as an integral part of line protection relays, shall be acceptable provided these meet the technical requirements as specified in the respective clauses.

12.20.6 Auto reclose relay function if offered as an integral part of line distance protection relay, shall be acceptable **for 132 KV lines only** provided the auto reclose relay feature meets the technical requirements as specified in the respective clause.

12.20.7 The following protections shall be provided for each of the Transmission lines:

For 132KV

Main: Numerical distance protection scheme

Back up: Directional Over Current and Earth fault Protection

The detailed description of line protections is given here under.

12.20.8 Main distance protection scheme

(a) The distance protection shall be a microprocessor based high speed non-switched distance relay suitable for all phase to phase faults and phase to earth faults based on numerical principles. It shall also have necessary phase selection and direction selection facilities. The relay shall be field selectable for various permissive over reaching, permissive under reaching and for blocking/ intertripping through communication schemes. The relay shall have polygonal/quadrilateral characteristics with a facility to set resistance and reactance characteristics independently.

(b) Shall be non-switched type with separate measurements for all phase to phase and phase to ground faults

(c) The relay shall have three forward and one reverse zone of protection for each PH-PH & PH-E fault loop with sufficient impedance or reactance and resistance reach of each zone. It shall have three zone time stepped characteristics. The second and third zone elements shall provide backup protection in the event of the carrier protection on the first zone element failing to clear the fault.

(d) It shall be provided with self-continuous supervision features along with self-diagnostic feature, having output IRF contact for annunciation purpose.

(e) Shall have following maximum operating time (including trip relay time, if any) under given set of conditions and with CVT being used on line (with all filters included)

(f) Shall have following maximum operating time (including trip relay time, if any) under given set of conditions and with CVT being used on line (with all filters included). Maximum operating time 45ms for 3 ph. Faults & 60ms for all other faults. A relaxation of 5 ms in above timings is allowed for 132 KV lines.

(g) Line Protection for 132 kV system for remote end tripping will be done through OPGW.

(h) The relay shall have an adjustable characteristics angle setting range of 30 -85 degree or shall have independent resistance(R) and reactance (X) setting.

(i) Shall have two independent continuously variable time setting range of 0-3 seconds for zone-2 and 0-5 seconds for zone-3

(j) Shall have resetting time of less than 55 milli-seconds (including the resetting time of trip relays)

(k) Shall have facilities for offset features with adjustable 10-20% of Zone-3 setting

(l) Shall have variable residual compensation

(m) Shall have memory circuits with defined characteristics in all three phases to ensure correct operation during close-up 3 phase faults and other adverse conditions and shall operate instantaneously when circuit breaker is closed to zero-volt 3 phase fault

(n) Shall have weak end in-feed feature

(o) Shall be suitable for single & three phase tripping

(p) Shall have a continuous current rating of two times of rated current. The voltage circuit shall be capable of operation at 1.2 times rated voltage. The relay shall also be capable of carrying a high short time current of 70 times rated current without damage for a period of 1 sec.

(q) Shall be provided with necessary self-reset type trip duty contacts for completion of the scheme (Minimum number of these trip duty contacts shall be four per phase) either through built in or through separate highspeed trip relays. Making capacity of these trip contacts shall be 30 amp for 0.2 seconds with an inductive load of L/R > 10 mill seconds. If separate high speed trip relays are used, the operating time of the same shall not be more than 10 milliseconds

(r) Shall be suitable for use in permissive under reach/ over reach/ blocking communication mode

(s) Shall have suitable number of potential free contacts for inter Tripping, Auto reclosing, CB failure, Disturbance recorder & Data acquisition system.

(t) Include power swing blocking protection which shall

- have suitable setting range to encircle the distance protection described above
- block tripping during power swing conditions
- release blocking in the event of actual fault

(u) Include fuse failure protection which shall monitor all the three fuses of C.V.T. and associated cable against open circuit

- inhibit trip circuits on operation and initiate annunciation
- have an operating time less than 7 milliseconds
- remain inoperative for system earth faults

(v) Include a directional back up Inverse Definite Minimum Time (IDMT) earth fault relay with normal inverse characteristics as per IEC 60255-3 as a built in feature

(w) Must have a current reversal guard feature.

12.20.9 Back-up Directional Over Current and Earth fault protection scheme

(a) shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s)

(b) shall include necessary VT fuse failure relays for alarm purposes

(c) LED indication facility for visual annunciation of different types of faults within the relay and the relay should have potential free 'change over' contact for annunciation in the event of internal failure

(d) Relay should show fault current with time stamping.

(e) The relay should have more than one selectable setting group.

(f) The relay should have non-volatile memory for

- Event Recorder – shall have facility of recording up to 75 events with time stamping
- Setting Values
- Disturbance recorder data – Recorded data of last 5 events with time stamp.

(g) Fault records – at least five nos. fault records shall be available with the following indications:

- Fault Indication
- Current values
- Tripping time

(h) **over current elements** shall

- have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting
- have a variable setting range of 50-200% of rated current
- have a characteristic angle of 30/45 degree lead
- include hand reset flag indicators or LEDs

(i) **earth fault element** shall

- have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting
- have a variable setting range of 20-80% of rated current
- have a characteristic angle of 45/60 degree lag
- include hand reset flag indicators or LEDs
- include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay

12.20.10 **Line Over Voltage Protection Relay** shall

(a) monitor all three phases

(b) stage – I & II as built-in with line distance relays Main I & Main II respectively are acceptable.

(c) have an adjustable setting range of 100-170% of rated voltage with an adjustable time delay range of 1 to 60 seconds for the first stage

(d) have an adjustable setting range of 100-170% of rated voltage with a time delay of 100-200 mill seconds for the second stage

(e) be tuned to power frequency

(f) provided with separate operation indicators (flag target) for each stage relays

(g) have a drop-off to pick-up ratio greater than 95%

(h) provide separate out-put contacts for each 'Phase' and stage for breaker trip relays, event logger and other scheme requirements.

12.20.11 All trip relays used in transmission line protection scheme shall be of self/electrical reset type depending on application requirement.

12.21 Circuit Breaker Protection

This shall include following functions:

12.21.1 **Numerical AUTO RECLOSING** function shall

(a) It shall be compatible with the distance relaying scheme. It shall have single and/or three phase reclosing facilities. The bidder shall coordinate the auto-reclose relaying scheme with that of the circuit breaker so as to ensure satisfactory and reliable operation of the auto reclosing scheme.

(b) have a continuously variable single-phase dead time range of 0.1-2 seconds

(c) have a continuously variable reclaim time range of 5-300 seconds

(d) Incorporate a **two** position selector switch, from which single phase auto-reclosure and non-auto reclosure mode can be selected. Alternatively, the mode of auto reclosing can be selected through programming.

(e) be of single shot type

(f) have priority circuit to closing of both circuit breakers in case one and half breaker arrangements to allow sequential closing of breakers

(g) However, Auto-reclose as in built function of bay controller unit (BCU) (if supplied) provided for sub-station automation system is also acceptable.

12.21.2 **LOCAL BREAKER BACK-UP PROTECTION SCHEME** shall

(a) be triple pole type

(b) have an operating time of less than 15 milli seconds

(c) have a resetting time of less than 15 milli seconds

(d) have three over current elements with facility for phase wise initiation.

(e) be arranged to get individual initiation from the corresponding phase of main protections of line for each over current element. However, common three phase initiation is acceptable for other protections and transformer /reactor equipment protections

(f) have a current setting range of 20-320% of rated current for over current.

(g) have a continuous thermal withstand two times rated current irrespective of the setting

(h) have a timer with continuously adjustable setting range of 0.1-1 seconds

(i) have necessary auxiliary relays to make a comprehensive scheme

(j) be similar relays for complete scope of work as per specification.

12.21.3 **Restricted Earth Fault Protection** shall

(a) be single pole, stand-alone type

(b) be of current/voltage operated high impedance type with a suitable setting to cover the maximum portion of transformer winding. Necessary calculation to prove the above winding coverage shall be furnished.

(c) have a current setting range of 10-40% of 1 Amp. / have a suitable voltage setting range

(d) have suitable nonlinear resistor to limit the peak voltage without detriment to the scheme.

(e) Operating time shall be less than 20ms.

(f) Have suitable stabilizing resistor to prevent mal-operation during external faults if necessary.

(g) be tuned to the system frequency

12.22 **Back-up Over Current and Earth fault protection scheme with high set feature**

(a) Shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s).

(b) The scheme shall include necessary VT fuse failure relays for alarm purposes

(c) Over current relay shall

- have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current
- have low transient, over reach high set instantaneous unit of continuously variable setting range 500-2000 % of rated current
- have a characteristic angle of 30/45 degree lead
- include hand reset flag indicators or LEDs.

(d) Earth fault relay shall

- have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 20-80% of rated current
- have low transient, over reach high set instantaneous unit of continuously variable setting range 200-800 % of rated current
- have a characteristic angle of 45/60 degree lag
- include hand reset flag indicators or LEDs
- include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay

12.23 Trip Circuit Supervision Relay

a) The relay shall be capable of monitoring the healthiness of each 'phase' trip-coil and associated circuit of circuit breaker during 'ON' and 'OFF' conditions.

b) The relay shall have adequate contacts for providing connection to alarm and event logger.

c) The relay shall have time delay on drop-off of not less than 200 milli seconds and be provided with

operation indications for each phase.

d) These relays shall monitor the whole of the trip circuit whether the breaker is in open or closed and give an alarm for the (i) loss of D.C. supply or (ii) for faults in the trip coil or for faults in the trip circuit leads or for faults in the breaker auxiliary contacts or faults in the supervisory relay itself. The relay shall have a delay in drop off at least 200ms to avoid a false alarm during a normal tripping operation.

e) DC supply to each trip coil of the circuit breakers shall be supervised with an independent trip circuit supervision relay. These relays shall be mounted in the relay panel associated with the circuit breaker.

12.24 Tripping Relay

High Speed Tripping Relay shall

(a) be instantaneous (operating time not to exceed 10 milli-seconds).

(b) reset within 20 milli seconds

(c) be D.C. operated

(d) have adequate contacts to meet the requirement of scheme, other functions like auto-reclose relay, LBB relay as well as cater to associated equipment like event logger, Disturbance recorder, fault Locator, etc.

(e) be provided with operation indicators for each element/coil.

12.25 DC Supply Supervision Relay

a) The relay shall be capable of monitoring the failure of D.C. supply to which, it is connected.

b) It shall have adequate potential free contacts to meet the scheme requirement.

c) The relay shall have a 'time delay on drop-off' of not less than 100 milli seconds and be provided with operation indicator/flag.

12.26 Bus Bar Protection

[The IED should be latest IEC 61850 compliant having rear port compatible to latest IEC 61850 protocol].

The bus bar protection relay should support various bus architectures selectable by means of the relay configuration (Single bus bar, Double bus bar, Breaker and a half bus bar, two section bus bars with a bus tie, Double bus bar with transfer bus and tie breaker) for its bus bar protection. Bus Bar protection scheme should operate selectively for each bus bar. Bus bar protection for each busbar shall incorporate a main protection feature.

The relay shall incorporate dynamic bus replica and provide necessary end zone/ blind zone fault protection depending on the bus bar protection CT's location.

Facility to monitor the bus differential currents and bus restraint current for each zone shall be supported in the relay display as well as through configuration tools.

Built-in Local Breaker Backup protection feature as a part of bus bar protection scheme shall also be acceptable.

12.26.1 Each Bus Bar protection scheme shall

(a) Shall be phase segregated and triple pole type with separate relay for each phase

and provide independent zone of protection. If bus section is provided, then each side of the bus section shall have separate set of bus bar protection scheme.

(b) The bus section breaker and bus coupler breaker shall be covered by overlapping busbar protection scheme of respective buses.

(c) Shall include one overall check zone protection in addition to single/multiple zones specified.

(d) Shall incorporate continuous supervision for CT secondary against any possible open circuit and if it occurs, shall render the relevant zone of protection inoperative and initiate an alarm.

(e) Include protection 'IN/OUT' switch for each zone.

(f) have maximum operating time up to trip impulse to trip relay for all types of faults of 25 milli seconds at 5 times setting value.

(g) operate selectively for each bus bar

(h) give hundred percent security up to 40 kA fault level for 132 KV

(i) incorporate continuous supervision for CT secondary against any possible open circuit and if it occurs, shall render the relevant zone of protection inoperative and initiate an alarm

(j) not give false operation during normal load flow in bus bars

(k) incorporate clear zone indication

(l) provide independent zones of protection (including transfer bus if any). If the bus section is provided then each side of bus section shall have separate set of bus bar protection schemes

(m) include individual high speed electrically reset tripping relays for each feeder. However, in case of distributed Bus bar protection, individual trip relay shall not be required if bay unit is having trip duty contacts for breaker tripping.

(n) be transient free in operation

(o) include continuous D.C. supplies supervision

(p) not cause tripping for the differential current below the load current of heaviest loaded feeder. Contractor shall submit application check for the same.

(q) shall include necessary C.T. switching relays wherever C.T. switching is involved and have 'CT' selection incomplete alarm

(r) include protection 'IN/OUT' switch for each zone

(s) shall include trip relays, CT switching relays (if applicable), auxiliary CTs (if applicable) as well as additional power supply modules, input modules etc. as may be required to provide a Bus-bar protection scheme for the complete bus arrangement i.e. for all the bays or breakers including future bays as per the Single line diagram for new substations. However, for extension of bus bar protection scheme in existing substations, scope shall be limited to the bay or breakers covered under this specification. Suitable panels (if required) to mount these are also included in the scope of the work.

(t) In case of distributed Bus bar Protection, the bay units for future bays may be

installed in a separate panel and the same shall be located in switchyard panel room where bus bar protection panel shall be installed.

12.26.2 Built-in Local Breaker Backup protection feature as a part of bus bar protection scheme shall also be acceptable.

12.26.3 The test terminal blocks (TTB) to be provided shall be fully enclosed with removable covers and made of moulded, non-inflammable plastic material with boxes and barriers moulded integrally. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring. Terminal block shall have shorting, disconnecting and testing facilities for CT circuits.

12.27 Weather Proof Relay Panels (if applicable)

(a) This panel shall include necessary number of electrically reset relays each with at least eight contacts for isolator auxiliary contacts multiplication and for changing the CT and DC circuits to relevant zones of bus bar protection.

(b) The panel shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be at least 2.0 mm thick and properly braced to prevent wobbling.

(c) The enclosures of the panel shall provide a degree of protection of not less than IP-55 (as per IEC-60529).

(d) The panel shall be of free-standing floor mounting type or pedestal mounting type as per requirement.

(e) The panel shall be provided with double hinged doors with padlocking arrangement.

(f) All doors, removable covers and panels shall be gasketed all around with synthetic gaskets Neoprene/EPDM. However, XLPE gaskets can also be used for fixing protective glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh

(g) Cable entries shall be from bottom. Suitable removable cable gland plate shall be provided on the cabinet for this purpose.

(h) All sheet steel work shall be degreased, pickled, phosphated and then applied with two coats of zinc chromates primer and two coats of finishing synthetic enamel paint, both inside and outside. The colour of the finishing paint shall be light grey.

(i) Suitable heaters shall be mounted in the panel to prevent condensation. Heaters shall be controlled by thermostats so that the cubicle temperature does not exceed 30^{o}C. On-off switch and fuse shall be provided. Heater shall be suitable for 230V AC supply Voltage.

(j) The test terminal blocks (TTB) to be provided shall be fully enclosed with removable covers and made of moulded, non-inflammable plastic material with boxes and barriers moulded integrally. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring. Terminal block shall have shorting, disconnecting and testing facilities for CT circuits.

12.28 Fault Recorder

12.28.1 The fault recorder shall be provided for transmission line and the fault recorder as in-built feature of line distance relay is also acceptable provided the requirements of following clauses are met.

12.28.2 Fault recorder shall be microprocessor based and shall be used to record the graphic form of instantaneous values of voltage and current in all three phases, open delta voltage & neutral current, open or closed position of relay contacts and breakers during the system disturbances.

12.28.3 The Fault recorder shall consist of individual acquisition units, one for each feeder and an Evaluation unit which is common for the entire Substation. Whenever, more than one acquisition units are connected to an Evaluation unit, necessary hardware and software shall also be supplied for on line transfer of data from all acquisition units to Evaluation unit.

12.28.4 Fault recorder shall have atleast 8 analogue and 16 digital channels for each feeder.

12.28.5 Acquisition units shall acquire the Disturbance data for the pre fault and post fault period and transfer them to Evaluation unit automatically to store in the hard disk. The acquisition units shall be located in the protection panels of the respective feeders.

12.28.6 The acquisition unit shall be suitable for inputs from current transformers with 1A rated secondary and capacitive voltage transformers with 63.5V (phase to neutral voltage) rated secondary. Any device required for processing of input signals in order to make the signals compatible to the Fault recorder equipment shall form an integral part of it. However, such processing of input signals shall in no way distort its waveform.

12.28.7 The equipment shall be carefully screened, shielded, earthed and protected as may be required for its safe functioning. Also, the Fault recorder shall have stable software, reliable hardware, simplicity of maintenance and immunity from the effects of the hostile environment of EHV switchyard which are prone to various interference signals typically from large switching transients.

12.28.8 Necessary software for transferring the data automatically from local evaluation unit to a remote station and receiving the same at the remote station through owner's OPGW/PLCC/VSAT/LEASED LINE shall be provided.

12.28.9 Fault recorder acquisition units shall be suitable to operate from 110V DC as available at sub-station. The acquisition unit shall have the following features

(a) Facility shall exist to alarm operator in case of any internal faults in the acquisition units such as power supply fail, processor / memory fail etc and same shall be wired to annunciation system.

(b) The frequency response shall be 5 Hz on lower side and 250 Hz or better on upper side.

(c) Scan rate shall be 1000 Hz/channel or better.

(d) Pre-fault time shall not be less than 100 milliseconds and the post fault time shall not be less than 2 seconds (adjustable). If another system fault occurs during one post-fault run time, the recorder shall also be able to record the same. However, the total memory of acquisition unit shall not be less than 5.0 seconds

(e) The open delta voltage and neutral current shall be derived either through software or externally by providing necessary auxiliary transformers.

(f) The acquisition unit shall be typically used to record the following digital channels:

1. Main CB R phase open
2. Main CB Y phase open
3. Main CB B phase open
4. Main carrier received
5. Main protection operated
6. Main BC Auto reclosed operated
7. Over Voltage -Stage-1 /2 operated
8. Direct Trip received
9. Back Up protection operated
10. Bus bar protection operated
11. LBB operated of main /BC circuit breaker
12. BC CB R phase open
13. BC CB Y phase open
14. BC CB B phase open

(g) In case the Fault recorder is in-built part of line distance protection, above digital channels may be interfaced either externally or internally.

(h) Any digital signal can be programmed to act as trigger for the acquisition unit. Analog channels should have programmable threshold levels for triggers and selection for over or under levels should be possible.

12.28.10 Each Fault recorder shall have its own time generator and the clock of the time generator shall be such that the drift is limited to $\pm$0.5 seconds/day, if allowed to run without synchronisation. Further, Fault recorder shall have facility to synchronise its time generator from Time Synchronisation Equipment having output of following types

- Voltage signal: (0-5V continuously settable, with 50m Sec. minimum pulse duration)
- Potential free contact (Minimum pulse duration of 50 m Sec.)
- IRIG-B
- RS232C

The recorder shall give annunciation in case of absence of synchronising within a specified time.

12.28.11 Substations where Time Synchronisation Equipment is not available, time generator of any one of the Fault recorders can be taken as master and time generators of other Fault recorders and Event loggers in that station shall be synchronised to follow the master.

12.29 **Distance to Fault Locator** shall

a) be electronic or microprocessor-based type

b) be 'On-line' type

c) be suitable for breaker operating time of 2 cycles

d) have built-in display unit

e) the display shall be directly in percent of line length or kilometres without requiring any further calculations.

f) have an accuracy of 3% or better for the typical conditions defined for operating timings measurement of distance relays

g) The above accuracy should not be impaired under the following conditions:

- presence of remote end infeed
- predominant D.C. component in fault current
- high fault arc resistance
- severe CVT transients

h) shall have mutual zero sequence compensation unit if fault locator is to be used on double circuit transmission line

i) built in feature of line distance relay is acceptable provided the requirements of above clauses are met

12.30 Time Synchronisation Equipment

12.30.1 The Time synchronisation equipment shall receive the co-ordinated Universal Time (UTC) transmitted through Geo Positioning Satellite System (GPS) and synchronise equipments to the Nepal Standard Time in a substation.

12.30.2 Time synchronisation equipment shall include antenna, all special cables and processing equipment etc.

12.30.3 It shall be compatible for synchronisation of Event Loggers, Disturbance recorders and SCADA at a substation through individual port or through Ethernet realised through optic fibre bus.

12.30.4 Equipment shall operate up to the ambient temperature of 50 degree centigrade and 80% humidity.

12.30.5 The synchronisation equipment shall have 2 micro-second accuracy. Equipment shall give real time corresponding to IST (taking into consideration all factors like voltage, & temperature variations, propagation & processing delays etc.).

12.30.6 Equipment shall meet the requirement of IEC 60255 for storage & operation.

12.30.7 The system shall be able to track the satellites to ensure no interruption of synchronisation signal.

12.30.8 The output signal from each port shall be programmable at site for either one hour, half hour, minute or second pulse, as per requirement.

12.30.9 The equipment offered shall have six (6) output ports. Various combinations of output ports

shall be selected by the customer, during detailed engineering, from the following:

- Potential free contact (Minimum pulse duration of 50 milli Seconds.)
- IRIG-B
- RS232C
- SNTP Port

12.30.10 The equipment shall have a periodic time correction facility of one second periodicity.

12.30.11 Time synchronisation equipment shall be suitable to operate from 110V DC as available at Substation.

12.30.12 Equipment shall have real time digital display in hour, minute, second (24-hour mode) & have a separate time display unit to be mounted on the top of control panels having display size of approx. 100 mm height.

12.31 Protection Philosophy

The contractor has to design the protection scheme for lines of 132KV system as applicable depending upon the substation layout arrangement and the schemes are to be submitted for Employer's approval. All the protective relays etc. of each bay shall be mounted in the respective bay panel. However, the protection schemes shall be generally based on the requirement listed below:

12.31.1 132 kV Line Protection

a) It should have one Numerical Distance Relay as main protection along with one Numerical Directional Over Current & Earth Fault Relay as back up.

b) Carrier aided distance protection scheme numerical relay shall be offered.

c) Back up protection with voltage polarized, IDMT, directional Three Over current and one earth fault relaying scheme with necessary PT fuse failure monitoring scheme for both the above cases.

d) Local breaker back up protection.

e) The auto-recloser, disturbance recorder, fault locator, event logger etc. shall be built in with Main Numerical protection relay as specified

12.32 Type Tests

12.32.1 The reports for following type tests shall be submitted during detailed engineering for the Protective relays, Fault Recorder, Fault locator and Disturbance recorder:

a) Insulation tests as per IEC 60255-5

b) DC Voltage dips and interruptions/Variation as per IEC 6100-4-29.

c) High frequency disturbance test as per IEC 61000-4 16, Class IV (Not applicable for electromechanical relays)

d) Electrostatic discharges as per IEC 61000-4-2, level; 4 (not applicable for Electromechanical relays)

e) Fast transient test as per IEC 61000, Level I**V** (Not applicable for electromechanical relays)

f) Relay characteristics, performance and accuracy test as per IEC 60255

- Steady state Characteristics and operating time
- Dynamic Characteristics and operating time for distance protection relays and current differential protection relays
- Conformance test as per IEC 61850-10.

For Fault recorder, Disturbance recorder; only performance tests are intended under this item.

g) Tests for thermal and mechanical requirements as per IEC 60255-6

h) Tests for rated burden as per IEC 60255-6

i) Contact performance test as per IEC 60255-0-20 (not applicable for Distance to fault locator and Disturbance recorder)

In case there is a change either in version or in model (Except firmware) of the relay, the contractor has to submit the type test reports for the offered revision/model.

12.32.2 Steady state & Dynamic characteristics test reports on the distance protection relays, as type test, shall be based on test programme specified in Appendix A on simulator/network analyser/PTL. Alternatively, the files generated using Electromagnetic transient Programme (EMTP) can also be used for carrying out the above tests. Single source dynamic tests on transformer differential relay shall be/ should have been conducted based on general guidelines specified in CIGRE committee 34 report on Evaluation of characteristics and performance of Power system protection relays and protective systems.

12.33 Configuration of Relay and Protection Panels

The following is the general criteria for the selection of the equipments to be provided in each type of panel. However, contractor can optimize the requirement of panels by suitably clubbing the feeder protection and CB relay panels.

Control Panel

Various types of control panels shall consist of the following:

S. No:	Description	Quantity
a.	Ammeter	3 set for each line, BC, Bus Section, Transformer
b.	Wattmeter with transducer	1 set for each line, transformer
c.	VAR meter with transducer	1 set for each line, transformer
d.	CB control switch	1 no. for each circuit breaker
e.	Isolator control switch	1 no. for each isolator
f.	Semaphore	1 no. for each earth switch

g.	Red indicating lamp	1 no. for each circuit breaker
h.	Green indicating lamp	1 no. for each circuit breaker, isolator
i.	White indicating lamp (DC healthy lamp)	2 nos for each feeder
j.	Annunciation windows with associated annunciation relays	18 nos for each feeder except 24 nos. for 132/33 kV Transformer
l.	Push button for alarm (Accept/reset/lamp test)	3 nos for each control panel
m.	Synchronising Socket required	1 nos for each circuit breaker
n.	Synchronising selector switch	1 nos for each circuit breaker switch
o.	Protection Transfer switch	1 no. for each breaker
p.	Voltmeter with selector switch	1 no for each line, transformer
q.	Cut out, mounting and wiring of RWTI and selector switch	Lot for transformer
r.	Mimic to represent SLD	Lot in all control panels

Notes:

1) For transformer feeders, all equipments of control panel shall be provided separately for HV and LV sides.
2) The above list of equipments mentioned for control panel is generally applicable unless it is defined elsewhere and in case of bay extension in existing substations, necessary equipments for matching the existing control panel shall be supplied.
3) Each line /HV side of transformer/MV/LV side of transformer / BC/ Bus Section shall be considered as one feeder for above purpose.

a) Line Protection Panel (132 kV)

The line protection panel for transmission line shall consists of following protection features/schemes:

S. No:	Description	Quantity
a.	Main – I Numerical Distance Protection scheme having inbuilt feature of disturbance recorder, distance to fault locator	1 set
b.	DC Supply supervision relay	2 Nos.
c.	Breaker Failure Protection	Built in BCU
d.	Energy meter 3 phase, 4 wire, ABT	1 No.

e.	3 Phase trip relays	2 Nos.
f.	Flag relays, carrier receive relays, aux. relays, timers etc. as per scheme requirements	Built in Main Relay
g.	Under voltage protection relay for isolator/earth switch	2 Nos./Built in BCU in Main- I
h.	Cut-out and wiring with TTB for supplied energy meter	1 Set
i.	Directional Backup Over current and E/F protection scheme	1 Set/ Built in BCU in Main – I

BCU for 132kV Bay has been included in BoQ of Substation Automation System

12.34 Erection and Maintenance Tool Equipment

All special testing equipment required for the installation and maintenance of the apparatus; instruments devices shall be furnished in relevant schedule.

12.35 Tropicalisation

Control room shall be normally air-cooled/air- conditioned. All equipments shall however be suitable for installation in a tropical monsoon area having hot, humid climate and dry and dusty seasons with ambient conditions specified in the specification. All control wiring, equipment and accessories shall be protected against fungus growth, condensation, vermin and other harmful effects due to tropical environment.

12.36 Other Requirements

All auxiliary relays, if and when required for the completeness of the various protection schemes covered in this specification, shall be deemed to be included in the scope of supply whether or not such items are specifically mentioned in the enclosed bill of material.

All terminal blocks for CT and PT circuits shall be of disconnecting link type. Suitable plastic covers for all terminal blocks shall be provided in order to prevent dust accumulation.

Panels shall be mounted to concrete foundation on galvanized steel channels with an intervening layer of anti-vibration strips made of shock absorbing materials, which shall be supplied by the Contractor.

Cable entries for all the panels shall be from bottom. The bottom plates of the panels shall be fitted with 4mm thick removable plates of adequate size for holding cables and sealing from dust and moisture.

A ground bus of bare copper strip of minimum size 25 x 6mm along the length of each panel shall be provided and shall be connected to the ground mat of the station.

12.37 Energy Meters

Energy meters shall be numerical type manufactured by internationally reputed manufacturer. Each 132 kV line shall be equipped with one set of 3 ph, 4wire kWh and kVARh meters suitable for import and export

measurements as specified. The meters shall preferably be four quadrant type. In case of numerical type energy meters, the Contractor shall furnish probe, copy write software and other necessary items (serial port, suitable to connect these meters with laptop) for operational programming of the meters.

All kWh and kVARh meters shall be of 0.2 class accuracy, the details of which has been given in technical specifications in Chapter-1.

12.38 Tests

12.38.1 Routine Tests

Relay and Control Panels shall be subjected the following routine tests at manufacturers:

a) Works Construction Inspection
b) Mechanical operation test
c) Calibration test for meters
d) Characteristic test for relays
e) High voltage test of insulation (2000 volts for 1 minute)
f) Electrical control, interlock and sequential operation tests
g) Verification of wiring as per approved schematic diagram, etc.

Routine test certificates of all the relays supplied under this contract shall be submitted for the Employer's approval before dispatching the control and relay panel.

12.38.2 Field Tests

After completion of the installation, panels shall be subjected the following field tests:

a) Electrical control, interlock and sequential operation tests
b) Calibration test for meters
c) Measurement of insulation resistance
d) Characteristic test for relays, etc.

12.38.3 Drawings, Data and Manual

Outline drawings of Control and Relay panels along with make, model and catalogue of all main relays shall furnish along with the bids.
After award of Contract the successful Bidder shall submit the required number of copies of the following drawings and data for approval of the Employer.

n) General equipment layout
o) Outline drawings of panels showing front and rear elevations
p) Loading data and foundation detail
q) Elementary control wiring diagrams
r) Internal wiring diagrams
s) External connection diagrams, showing terminal boards and other external Connection points for each panel and the required interconnecting wiring
t) AC and DC diagram for control, metering, relaying, communication alarm etc.
u) Instruction manual for storage, installation, operation and maintenance of relay and accessories.
v) Engineering Manual of protective relay used in control & relay panel with any supporting documents.

w) Routine and type test certificates of all protective relays carried out as per relevant IEC standard from a recognized laboratory shall be furnished.

12.39 Training

Contractor personnel who are experienced instructors and who speak understandable English shall conduct training. The contractor shall arrange on its own cost all hardware training platform required for successful training and understanding in Nepal. The Contractor shall provide all necessary training material. Each trainee shall receive individual copies of all technical manuals and all other documents used for training. These materials shall be sent to Employer at one/two months before the scheduled commencement of the training course. Class materials, including the documents sent before the training courses as well as class handouts, shall become the property of Employer. Employer reserves the right to copy such materials, but for in-house training and use only. Hands-on training shall utilize equipment identical to that being supplied to Employer.

The Contractor shall design and arrange above mentioned training programme at least for seven (7) days at the manufacturer/supplier's premises for the IEDs, protection relays and control panels for two (2) concerned RPGCL personnel before commencement of the control and relay panel program under this project to make them competent enough to understand, operate and maintenance of IEDs and protection coordination.

All the cost of trainings including but not limited to (i) Accommodation charges (ii) payment of per Diem allowance to RPGCL trainees @ daily allowance USD 150 per day per trainee for the duration of training abroad towards meals and other incidental expenses and (iii) to and fro economy class air ticket from Nepal to place of training (travelling allowance) shall be paid by the Contractor. Therefore, bidders are instructed to include all the cost of training including travelling and daily allowance of RPGCL personnel in overall bid price

APPENDIX-A

Test programme for distance relays

General Comments:

1. These test cases are evolved from the report of working group 04 of study committee 34 (Protection) on evaluation of characteristics and performance of power system protection relays and protective systems. For any further guidelines required for carrying out the tests, reference may be made to the above document.
2. The test shall be carried out using network configuration and system parameters as shown in the figure-1
3. All denotations regarding fault location, breakers etc are referred in figure –1
4. The fault inception angles are referred to R- N voltage for all types of faults
5. The fault inception angle is zero degree unless otherwise specified
6. Where not stated specifically, the fault resistance (Rf) shall be zero or minimum as possible in simulator
7. Single pole circuit breakers are to be used
8. The power flow example in double source test for 500 MW

System parameters

System voltage =132 KV

CTR= 1000/1

PTR = 132000/110 (with CVT, the parameters of CVT model are shown in figure –2)

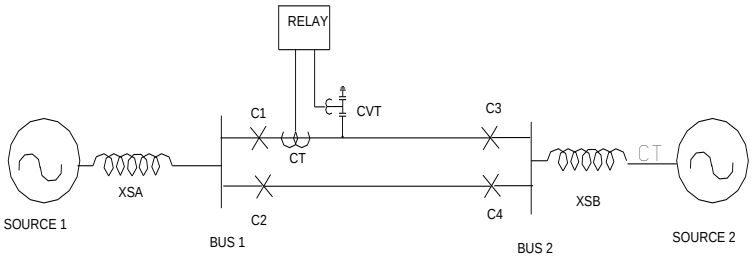


FIGURE 1

Line parameters/km

Positive Sequence Resistance, (r1) = 0. 02897 Ω

Positive Sequence Reactance (x1) = 0.3072 Ω
Zero Sequence Resistance (r0) = 0.2597 Ω
Zero Sequence Reactance (x1) = 1.0223 Ω
Zero Sequence Mutual Resistance (rm) = 0.2281 Ω
Zero Sequence Mutual Reactance (xm) = 0.6221 Ω
Zero Sequence succeptance (bo) = 2.347 µ mho
Positive Sequence succeptance (b1) =3.630 µ mho

Type of line	Short		Long
Secondary line impedance	2 Ω		20 Ω*
Length of line in Kms	23.57		235.7
SIR	4	15	4
Source impedance (pry) (at a time constant of 50 ms)	29.09 Ω (5500 MVA)	109.09 Ω (1467 MVA)	290.9 Ω (550 MVA)

* Alternatively, the tests can be done with 10 Ω secondary impedance and source impedance may accordingly be modified

CVT Model

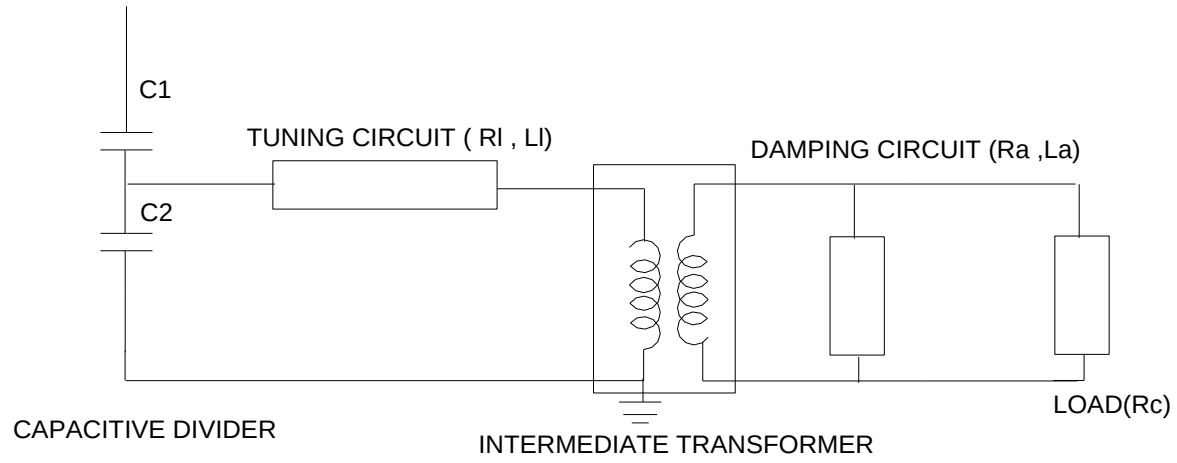


Figure-2

XC1	***1.455 µ mho***
XC2	27.646 µ mho
Rl	320 Ω
XLl	34243 Ω
Ra	4.200 Ω
Xla	197.92 Ω
Rc	14.00 Ω
Transformation ratio of Intermediate transformer	181.8

Details of fault cases to be done

Sl no	*Description*	Single source with short line (2 Ω)		Single source long line (20 Ω)	Double source with short double line (2 Ω)	Double source with long single line (20 Ω)
		CLOSE C1, OPEN C2,C3,C4		CLOSE C1, OPEN C2,C3,C4	CLOSE C1, C2,C3,C4	CLOSE C1,C3 OPEN C2,C4
		SIR=4	SIR=15	SIR =4	SIR = 4	SIR=4
1	Dynamic accuracy for zone 1	Tests to be done at 2 locations (84 % and 76 % of line length) X 4 faults (RN , YB,	Tests to be done at 2 locations (84 % and 76 % of line length) X 4 faults (RN , YB, YBN,	Tests to be done at 2 locations (84 % and 76 % of line length) X 4 faults (RN , YB, YBN, RYB) X 2 fault		Tests to be done at 2 locations (84% and 76% of line length) X 4 faults (RN , YB, YBN, RYB) X 2 fault inception angle

Sl no	*Description*	Single source with short line (2 Ω)		Single source long line (20 Ω)	Double source with short double line (2 Ω)	Double source with long single line (20 Ω)
		YBN, RYB) X 2 fault inception angle (0°, 90°)= 16 cases	RYB) X 2 fault inception angle (0°,90°)= 16 cases	inception angle (0°,90°)= 16 cases		(0°, 90°)= 16 cases
2	Operating time for zone 1 at SIR =4	Tests to be done at 3 locations (0% , 40% and 64% of line length) X 4 faults (RN, YB, YBN, RYB) X 4 fault inception angle	Tests to be done at 3 locations (0 % , 40 % and 64 % of line length) X 4 faults (RN , YB, YBN, RYB) X 4 fault inception angle (0°,30°,60° and 90°)= 48 cases	Tests to be done at 3 locations (0 % , 40 % and 64 % of line length) X 4 faults (RN , YB, YBN, RYB) X 4 fault inception angle (0°, 30°,60° and 90°)= 48 cases	Tests to be done at 1 location (40 % of line length) X 4 faults (RN, YB, YBN, RYB) X 4 fault inception angle (0°,30°,60° and 90 °)= 16 cases	Tests to be done at 1 location (40 % of line length) X 4 faults (RN, YB, YBN, RYB) X 4 fault inception angle (0°,30°,60° and 90°)= 16cases

Sl no	*Description*	Single source with short line (2 Ω)		Single source long line (20 Ω)	Double source with short double line (2 Ω)	Double source with long single line (20 Ω)
		(0°, 30°,60° and 90°) = 48 cases				
3	Operating time for zone II and Zone III	Tests to be done at 1 location (100 % of line length) X 1 faults (RN, YB, YBN, RYB) X 2 zones (II and III) = 2 cases	Tests to be done at 1 location (100 % of line length) X 1 faults (RN , YB, YBN, RYB) X 2 zones (II and III) = 2 cases	Tests to be done at 1 location (100 % of line length) X 1 faults (RN , YB, YBN, RYB) X 2 Zones (II and III) = 2 cases		
4	Switch on to fault feature			Tests to be done at 2 location (0 % and 32 %) X 1 faults (RYB) Any fault inception angle = 2 cases		
5	Operation during current reversal				Tests to be done at 2 location (0 % and 80 % of line length) X 1 faults (RN) X 1 fault inception angle (0 degrees) = 2 cases	

Sl no	*Description*	Single source with short line (2 Ω)		Single source long line (20 Ω)	Double source with short double line (2 Ω)	Double source with long single line (20 Ω)
		CLOSE C1, OPEN C2,C3,C4		CLOSE C1, OPEN C2,C3,C4	CLOSE C1, C2,C3,C4	CLOSE C1,C3 OPEN C2,C4
		SIR=4	SIR=15	SIR =4	SIR = 4	SIR=4
6	Operation at simultaneous faults				Tests to be done at 2 location (8 % and 64 % of line length) X 2 faults (RN in circuit 1 to BN in circuit 2 and RN in circuit 1 to RYN in circuit 2 in 10 ms) X 1 fault inception angle (0 °) = 4 cases (*1)	
7	Directional sensitivity					Tests to be done at 1 location (0% reverse) X 6 faults (RN ,YB, YBN , RYB,RN with Rf=13.75 ohm(sec) and RYN with Rf= 13.75 Ohm (sec) X 2 fault inception angle (0° ,90°) = 12cases

Sl no	*Description*	Single source with short line (2 Ω)		Single source long line (20 Ω)	Double source with short double line (2 Ω)	Double source with long single line (20 Ω)
8	Limit for fault resistance					Tests to be done at 2 location (0% and 68 % of line length) X 1 fault (RN with Rf=13.75 ohm(sec) X 2 fault inception angle (0°,90°) = 4 cases
9	Operation at evolving faults					Tests to be done at 2 location (32 % and 0% of line length) X 2 faults (RN to RYN) x in 2 timings (10 ms and 30 ms) X 2 load direction (from A to B and from B to A) = 16 cases
9	Fault locator function, in case the same is offered as built in feature	Measure fault location for all cases under 1 and 2	Measure fault location for all cases under 1 and 2	Measure fault location for all cases under 1 and 2	Measure fault location for all cases under 2 and 6	Measure fault location for all cases under 2, 7 and 9

Chapter 13: Substation Automation System

13.1 General Information and Scope

13.1.1 The substation automation system shall be offered from a manufacturer who must have designed, manufactured, tested, installed and commissioned substation automation system which must be in satisfactory operation on 132 kV system or higher for at least 2 (Two) years as on the date of bid opening.

13.1.2 The Substation Automation System (SAS) shall be installed to control and monitor all the sub-station equipment from remote control centre (RCC) as well as from local control centre.

The SAS shall contain the following main functional parts:

- Bay control Intelligence Electronic Devices (IEDs) for control and monitoring.
- Station Human Machine Interface (HMI) with separate CPU.
- Redundant managed switched Ethernet Local Area Network communication infrastructure with hot standby.
- Gateway for remote control via industrial grade hardware (to RCC) through IEC60870-5-101 with 104 protocols (minimum two ports each).
- Gateway for remote supervisory control (to RSCC), the gateway should be able to communicate with RSCC on IEC 60870-5-101 with 104 protocols. The specific protocol to be implemented is enclosed as Appendix-I. It shall be the bidder's responsibility to integrate his offered system with existing RSCC system for exchange of desired data. The requirement of IO point shall be worked out by the bidder as per criterion enclosed as Appendix-II for data exchange with RLDCs.
- **Remote HMI.**

13.1.3 Peripheral equipment like printers, display units, key boards, Mouse etc. It shall enable local station control via a separate dedicated PC and CPU by means of human machine interface (HMI) and control software package, which shall contain an extensive range of supervisory control and data acquisition (SCADA) functions. It shall include communication gateway, intelligent electronic devices (IED) for bay control and inter IED communication infrastructure. An architecture drawing for SAS is enclosed.

13.1.4 The communication gateway shall facilitate the information flow with remote control centers. The bay level intelligent electronic devices (IED) for protection and control shall provide the direct connection to the switchgear without the need of interposing components and perform control, protection, and monitoring functions.

13.2 System Design

13.2.1 General System Design

The Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including future extensions as given in Chapter 1 - GTS.

The systems shall be of the state-of-the art suitable for operation under electrical environment present in extra high voltage substations, follow the latest engineering practice, and ensure long-term compatibility requirements and continuity of equipment supply and the safety of the operating staff.

The offered SAS shall support remote control and monitoring from Remote Control centres via gateways.

The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.

The system shall incorporate the control, monitoring and protection functions specified, self-monitoring, signaling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

Maintenance, modification or extension of components may not cause a shutdown of the whole substation automation system. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

Bidder shall offer the Bay level unit (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer), bay mimic along with relay and protection panels and communication panels (described in other sections of technical specifications) and Station HMI in Control Room building for overall optimisation in respect of cabling.

13.2.2 System Architecture

The SAS shall be based on a decentralized architecture and on a concept of bay-oriented, distributed intelligence.

Functions shall be decentralized, object-oriented and located as close as possible to the process.

The main process information of the station shall be stored in distributed databases. The typical SAS architecture shall be structured in two levels, i.e. in a station and a bay level.

At bay level, the IEDs shall provide all bay level functions regarding control, monitoring and protection, inputs for status indication and outputs for commands. The IEDs should be directly connected to the switchgear without any need for additional interposition or transducers.

Each bay control IED shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the other bay control units of the station.

The data exchange between the electronic devices on bay and station level shall take place via the communication infrastructure. This shall be realized using fibre-optic cables, thereby guaranteeing disturbance free communication. The fibre optic cables shall be run in G. I conduit pipes. Data exchange is to be realised using IEC 61850 protocol with a redundant managed switched Ethernet communication infrastructure

The communication shall be made in fault tolerant ring in redundant mode, excluding the links between individual bay IEDs to switch wherein the redundant connections are not envisaged, such that failure of one set of fibre shall not affect the normal operation of the SAS. However, failure of fibre shall be alarmed in SAS. Each fibre optic cable shall have four (4) spare fibres

At station level, the entire station shall be controlled and supervised from the station HMI. It shall also be possible to control and monitor the bay from the bay level equipment at all times.

Clear control priorities shall prevent operation of a single switch at the same time from more than one of the various control levels, i.e. RCC, station HMI, bay level or apparatus level. The priority shall always be on the lowest enabled control level.

The station level contains the station-oriented functions, which cannot be realised at bay level, e.g. alarm list or event list related to the entire substation, gateway for the communication with remote control centres.

The GPS time synchronising signal (as specified in the section relay & protection) for the synchronization of the entire system shall be provided.

The SAS shall contain the functional parts as described in para 13.1.2 above.

13.2.3 Functional Requirements

The high voltage apparatus within the station shall be operated from different places:

- Remote Control centers
- Station HMI
- Local Bay Controller IED (in the bays)

Operation shall be possible by only one operator at a time.

The operation shall depend on the conditions of other functions, such as interlocking, synchrocheck, etc. (see description in "Bay level control functions").

13.2.3.1 Select-before-execute

For security reasons the command is always to be given in two stages: selection of the object and command for operation under all mode of operation except emergency operation. Final execution shall take place only when selection and command are actuated.

13.2.3.2 Command supervision

Bay/Station interlocking and blocking

Software Interlocking is to be provided to ensure that inadvertent incorrect operation of switchgear causing damage and accidents in case of false operation does not take place.

In addition to software interlocking hardwired interlocking are to be provided for:

a) Bus Earth Switch Interlocking

b) Transfer Bus interlocking (if applicable)

It shall be a simple layout, easy to test and simple to handle when upgrading the station with future bays. For software interlocking the bidder shall describe the scenario while an IED of another bay is switched off or fails.

A software interlock override function shall be provided which can be enabled to bypass the interlocking function.

13.2.3.3 Run Time Command Cancellation

Command execution timer (configurable) must be available for each control level connection. If the control action is not completed within a specified time, the command should get cancelled.

13.2.3.4 Self-Supervision

Command execution timer (configurable) must be available for each control level connection. If the control action is not completed within a specified time, the command should get cancelled.

13.2.3.5 User Configuration

The monitoring, controlling and configuration of all input and output logical signals and binary inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

It shall also be possible to interconnect and derive input and output signals, logic functions, using built-In functions, complex voltage and currents, additional logics (AND-gates, OR gates and timers). (Multiactivation of these additional functions should be possible).

The functional requirements shall be divided into following levels:

a) Bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer) level functions.

b) System Level Functions

13.3.1 Bay Level Functions

In a decentralized architecture the functionality shall be as close to the process as possible. In this respect, the following functions can be allocated at bay level:

- Bay control functions including data collection functionally in bay control/protection unit.
- Bay protection functions

Separate IEDs shall be provided for bay control function and bay protection functions.

13.3.1.1 Bay Control Functions

13.3.1.1.1 Overview

Functions

- Control mode selection
- Select-before-execute principle
- Command supervision:
    - Interlocking and blocking

- Double command

- Synchrocheck, voltage selection
- Run Time Command cancellation
- Transformer tap changer control (Raise and lower of tap) (for power transformer bays)
- Operation counters for circuit breakers and pumps
- Hydraulic pump/ Air compressor runtime supervision
- Operating pressure supervision through digital contacts only
- Breaker position indication per phase
- Alarm annunciation
- Measurement display
- Local HMI (local guided, emergency mode)
- Interface to the station HMI.
- Data storage for at least 200 events
- Extension possibilities with additional I/O's inside the unit or via fibre-optic communication and process bus

13.3.1.1.2 Control Mode Selection

Bay Level Operation

As soon as the operator receives the operation access at bay level the operation is normally performed via bay control IED. During normal operation bay control unit allows the safe operation of all switching devices via the bay control IED.

EMERGENCY Operation

It shall be possible to close or open the selected Circuit Breaker with ON or OFF push buttons even during the outage of bay IED.

REMOTE mode

Control authority in this mode is given to a higher level (Remote Control Centre) and the installation can be controlled only remotely. Control operation from lower levels shall not be possible in this operating mode.

13.3.1.1.3 Synchronism and energizing check

The synchronism and energizing check functions shall be bay-oriented and distributed to the bay control and/or protection devices. These features are:

- Settable voltage, phase angle, and frequency difference.
- Energizing for dead line - live bus, live line - dead bus or dead line – dead bus with no synchro-check function.
- Synchronising between live line and live bus with synchro-check function

Voltage Selection

The voltages relevant for the Synchro check functions are dependent on the station topology, i.e. on the positions of the circuit breakers and/or the isolators. The correct voltage for synchronizing and energizing is derived from the auxiliary switches of the circuit breakers, the isolator, and earthing switch and shall be selected automatically by the bay control and protection IEDs.

13.3.1.1.4 Transformer tap changer control

Raise and lower operation of OLTC taps of transformer shall be facilitated through Bay controller IED.

13.3.1.2 Bay Protection Function

13.3.1.2.1 General

The protection functions are independent of bay control function. The protection shall be provided by separate protection IEDs (numerical relays) and other protection devices as per section Relay & Protection.

IEDs, shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions. The data presentation and the configuration of the various IEDs shall be compatible with the overall system communication and data exchange requirements.

Event and disturbing recording function

Each IED should contain an event recorder capable of storing at least 200 time-tagged events. The disturbance recorder function shall be as per detailed in Chapter 16 – Control and Relay Panels.

13.3.1.2.2 Bay Monitoring Function

Analogue inputs for voltage and current measurements shall be connected directly to the voltage transformers (VT) and the current transformers (CT) without intermediate transducers. The values of active power (W), reactive power (VAR), frequency (Hz), and the rms values for voltage (U) and current (I) shall be calculated in the Bay control/protection unit.

13.3.2 System Level Functions

13.3.2.1 Status supervision

The position of each switchgear, e.g. circuit breaker, isolator, earthing switch, transformer tap changer etc., shall be supervised continuously. Every detected change of position shall be immediately displayed in the single-line diagram on the station HMI screen, recorded in the event list, and a hard copy printout shall be produced. Alarms shall be initiated in the case of spontaneous position changes.

The switchgear positions shall be indicated by two auxiliary switches, normally closed (NC) and normally open (NO), which shall give ambivalent signals. An alarm shall be initiated if these position indications are inconsistent or if the time required for operating mechanism to change position exceeds a predefined limit.

The SAS shall also monitor the status of sub-station auxiliaries. The status and control of auxiliaries shall be done through separate one or more IED and all alarm and analogue values shall be monitored and recoded through this IED.

13.3.2.2 Measurements

The analogue values acquired/calculated in bay control/protection unit shall be displayed locally on the station HMI and in the control centre. The abnormal values must be discarded. The analogue values shall be updated every 2 seconds.

Threshold limit values shall be selectable for alarm indications.

13.3.2.3 Event and Alarm Handling

Events and alarms are generated either by the switchgear, by the control IEDs, or by the station level unit. They shall be recorded in an event list in the station HMI. Alarms shall be recorded in a separate alarm list and appear on the screen. All, or a freely selectable group of events and alarms shall also be printed out on an event printer. The alarms and events shall be time-tagged with a time resolution of 1 ms. The tentative list for various feeders and systems are enclosed as **Annexure-I.**

13.3.2.4 Station HMI

13.3.2.4.1 Substation HMI Operation

On the HMI the object has to be selected first. In case of a blocking or interlocking condition are not met, the selection shall not be possible and an appropriate alarm annunciation shall occur. If a selection is valid the position indication will show the possible direction, and the appropriate control execution button shall be pressed in order to close or open the corresponding object.

Control operation from other places (e.g. REMOTE) shall not be possible in this operating mode.

13.3.2.4.2 Presentations and dialogues

General

The operator station HMI shall be a redundant with hot standby and shall provide basic functions for supervision and control of the substation. The operator shall give commands to the switchgear on the screen via mouse clicks.

The HMI shall give the operator access to alarms and events displayed on the screen. Aside from these lists on the screen, there shall be a printout of alarms or events in an event log.

An acoustic alarm shall indicate abnormalities, and all unacknowledged alarms shall be accessible from any screen selected by the operator.

The following standard pictures shall be available from the HMI:

- Single-line diagram showing the switchgear status and measured values
- Control dialogues with interlocking or blocking information details. This control dialogue shall tell the operator whether the device operation is permitted or blocked**.**
- Measurement dialogues
- Alarm list, station / bay-oriented
- Event list, station / bay-oriented
- System status

13.3.2.4.3 HMI design principles

Consistent design principles shall be adopted with the HMI concerning labels, colours, dialogues and fonts. Non-valid selections shall be dimmed out.

The object status shall be indicated using different status colours for:

- Selected object under command
- Selected on the screen
- Not updated, obsolete values, not in use or not sampled
- Alarm or faulty state
- Warning or blocked
- Update blocked or manually updated
- Control blocked
- Normal state

13.3.2.4.4 Process status displays and command procedures

The process status of the substation in terms of actual values of currents, voltages, frequency, active and reactive powers as well as the positions of circuit breakers, isolators and transformer tap-changers shall be displayed in the station single-line diagram.

In order to ensure a high degree of security against undesired operation, a "select-before execute" command procedure shall be provided. After the "selection" of a switch, the operator shall be able to recognize the selected device on the screen, and all other switchgear shall be blocked. As communication between control centre and device to be controlled is established, the operator shall be prompted to confirm the control action and only then final execute command shall be accepted. After the "execution" of the command the operated switching symbol shall flash until the switch has reached its new position.

The operator shall be in a position to execute a command only, if the switch is not blocked and if no interlocking condition is going to be violated. The interlocking statements shall be checked by the interlocking scheme implemented at bay and station level.

After command execution the operator shall receive a confirmation that the new switching position has been reached or an indication that the switching procedure was unsuccessful with the indication of the reason for non-functioning.

13.3.2.4.5 System supervision/ display and common base time

The SAS system shall be comprehensively self-monitored such that faults are immediately indicated to the operator, possibly before they develop into serious situations. Such faults are recorded as a faulty status in a system supervision display. This display shall cover the status of the entire substation including all switchgear, IEDs, communication infrastructure and remote communication links, and printers at the station level, etc.

The internal clock of each SAS/RTUs shall be synchronized either from an internal. Contractor supplied and installed time synchronization source, such as a Global Positioning System (GPS) or an Omega synchronizing signal receiver or through the telecommunication network from a master clock installed at the LDC.

The synchronization shall be done periodically such that the time- tags in each RTU shall be with five milliseconds (5 ms) accuracy between all RTUs.

Bidders shall clearly indicate the method used for time synchronization and describe in detail how the required accuracy is achieved.

In the SAS/RTU there shall be a digital output from which time synchronization message can be forwarded to external devices. The frequency of the activation of message shall be adjustable.

13.3.2.4.6 Event List

The event list shall contain events that are important for the control and monitoring of the substation.

The event and associated time (with1 ms resolution) of its occurrence has to be displayed for each event.

The operator shall be able to call up the chronological event list on the monitor at any time for the whole substation or sections of it.

A printout of each display shall be possible on the hard copy printer.

The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. It shall be possible to store all events in the computer for at least one month. The information shall be obtainable also from a printed event log.

The chronological event list shall contain:

- Position changes of circuit breakers, isolators and earthing devices
- Indication of protective relay operations
- Fault signals from the switchgear
- Indication when analogue measured values exceed upper and lower limits. Suitable provision shall be made in the system to define two level of alarm on either side of the value or which shall be user defined for each measurands.
- Loss of communication.

Filters for selection of a certain type or group of events shall be available. The filters shall be designed to enable viewing of events grouped per:

- Date and time
- Bay
- Device
- Function e.g. trips, protection operations etc.
- Alarm class

13.3.2.4.7 Alarm List

Faults and errors occurring in the substation shall be listed in an alarm list and shall be immediately transmitted to the control centre. The alarm list shall substitute a conventional alarm tableau, and shall constitute an evaluation of all station alarms. It shall contain unacknowledged alarms and persisting faults. The date and time of occurrence shall be indicated.

The alarm list shall consist of a summary display of the present alarm situation. Each alarm shall be reported on one line that contains:

- The date and time of the alarm
- The name of the alarming object
- A descriptive text
- The acknowledgement state

Whenever an alarm condition occurs, the alarm condition must be shown on the alarm list and must be displayed in a flashing state along with an audible alarm. After acknowledgement of the alarm, it should appear in a steady (i.e. not flashing) state and the audible alarm shall stop. The alarm should disappear only if the alarm condition has physically cleared and the operator has reset the alarm with a reset command. The state of the alarms shall be shown in the alarm list (Unacknowledged and persistent, Unacknowledged and cleared, Acknowledged and persistent).

Filters for selection of a certain type or group of alarms shall be available as for events.

13.3.2.4.8 Object Picture

When selecting an object such as a circuit breaker or isolator in the single-line diagram, the associated bay picture shall be presented first. In the selected object picture, all attributes like

- Type of blocking
- Authority
- Local / remote control
- RSCC / SAS control
- Errors etc.,

Shall be displayed.

13.3.2.4.9 Control dialogues

The operator shall give commands to the system by means of mouse click located on the single-line diagram. Data entry is performed with the keyboard. Dedicated control dialogues for controlling at least the following devices shall be available:

- Breaker and disconnector
- Transformer tap-changer

13.3.2.5 User-authority levels

It shall be possible to restrict activation of the process pictures of each object (bays, apparatus...) within a certain user authorisation group. Each user shall then be given access rights to each group of objects, e.g.:

- Display only
- Normal operation (e.g. open/close of switchgear)
- Restricted operation (e.g. by-passed interlocking)
- System administrator

For maintenance and engineering purposes of the station HMI, the following authorisation levels shall be available:

- No engineering allowed
- Engineering/configuration allowed
- Entire system management allowed

The access rights shall be defined by passwords assigned during the login procedure. Only the system administrator shall be able to add/remove users and change access rights.

13.3.2.6 Reports

The reports shall provide time-related follow-ups of measured and calculated values. The data displayed shall comprise:

- Trend reports:
  - Day (mean, peak)
  - Month (mean, peak)
  - Semi-annual (mean, peak)
  - Year (mean, peak)
- Historical reports of selected analogue values
  - Day (at 15 minutes interval)
  - Week
  - Month
  - Year

It shall be possible to select displayed values from the database in the process display on-line. Scrolling between e.g. days shall be possible. Unsure values shall be indicated. It shall be possible to select the time period for which the specific data are kept in the memory.

Following printouts shall be available from the printer and shall be printed on demand:

i. Daily voltage and frequency curves depicting time on X-axis and the appropriate parameters on the Y-axis. The time duration of the curve is 24 hours.

ii. Weekly trend curves for real and derived analogue values.

iii. Printouts of the maximum and minimum values and frequency of occurrence and duration of maximum and minimum values for each analogue parameter for each circuit in 24 hr. period.

iv. Provision shall be made for logging information about breaker status like number of operations with date and time indications along with the current value it interrupts (in both conditions i.e.

v. manual opening and fault tripping)

vi. Equipment operation details shift wise and during 24 hours.

vii. Printout on adjustable time period as well as on demand for MW, MVAR, Current, Voltage on each feeder and transformer as well as Tap Positions, temperature and status of pumps and fans for transformers.

viii. Printout on adjustable time period as well as on demand system frequency and average frequency.

ix. Reports in specified formats which shall be handed over to successful bidder. The bidder has to develop these reports. The reports are limited to the formats for which data is available in the SAS database.

13.3.2.7 Trend display (historical data)

It shall be possible to illustrate all types of process data as trends – input and output data, binary and analogue data. The trends shall be displayed in graphical form as column or curve diagrams with a maximum of 10 trends per screen. Adjustable time span and scaling ranges must be provided.

It shall be possible to change the type of value logging (direct, mean, sum, or difference) on-line in the window. It shall also be possible to change the update intervals on-line in the picture as well as the selection of threshold values for alarming purposes.

13.3.2.8 Automatic disturbance file transfer

All recorded data from the IEDs with integrated disturbance recorder as well as dedicated disturbance recording systems shall be automatically uploaded (event triggered or once per day) to a dedicated computer and be stored on the hard disc.

13.3.2.9 Disturbance analysis

The PC-based work station shall have necessary software to evaluate all the required information for proper fault analysis.

13.3.2.10 IED parameter setting

It shall be possible to access all protection and control IEDs for reading the parameters (settings) from the station HMI or from a dedicated monitoring computer. The setting of parameters or the activation of parameter sets shall only be allowed after entering a password.

13.3.2.11 Automatic sequences

The available automatic sequences in the system should be listed and described, (e.g. sequences related to the bus transfer). It must be possible to initiate pre-defined automatic sequences by the operator and also define new automatic sequences.

13.3.3 Gateway

13.3.3.1 Communication Interface

The Substation Automation System shall have the capability to support simultaneous communications with multiple independent remote master stations,

The Substation Automation System shall have communication ports as follows:

a) Two ports for Remote Control Centre

b) Two ports for Regional System Coordination Centre (RSCC)

The communication interface to the SAS shall allow scanning and control of defined points within the substation automation system independently for each control centre. The substation automation system shall simultaneously respond to independent scans and commands from employer's control centres (RCC & RSCC/LDC). The substation automation system shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol to each remote control centre. Also, each control center's data scan and control commands may be different for different data points within the substation automation system's database.

13.3.3.2 Remote Control Centre Communication Interface

Employer will supply communication channels between the Substation Automation System and the remote control centre. The communication channels provided by Employer will consist either of power line carrier, optical fibre or leased line, the details of which shall be provided during detailed Engineering

13.3.3.3 Interface Equipment

The Contractor shall provide interface equipment for communicating between Substation Automation system and Remote control centre and between Substation Automation system and Regional System Coordination Centre (RSCC). However, the communication channels available for this purpose are specified in Chapter 1 - GTS.

13.3.3.4 Communication Protocol

The communication protocol for gateway to control centre must be open protocol and shall support IEC 60870-5-101 with 104 and IEC 61850 for all levels of communication for sub-station automation such as Bay to station HMI, gateway to remote station etc.

13.4 System Hardware

13.4.1 Redundant Station HMI, Remote HMI and Disturbance Recorder Work Station

The contractor shall provide redundant station HMI in hot standby mode. The servers used in these work stations shall be of industrial grade.

It shall be capable to perform all functions for entire substation including future requirements as indicated in the SLD. It shall use industrial grade components. Processor and RAM shall be selected in such a manner that during normal operation not more than 30% capacity of processing and memory are used. Supplier shall demonstrate these features.

The capacity of hard disk shall be selected such that the following requirement should occupy less than 50% of disk space:

1. Storage of all analogue data (at 15 Minutes interval) and digital data including alarm, event and trend data for thirty (30) days,
2. Storage of all necessary software,
3. 20GB space for EMPLOYER'S use.

Supplier shall demonstrate that the capacity of hard disk is sufficient to meet the above requirement.

13.4.1.1 HMI (Human Machine Interface)

The VDU shall show overview diagrams (Single Line Diagrams) and complete details of the switchgear with a colour display. All event and alarm annunciation shall be selectable in the form of lists. Operation shall be by a user-friendly function keyboard and a cursor positioning device. The user interface shall be based on WINDOWS concepts with graphics & facility for panning, scrolling, zooming, decluttering etc.

13.4.1.2 Visual Display Unit/ TFTs (Thin Film Technology)

The display units shall have high resolution and reflection protected picture screen. High stability of the picture geometry shall be ensured.

The screen shall be at least 32" diagonally in size and capable of colour graphic displays. The display shall accommodate resolution of 1280 X 1024 pixels.

13.4.1.3 Printer

It shall be robust & suitable for operation with a minimum of 132 characters per line. The printing operation shall be quiet with a noise level of less than 45 dB suitable for location in the control room. Printer shall accept and print all ASCII characters via master control computer unit interface.

The printer shall have in built testing facility. Failure of the printer shall be indicated in the Station HMI. The printer shall have an off line mode selector switch to enable safe maintenance. The maintenance should be simple with provisions for ease of change of print head, ribbon changing, paper insertion etc.

All reports and graphics prints shall be printed on laser printer. One dot matrix printer shall be exclusively used for hourly log printing.

All printers shall be continuously online.

13.4.1.4 Mass Storage Unit

The mass storage unit shall be built-in to the Station HMI. All operational measured values, and indications shall be stored in a mass-storage unit in form of DVD RW. The unit should support at least Read (48X), Write(24X), and Re-Write (10X) operations, with Multi-Session capability. It should support ISO9660, Rockridge and Joliet Filesystems. It should support formatting and use under the operating system provided for Station HMI. The monthly back up of data shall be taken on disc. The facility of back up of data shall be inherent in the software.

13.4.1.5 Switched Ethernet Communication Infrastructure

The bidder shall provide the redundant switched optical Ethernet communication infrastructure for SAS. One switch shall be provided to connect all IEDs for two bays of yard to communication infrastructure. Each switch shall have at least two spare ports for connecting bay level IEDs and one spare port for connecting station bus.

13.4.2 Bay Level Unit

The bay unit shall use industrial grade components. The bay level unit, based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals. They shall incorporate select-before-operate control principles as safety functions, such as control commands, bay interlocking, data acquisition, data storage, event recording and shall provide inputs for status indication and outputs for commands. They shall be directly connected to the switchgear. The bay

unit shall acquire and process all data for the bay (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the other devices in sub-station automation system. In addition, this shall receive the operation commands from station HMI and control centre. The bay unit shall have the capability to store all the data for at least 24 hours.

One number Bay level unit shall be provided for supervision and control of each 132 kV bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer). The Bay level unit shall be equipped with analogue and binary inputs/outputs for handling the control, status monitoring and analogue measurement functions. All bay level interlocks are to be incorporated in the Bay level unit so as to permit control from the Bay level unit/ local bay mimic panel, with all bay interlocks in place, during maintenance and commissioning or in case of contingencies when the Station HMI is out of service.

The bay control unit to be provided for the bays shall be preferably installed in the CB relay panel/feeder protection panel for respective bay.

The bay control unit for future bay (if required as per Chapter 1 – Project Specification Requirement) shall be installed in a separate panel.

The Bay level unit shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

13.4.2.1 Input/ Output (I/O) modules

The I/O modules shall form a part of the bay level unit and shall provide coupling to the substation equipment. The I/O modules shall acquire all switchgear information (i.e. data coming directly from the switchgear or from switchgear interlocking devices) and transmit commands for operation of the switchgear. The measured values of voltage and current shall be from the secondaries of instrument transformers. The digital inputs shall be acquired by exception with 1 ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state.

13.4.3 Extendibility in future

Offered substation automation system shall be suitable for extension in future for additional bays. During such requirement, all the drawings and configurations, alarm/event list etc displayed shall be designed in such a manner that its extension shall be easily performed by the employer. During such event, normal operation of the existing substation shall be unaffected and system shall not require a shutdown. The contractor shall provide all necessary software tools along with source codes to perform addition of bays in future and complete integration with SAS by the user. These software tools shall be able to configure IED, add additional analogue variable, alarm list, event list, modify interlocking logics etc. for additional bays/equipment which shall be added in future.

13.5 Software Structure

The software package shall be structured according to the SAS architecture and strictly divided in various levels. Necessary firewall shall be provided at suitable points in software to protect the system. An extension of the station shall be possible with lowest possible efforts. Maintenance, modification or an extension of components of any feeder may not force a shut-down of the parts of the system which are not affected by the system adaptation.

13.5.1 Station Level Software

13.5.1.1 Human Machine Interface (HMI)

The base HMI software package for the operator station shall include the main SAS functions and it shall be independent of project specific hardware version and operating system. It shall further include tools for picture editing, engineering and system configuration. The system shall be easy to use, to maintain, and to adapt according to specific user requirements. Systems shall contain a library with standard functions and applications.

13.5.2 Bay Level Software

13.5.2.1 System Software

The system software shall be structured in various levels. This software shall be placed in a non-volatile memory. The lowest level shall assure system performance and contain basic functions, which shall not be accessible by the application and maintenance engineer for modifications. The system shall support the generation of typical control macros and a process database for user specific data storage. In case of restoration of links after failure, the software along with hardware shall be capable of automatically synchronising with the remaining system without any manual interface. This shall be demonstrated by contractor during integrated system test.

13.5.2.2 Application Software

In order to ensure robust quality and reliable software functions, the main part of the application software shall consist of standard software modules built as functional block elements. The functional blocks shall be documented and thoroughly tested. They form part of a library.

The application software within the control/protection devices shall be programmed in a functional block language.

13.5.2.3 Network Management System (NMS)

The contractor shall provide a network management system software for following management functions:

a) Configuration Management

b) Fault Management

c) Performance Monitoring

This system shall be used for management of communication devices and other IEDs in the system. This NMS can be loaded in DR work-station and shall be easy to use, user friendly and menu based. The NMS shall monitor all the devices in the SAS and report if there is any fault in the monitored devices. The NMS shall

a) Maintain performance, resource usage, and error statistics for all managed links and devices and present this information via displays, periodic reports and on demand reports.

b) Maintain a graphical display of SAS connectivity and device status.

c) Issue alarms when error conditions occurs

d) Provide facility to add and delete addresses and links

The contractor shall provide each software in two copies in CD to load into the system in case of any problem related with Hardware/Communication etc.

13.6 TESTS

The substation automation system offered by the bidder shall be subjected to following tests to establish compliance with IEC 61850 for EHV sub-station equipment installed in sheltered area in the outdoor switchyard and specified ambient conditions:

13.6.1 Type Tests

13.6.1.1 Control IEDs and Communication Equipments

a) Power Input

i. Auxiliary Voltage
ii. Current Circuits
iii. Voltage Circuits
iv. Indications

b) Accuracy Tests

i. Operational Measured Values
ii. Currents
iii. Voltages
iv. Time resolution

c) Insulation Tests

i. Dielectric Tests
ii. Impulse Voltage withstand Test

d) Influencing Quantities

i. Limits of operation
ii. Permissible ripples
iii. Interruption of input voltage

e) Electromagnetic Compatibility Test

i. 1 MHZ. burst disturbance test
ii. Electrostatic Discharge Test
iii. Radiated Electromagnetic Field Disturbance Test
iv. Electrical Fast transient Disturbance Test
v. Conducted Disturbances Tests induced by Radio Frequency Field
vi. Magnetic Field Test

vii. Emission (Radio interference level) Test.

viii. Conducted Interference Test

f) Function Tests

i. Indication

ii. Commands

iii. Measured value Acquisition

iv. Display Indications

g) Environmental Tests

i. Cold Temperature

ii. Dry Heat

iii. Wet heat

iv. Humidity (Damp heat Cycle)

v. Vibration

vi. Bump

vii. Shock

13.6.2 Factory Acceptance Tests

The supplier shall submit a test specification for factory acceptance test (FAT) and commissioning tests of the station automation system for approval. For the individual bay level IED's applicable type test certificates shall be submitted**.**

The manufacturing and configuration phase of the SAS shall be concluded by the factory acceptance test (FAT). The purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. During FAT the entire Sub-station Automation System including complete control and protection system to be supplied under present scope shall be tested for complete functionality and configuration in factory itself. The extensive testing shall be carried out during FAT. The purpose of Factory Acceptance Testing is to ensure trouble free installation at site. No major configuration setting of system is envisaged at site.

If the complete system consists of parts from various suppliers or some parts are already installed on site, the FAT shall be limited to sub-system tests. In such a case, the complete system test shall be performed on site together with the site acceptance test (SAT).

13.6.2.1 Hardware Integration Tests

The hardware integration test shall be performed on the specified systems to be used for Factory tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware

integration tests. The vendor specifically demonstrates how to add a device in future in SAS during FAT. The device shall be from a different manufacturer than the SAS supplier.

13.6.2.2 Integrated System Tests

Integrated system tests shall verify the stability of the hardware and the software. During the tests all functions shall run concurrently and all equipment shall operate a continuous 100 Hours period. The integrated system test shall ensure the SAS is free of improper interactions between software and hardware while the system is operating as a whole.

13.6.3 Site Acceptance Tests

The site acceptance tests (SAT) shall completely verify all the features of SAS hardware and software. The bidder shall submit the detailed SAT procedure and SAT procedure shall be read in conjunction with the specification.

13.7 SYSTEM OPERATION

13.7.1 Substation Operation

13.7.1.1 Normal Operation

Operation of the system by the operator from the remote RCC or at the substation shall take place via industry standard HMI (Human Machine interface) subsystem consisting of graphic colour VDU, a standard keyboard and a cursor positioning device (mouse).

The colored screen shall be divided into 3 fields:

i. Message field with display of present time and date
ii. Display field for single line diagrams
iii. Navigation bar with alarm/condition indication

For display of alarm annunciation, lists of events etc a separate HMI View node shall be provided.

All operations shall be performed with mouse and/or a minimum number of function keys and cursor keys. The function keys shall have different meanings depending on the operation. The operator shall see the relevant meanings as function tests displayed in the command field (i.e. operator prompting). For control actions, the switchgear (i.e. circuit breaker etc.) requested shall be selectable on the display by means of the cursor keys. The switching element selected shall then appear on the background that shall be flashing in a different color. The operator prompting shall distinguish between: -

i. Prompting of indications e.g. fault indications in the switchgear, and
ii. Prompting of operational sequences e.g. execution of switching operations

The summary information displayed in the message field shall give a rapid display of alarm/message of the system in which a fault has occurred and alarm annunciation lists in which the fault is described more fully.

Each operational sequence shall be divided into single operation steps which are initiated by means of the function keys/WINDOW command by mouse. Operator prompting shall be designed in such a manner that only the permissible keys are available in the command field related to the specific operation step. Only

those switching elements shall be accessed for which control actions are possible. If the operation step is rejected by the system, the operator prompting shall be supported by additional comments in the message field. The operation status shall be reset to the corresponding preceding step in the operation sequence by pressing one of the function keys. All operations shall be verified. Incorrect operations shall be indicated by comments in the message field and must not be executed.

The offer shall include a comprehensive description of the system. The above operation shall also be possible via WINDOWS based system by mouse.

13.8 Power Supply

Power for the substation automation system shall be derived from substation 110V DC system.

2 No.s of Inverter of minimum 2 KVA capacity shall be provided for servers, gateways station HMI disturbance recorder evaluation unit and its peripheral devices e.g. printer etc. In the event of Power failure, necessary safeguard software shall be built for proper shutdown. Inverter shall be connected to 110V DC independent source and should be used to drive 1 No each server/HMI/Gateway so that in case any failure of DC power supply system is not affected.

13.9 Documentation

The following documents shall be submitted for employer's approval during detailed engineering:

a) System Architecture Drawing
b) Hardware Specification
c) Functional Design Document
d) Clear procedure describing how to add an IED/bay/diameter in future covering all major supplier

The following documentation to be provided for the system in the course of the project shall be consistent, CAD supported, and of similar look/feel. All CAD drawings to be provide in "dxf" format.

- List of Drawings
- Substation automation system architecture
- Block Diagram
- Guaranteed technical parameters, Functional Design Specification and
- Guaranteed availability and reliability
- Calculation for power supply dimensioning
- I/O Signal lists
- Schematic diagrams
- List of Apparatus
- List of Labels
- Logic Diagram (hardware & software)
- **Switchyard Panel Room** layout drawing

- Control Room Lay-out
- Test Specification for Factory Acceptance Test (FAT)
- Product Manuals
- Assembly Drawing
- Operator's Manual
- Complete documentation of implemented protocols between various elements
- Listing of software and loadable in CD ROM
- Other documents as may be required during detailed engineering

Two sets of hard copy and four sets of CD ROM containing all the as built documents/drawings shall be provided.

13.10 SCADA Integration

The Supervisory Control and Data Acquisition (SCADA) system at the LDC shall scan the new SASs utilizing the communication network.

The Contractor shall be responsible for the complete design, installation, wiring, testing, commissioning and documentation of the SASs, including any required new or parallel connections to NEA's field equipment as described in the specification, including synchronization with the existing SCADA equipment.

Compatible interfacing shall be for all aspects, including software and hardware. In addition to other necessary compatibilities and interfacing, the Contractor shall be fully responsible for the integration of the SCADA data associated with the scope in this tender in the SINAUT MAKE, the processing software of the Load Dispatch Centre. This integration requires modification, addition and parameterization in the Spectrum for the following main activities:

a) SCADA data entry: this includes data entry of different components of the substations, lines and other relevant components.

b) Creating Graphics: this includes creating graphics for substations, lines and other relevant components, network map creation and integration with existing system etc.

c) Data entry for Telecontrols Interface (TCI);

d) Testing and Commissioning of the newly integrated SCADA system for its full functioning; and

e) Network Application data entry required for network analysis.

For these purposes, the Contractor shall carry out necessary studies/ investigation of the existing system carefully, in full coordination with the Load Dispatch Centre, and design / propose, install and integrate a suitable scheme/system to fulfil the specified scope of works for Tele protection, SCADA, voice communication etc as required by NEA (Load Dispatch Centre).

13.10.1 Data Acquisition Principles

New SASs at each substation shall be installed and interfacing of the following supervisory controls shall be executed and data to be acquired shall be provided for:

Remote control

- Remote control of all 132kV circuit breakers

Status Indicators

- Status indication of all 132 kV circuit breakers
- Status indication of all 132 kV bus bar and line isolators

Alarms

- All 132 kV main protection trip indications (MPT)
- All 132 kV backup protection trip indications (BPT)
- One grouped alarm summarizing all causes that prevent operation of a circuit breaker (circuit breaker fault alarm, CBF)
- One grouped alarm summarizing all faults not affecting operation of a circuit breaker (Bay fault alarm, BFA)
- Single indication for operation of auto re-closure relay for 132 kV transmission lines (ARO)
- For all 132 kV bus bars a voltage status alarm (BVS)
- General station alarms and warnings
- Station urgent fault (SUF)
- Station none urgent fault (SNF)
- RTU alarm (RTU)
- Communication Equipment Alarm (COM)
- Station Control Disabled (SCD) etc

A table summarizing the alarms to be acquired by LDC from each type of bay in the 132 kV network is shown in Table 13.1

Table 13.1: Alarms to be acquired from each type of bay

Type of alarm	Line bay
Main protection trip	MPT
Back-up protection trip	BPT
Bay fault	BFA
Circuit breaker fault	CBF
Auto-re-closer operated	ARO
Total	**5**

Measurements

- Bus bar voltage (separate for each bus bar and section) of all 132 kV bus bars
- Active/reactive power for
    - All 132 kV line feeders

In analog measurements, the information to the SAS is given in the form of an analog current supplied by the output of an analog measuring transducer.

The analog signals shall be converted to digital mode by an analog to digital converter to which the inputs are connected. All inputs of a module shall be measured within one cycle, regardless of the number of inputs in use. Thus, new points can be added to the SAS without reprogramming.

Analog measurements shall be transmitted to the master station with 16 bits or 16 bits+sign bit.

13.11 Training, Support Services, Maintenance and Spares

13.11.1 Training

On the job training: Contractor personnel who are experienced instructors and who speak understandable English shall conduct 7 days training for five RPGCL staffs on the site for SAS operation and maintenance. The contractor shall arrange on its own cost all hardware training platform required for successful training and understanding in Nepal. Each trainee shall receive individual copies of all technical manuals and all other documents used for training. These materials shall be sent to Employer at least one month before the scheduled commencement of the training course. Class materials, including the documents sent before the training courses as well as class handouts, shall become the property of Employer. Employer reserves the right to copy such materials, but for in-house training and use only. Hands-on training shall utilize equipment identical to that being supplied to Employer.

Training at manufacturer's premises: It shall be as specified in SCC, Vol-I.

Annexure – I

List of Analogue and Digital Inputs

Basic Monitoring requirements are:

- Switchgear status indication
- Measurements (U, I, P, Q, f)
- Event
- Alarm
- Winding temperature of transformers & reactors
- ambient temperature
- Status and display of 400V LT system, 1100V & 48V DC system
- Status of display of Fire protection system and Air conditioning system.
- Acquisition of all counters in PLCC panels through potential free contacts from PLCC or independently by counting the receive/send commands.
- Acquisition of alarm and fault record from protection relays
- Disturbance records
- Monitoring the state of batteries by displaying DC voltage, charging current and load current etc.
- Tap-position of Transformer

List of Inputs

The list of input for typical bays are as follows:

Analogue Inputs

i) For line

Current	R phase
	Y phase
	B phase
Voltage	R-Y phase
	Y-B phase
	B-R phase

ii) For transformer/ reactor

Current	R phase
	Y phase
	B phase

WTI (for transformer and reactor)

Tap position (for transformer only)

iii) For TBC and bus coupler

Current R phase

Y phase

B phase

iv) Common

a) Voltage for Bus-I, Bus-II and transfer bus wherever applicable

Voltage R-Y phase

Y-B phase

B-R phase

b) Frequency for Bus – I and Bus – II

c) Ambient temperature (switchyard)

d) Switchyard Panel Room Temperature

e) LT system

i. Voltage R-Y, Y-B, B-R of Main Switch Board section-I

ii. Voltage R-Y, Y-B, B-R of Main Switch Board section-II

iii. Voltage R-Y, Y-B, B-R of Diesel Generator

iv. Current from LT transformer-I

v. Current from LT transformer-II

vi. Current from Diesel Generator

vii. Voltage of 110V DCDB-I

viii. Voltage of 110V DCDB-II

ix. Current from 110V Battery set-I

x. Current from 110V Battery set-II

xi. Current from 110V Battery charger-I

xii. Current from 110V Battery charger-I

xiii. Voltage of 48V DCDB-I

xiv. Voltage of 48V DCDB-II

xv. Current from 48V Battery set-I

xvi. Current from 48V Battery set-II

xvii. Current from 48V Battery charger-I

xviii. Current from 48V Battery charger-I

Digital Inputs

The list of input for various bays/ SYSTEM is as follows:

1. **Line Bays**
    a) Status of Isolator, Earth switch
    b) CB trouble
    c) CB operation/closing lockout
    d) Pole discrepancy optd
    e) Trip coil faulty
    f) LBB optd
    g) Bus bar protection trip relay optd
    h) Main breaker auto recloser operated
    i) Tie/transfer auto recloser operated
    j) A/R lockout
    k) Tie/transfer breaker A/R lockout
    l) Direct trip-I/II sent
    m) Direct trip-I/II received
    n) Main I/II blocking
    o) Main I/II-Inter trip send
    p) Main I/II-Inter trip received
    q) O/V STAGE – I operated
    r) O/V STAGE – II operated
    s) FAULT LOCATOR FAULTY
    t) MAIN-I/II CVT FUSE FAIL
    u) MAIN-I PROTN TRIP
    v) MAIN-II PROTN TRIP
    w) MAIN-I PSB ALARM
    x) MAIN-I SOTF TRIP
    y) MAIN-I R-PH TRIP
    z) MAIN-I Y-PH TRIP
    aa) MAIN-I B-PH TRIP
    bb) MAIN-I START
    cc) MAIN-I/II Carrier aided trip
    dd) MAIN-I/II fault in reverse direction

ee) MAIN-I/II ZONE-2 TRIP

ff) MAIN-I/II ZONE-3 TRIP

gg) MAIN-I/II weak end infeed optd

hh) MAIN-II PSB alarm

ii) MAIN-II SOTF TRIP

jj) MAIN-II R-PH TRIP

kk) MAIN-II Y-PH TRIP

ll) MAIN-II B-PH TRIP

mm) MAIN-II start

nn) MAIN-II aided trip

oo) MAIN-I/II fault in reverse direction

pp) Back-up o/c optd

qq) Back-up e/f optd

rr) 110V DC-I/II source fail

ss) SPEECH CHANNEL FAIL

tt) PLCC Protection Channel-I FAIL

uu) PLCC Protection Channel-II FAIL

2. Auxiliary System

a) Incomer-I On/Off

b) Incomer-II On/Off

c) 400V Bus-I/II U/V

d) 400V bus coupler breaker on/off

e) DG set breaker on/off

f) Alarm/trip signals as listed in Section: DG set

g) LT transformer-I Bucholz Alarm & trip

h) LT transformer-II Bucholz Alarm & trip

i) LT transformer-I WTI Alarm & trip

j) LT transformer-II WTI Alarm & trip

k) LT transformer-I OTI Alarm & trip

l) LT transformer-II OTI Alarm & trip

m) PLCC exchange fail

n) Time sync. Signal absent

o) Alarm/trip signals as listed in Section: Battery and Battery charger

p) 110V DC-I earth fault

q) 110V DC-II earth fault

r) Alarm/trip signals as listed in Section: Fire protection system

3. Switchyard Panel Room

a) AC Compressor 1 ON/OFF

b) AC Compressor 2 ON/OFF

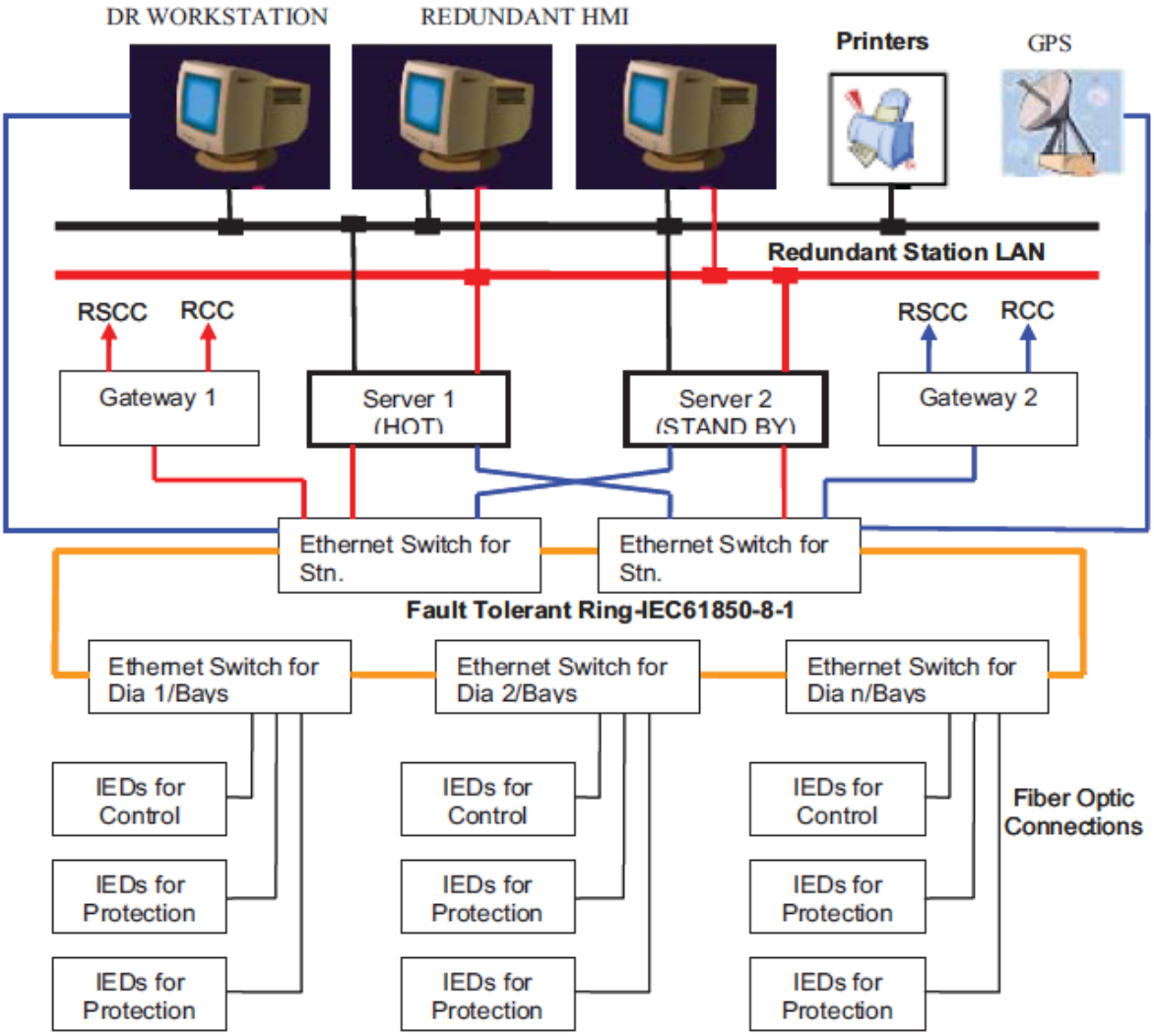
c) Fire Detection 1 ON/OFF

d) Fire Detection 2 On/OFF

e) Switchyard Panel Room Temperature High Alarm

The exact number and description of digital inputs shall be as per detailed engineering requirement. Apart from the above-mentioned digital inputs, minimum of 200 inputs shall be kept for future use.

TYPICAL ARCHITECTURE DRAWING OF SUBSTATION AUTOMATION SYSTEM



Note:

1) The redundant managed bus shall be realized by high speed optical bus using industrial grade components and shall be as per IEC 61850.
2) Inside the sub-station, all connections shall be realized as per IEC 61850 protocol.
3) For gateway, it shall communicate with Remote Supervisory Control Centre (RSCC) on IEC 60870-5-101 protocol.
4) The printer as required shall be connected to station bus directly and can be managed either from station HMI, HMI view node or disturbance recorder work station.
5) The above layout is typical. However, if any contractor offers slightly modified architecture based on their standard practice without compromising the working, the same shall be subject to approval during detailed engineering.

List of IO points to be transmitted to LDC

a) MW and MVAR for all lines, transformers, reactors and Capacitors
b) Voltage of all buses
c) Frequency of 132 kV Bus
d) All Breakers
e) All isolators
f) Tap Position for all transformers
g) Master protection signal for all feeders, transformers Units and Bus Bar
h) Loss of Voltage signal for Bus bar
i) All the points identified in point (e), (h) and (i) above as GPS Time stamped.
j) Temperature value per substation.
k) Any other point decided during detailed engineering

Chapter 14: Fibre Optic Based Communication Equipments

14.1 Introduction, General Information and Requirement

This document describes the technical specifications for Communication Equipment which includes Fibre Optic Terminal Equipment and Multiplexer Equipments for Establishment of Fibre Optic Communication System under the contract. This specification describes the functional and performance requirements of the system.

14.1.1 Scope and General Requirements

The broad scope of the procurement of this part include the survey, planning, design, engineering, supply, transportation, insurance, delivery at site, unloading, handling, storage, installation, termination, testing, training, and demonstration for acceptance, commissioning and documentation for:

i. SDH Equipment along with suitable optical line interfaces & tributary cards.

ii. (Associated Termination equipment (Drop-insert multiplexers, subscriber line interfacing card etc.)

iii. Local Craft Terminal

iv. All cabling, wiring, Digital Distribution Frame patch facilities, equipment MDF's and interconnections to the supplied equipment at the defined interfaces.

v. MDF & DDF cross connects required to route and activate circuits.

vi. System integration of the supplied subsystems and also integration with existing communication equipment such as SDH, MUX etc.

vii. System integration of the supplied equipments (termination equipment system) with existing equipments for seamless transmission of communication channel

viii. Integration of supplied system with the User equipments such as RTU/SASs, SCADA system, PLCC equipment etc.

ix. Maintenance of the supplied system.

All other associated works/items described in the technical specifications for a viable and fully functional communication network.

14.1.2 General Requirements

The Contractor is encouraged to offer standard products and designs. However, the Contractor must conform to the requirements and provide any special equipment necessary to meet the requirements stated herein.

The bay extension (132 kV) under construction 220/132 kV Dhungesaghu substation, Taplejung shall be constructed which shall be fed from Papung Substation, Taplejung having optical length around 20km where Nokia Siemens Network (NSN) make STM-1 level SDH equipment are installed at far end. Therefore, the contractor has to provide SDH equipment which shall be optically connected with far ends substations. The overall INPS communication shall not be affected due to communication works at Dhungesaghu substation as well as far ends substations.

It should be noted that preliminary design information and bill of quantity (BOQ) specified in this specification are indicative only. The Contractor shall verify the design data during the site surveys & detail engineering and finalize the BOQ as required for ultimate design & system performance.

The Bidder's proposal shall address all functional and performance requirements within this specification and shall include sufficient information and supporting documentation in order to determine compliance with this specification without further necessity for inquiries.

An analysis of the functional and performance requirements of this specification and/or site surveys, design, and engineering may lead the Contractor to conclude that additional items are required that are not specifically mentioned in this specification. The Contractor shall be responsible for providing at no added cost to the Employer, all such additional items and services such that a viable and fully functional communication equipment system is implemented that meets or exceeds the capacity, and performance requirements specified. Such materials and services shall be considered to be within the scope of the contract. To the extent possible, the Bidders shall identify and include all such additional items and services in their proposal.

All equipment provided shall be designed to interface with existing equipment and shall be capable of supporting all present requirements and spare capacity requirement identified in this specification.

The communication equipment shall be designed and provisioned for expansions and reconfigurations without impairing normal operation, including adding and removing circuits. The offered items shall be designed to operate in varying environments. Adequate measures shall be taken to provide protection against rodents, contaminants, pollutants, water & moisture, lightning & short circuit, vibration and electro-magnetic interference etc.

The Bidders are advised to visit sites (at their own expense), prior to the submission of a proposal, and make surveys and assessments as deemed necessary for proposal submission. The successful bidder (Contractor) is required to visit all sites. The site visits after contract award shall include all necessary surveys to allow the contractor to perform the design and implementation functions. The Contractor shall inform their site survey schedule to the Employer well in advance. The site survey schedule shall be finalised in consultation with the Employer. The Employer may be associated with the Contractor during their site survey activities.

After the site survey, the Contractor shall submit to the Employer a survey report on each link and site. This report shall include at least the following items:

a) Proposed layout of Equipment in the existing rooms and buildings.

b) Proposed routing of power, earthing, signal cables and patch cords etc.

c) Confirmation of adequacy of Space and AC/DC Power supply requirements

d) Proposals for new rooms/buildings if required

e) Identification of facility modifications if required

f) Identify all additional items required for integration for each site/location.

14.1.2.1 Synchronization of the Communication Network

The Contractor shall be responsible for synchronization of new communication equipment with existing network utilizing the existing clock (if available). The Contractor shall make an assessment of additional clock requirement for synchronization of the communication equipment.

14.1.2.2 Contractor's Responsibilities and Obligations

The Contractor shall be responsible for all cables and wiring associated with the equipment provided, both inside and outside buildings in accordance with technical specifications. The Contractor shall also be responsible for determining the adequacy of the local power source for the equipment and for wiring to it, with adequate circuit protective breakers. In addition, the Contractor shall be responsible for shielding equipment and cabling to eliminate potential interference to or from the equipment, and for earthing all cabinets and shields.

Contractor's obligations include, but are not limited to, the following:

i. Site visits, and surveys, necessary to identify and provide all equipment needed to implementation the network.

ii. Equipment Engineering and design specific to each location including review of, and conformance with local environmental and earthing considerations.

iii. Overall integration of communication equipments/subsystem procured in present and existing network.

iv. All cabling, wiring including supply, laying and termination etc of the cables, and distribution frame at wideband nodes required for full interconnectivity and proper operation of the telecommunications network including equipment supplied under this package and the connectivity and interfacing of user equipment.

v. Installation and integration of network management software, hardware and firmware (as applicable).

vi. Project management, project scheduling, including periodic project reports documenting progress, review meeting during the contract period.

vii. Engineering and technical assistance during the contract and warranty period.

viii. Implement all minor civil works and identify any major civil works i.e. expansion or construction of rooms, trenches necessary for installation of proposed equipment and provide the details of such work to the Employer.

ix. Factory and site testing of all hardware, software, and firmware provided.

x. Provide documented evidence of satisfactory Type Test performance to the Employer and if required by The Employer, conduct type test.

xi. Provide a Quality Assurance Plan, ensuring the Employer access to the manufacturing process.

xii. Training of the Employer personnel.

xiii. Hardware, software, and firmware maintenance, debugging, and support of the equipment through final acceptance, and maintenance on all new equipment throughout the warranty period and for a period of six (6) years after warranty period.

xiv. Availability of service, spare and expansion parts for the supplied items for the designed life of the equipment or seven (7) years after the declaration of withdrawal of equipment from production, whichever is earlier? However, the termination of production shall not occur prior to Operational Acceptance of the system by the Employer.

If any modification or addition of Cards/Software required at far end substations to complete the scope of work under this contract, bidders has to supply or install all required equipments or service without any additional cost to Employer.

Detailed descriptions of the Contractor's obligations, in relation to individual items and services offered, are delineated in other sections of this specification.

14.1.2.3 The Employer Responsibilities and Obligations

The Employer will provide the following items and services as part of this Project:

i. Overall project management of the project

ii. Review and approval of the Contractor's designs, drawings, and recommendations.

iii. Communication network configuration data, including:

(a)Channel assignments for voice and data

(b) Interconnection drawings for existing equipment

iv. Review and approval of test procedures.

v. Participation in and approval of "Type", factory and site acceptance tests where testing is required.

vi. Review and approval of training plans.

vii. Providing support and access to facilities at the sites.

viii. Implement the major civil works such as expansions or construction of rooms, trenches etc. as required for the equipment to be provided by the Contractor.

ix. Coordination of the Contractor's activities with the Employer's and constituents' concerned departments.

x. Provide to the extent possible drawings for existing sites and facilities for which equipment installations are planned.

xi. Approval of the key personnel for the project

14.1.3 Applicable Standards

The following standards and codes shall be generally applicable to the equipment and works supplied under this Contract:

i. IEEE 802.3

ii. ITU-T/CCITT Recommendations, G.652, G.701, G.702, G.703, G.711/ 12/ 14/35/ 36, G.721, G.742, G.811 and G.823

iii. ITU-T/CCITT Recommendations, G.801, G.821, G.822, G.823, G.826.

iv. ITU-T/CCITT Recommendations of the V Series

v. ITU-T/CCITT Recommendations R35, R37, and R38A (or R38B)

vi. ITU-T/CCITT Recommendations M3010, G771

vii. Internet Activities Board, RFC-1157 (SNMP)

viii. International Electro technical Commission standards, IEC801-2/3/4/5, IEC255-4, IEC-255-5, IEC-870-2-1, IEC-721-3-3, IEC-529.

ix. International Electro technical Commission standards, IEC 1000-4-xx series.

x. IEC publication 68, 68-2-2, 68-2-3, 68-2-14, 68-2-27, 68-2-32.

xi. ITU-T/CCITT Recommendations K.11, K.17, K.20.

xii. International CISPR standards

Specifications and codes shall be the latest version, inclusive of revisions, which are in force at the date of the contract award. Where new specifications, codes, and revisions are issued during the period of the contract, the Contractor shall attempt to comply with such, provided that no additional expenses are charged to the Employer without Employer's written consent.

In the event the Contractor offers to supply material and/or equipment in compliance to any standard other than Standards listed herein, the Contractor shall include with their proposal, full salient characteristics of the new standard for comparison.

In case values indicated for certain parameters in the specifications are more stringent than those specified by the standards, the specification shall override the standards.

14.2 Network Configuration and Equipment Characteristics

14.2.1 Introduction

This section describes the Fibre Optic Communication network configuration and the equipment characteristics for communication system to be installed under the project.

The sub-systems addressed within this section are:

i. Fibre Optic Transmission System (FOTS)

ii. Termination Equipment Subsystems

iii. MDF, DDF and Cabling

The requirements described herein are applicable to and in support of network requirements. The equipment supplied shall support existing network for Power system operational requirements.

The security related requirements of the equipment shall be as per relevant agency and shall be followed/complied by the vendor.

The manufacturer shall allow the Employer and/or its designated agencies to inspect the hardware, software, design, development, manufacturing, facility and supply chain and subject all software to a security/threat check any time during the supplies of equipment.

The contractor shall ensure that the supplied equipments have been got tested as per relevant contemporary International Security Standards e.g. IT and IT related elements against ISO/IEC 15408 standards, for Information Security Management System against ISO 27000 series Standards, Telecom and Telecom related elements against 3GPP security standards, 3GPP2 security standards etc. from any international

agency/ labs of the standards e.g. Common Criteria Labs in case of ISO/IEC 15408 standards or latest standards.

The Contractor shall also ensure that the equipment supplied has all the contemporary security related features and features related to communication security as prescribed under relevant security standards. A list of features, equipments, software etc. supplied and implemented in the project shall be given for use by the Employer

In case of any deliberate attempt for a security breach at the time of procurement or at a later stage after deployment/installation of the equipment or during maintenance, liability and criminal proceedings can be initiated against the Contractor as per guidelines of Government department.

14.2.2 General Network Characteristics

14.2.2.1 Description

The fibre optic network shall be based on the Synchronous Digital Hierarchy (SDH) having bit rate of STM-4 as identified in the BOQ. The network shall consist of overhead fibre optic links with a minimum bit rate of Synchronous Transport Module- 1 (STM-4). The Contractor can propose a system based on higher bit rate systems, if required, so as to meet the link budget requirements or any other specification requirement. The detailed BOQ is described in appendices.

14.2.2.2 Functional Requirement

The primary function of the communication network is to provide a highly reliable voice and data communication system for grid operation in support of the SCADA/EMS/RTU/SASs/PMUs. The communications support requirement for SCADA/EMS/RTU/SASs/PMUs system is for low & high-speed data, express voice circuits and administrative voice circuits as defined in appendices. A brief summary of the communication system requirements is as follows:

i. High speed E1 channel support
ii. 64kbps & nx64kbps data channel support
iii. Low speed (300 -9600 bps) data channel support
iv. Voice (2 wires, 4 wires) channel support.
v. Data transport supporting Network Management channels
vi. The connectivity envisaged between RTU/SASs and Control Centre over TCPIP using Ethernet interface or over serial interface.

14.2.2.3 General System Requirements

Required characteristics are defined and specified herein at the system level, subsystem level, and equipment level.

14.2.2.3.1 System Synchronization

The Contractor shall synchronize the existing equipments and all the new equipments under the contract using existing Master clock, if available. The Contractor shall provide the additional clocks as required

under the set of clocks indicated in BOQ. In addition to GPS input reference, the synchronization clock must have provision to take INPUT reference coming from other clock. The contractor shall submit the synchronization plan as per standard ITU-T G.811. All sync equipments proposed under this contract should meet ITU-T G.811 criterion. The holdover quality of slave clock, if any, shall meet ITU-T G.812 standard requirements.

The Contractor shall provide system wide synchronization fully distributed throughout the telecom network and connected to all equipments new & existing. The Contractor shall submit the synchronization plan for the entire network meeting the requirement of ITU-T G.803. The synchronization plan shall clearly indicate the requirement of additional clocks with full justification.

The system equipment requiring "clock" shall be connected to the master clock using external clocking. For this purpose, appropriate interfaces(s) in the transmission & termination equipment being supplied and all other associated hardware shall be provided by the Contractor.

14.2.2.3.2 System Maintainability

To facilitate performance trending, efficient diagnosis and corrective resolution, the system shall permit in-service diagnostic testing to be executed both locally and from remote locations, manually and/or initiated under TMN control (if provided). Such testing shall not affect the functional operation of the system.

14.2.2.3.3 System Upgradeability and Expandability

Equipment supplied shall be sized (though not necessarily equipped) to support system/ subsystem expansion to full capacity as provided by specified aggregate transmission rates. Equipment units provisioned for equipped subunits shall be terminated at appropriate patching facilities or termination blocks. Power supplies shall be sized for maximum equipped system capacity.

14.2.2.3.4 Equipment Availability

The calculated availability of each fibre optic link (E1 to E1) shall be at least 99.999%. The calculated availability is defined as the theoretical availability determined by a statistical calculation based on the mean-time-between-failure (MTBF) and the meantime-to-repair (MTTR) of the components and subsystems comprising the FOTS. For this analysis, an MTTR of at least 4 hours shall be assumed. The down time of the fibre optic cable shall not be considered in the aforesaid availability calculations. The calculated failure rates of the units and the calculated availabilities of the equipment being offered shall be provided by the Contractor during detailed engineering.

14.2.2.3.5 Revision Levels and Modifications

All hardware, firmware and software delivered as part of the communications network shall be field proven and at the most of current revision level. All modifications and changes necessary to meet this requirement shall be completed prior to the start of the factory tests or under special circumstances, on written approval by Employer, prior to the completion of SAT.

14.2.2.3.6 Equipment Capacities

Equipment supplied shall be sized and equipped with sufficient capacity to support BOQ and configuration requirements as identified in the appendices. Each subsystem supplied shall be sized (to be equipped as specified) to support full subsystem expansion.

14.2.2.3.7 Software Upgrades

The Contractor shall provide antivirus software along with all the computer hardware/software which shall be upgraded periodically till the maintenance services contract in the bid. Further, to meet all the specifications requirements during implementation and maintenance, if upgrade in the hardware/software of supplied item is required, the same shall be done by the contractor without any additional cost to the Employer.

14.2.2.3.8 General Site Considerations

All fiber optic links up to 25 kms transmission line length shall be implemented by the Contractor without repeaters. In order to meet the link budget requirement, the Contractor shall provide all the necessary equipments only in the end stations. The contractor may provide the optical amplifier, wave length translator, optical cards or high capacity SDH equipment with suitable rack/subrack to meet the maximum distance limit. All the provided equipments shall be monitored/managed by Craft Terminal.

14.2.2.3.9 Proposed Optical Fibre Characteristics

The link budget calculations and equipment design shall be based on the specified fibre parameters. The optical cables shall have Dual Window Single Mode (DWSM) fibres conforming to ITU-T Recommendations G.652D and the major parameters of these optical fibre(s) are defined in Table below.

Optical Fibre Characteristics

Fibre Description	Dual-Window Single-Mode (DWSM)
Mode Field Diameter	8.6 to 9.5 μm (±0.6 μm)
Cladding Diameter	125.0 μm + 1μm
Mode field Concentricity Error	< 0.6μm
Core-Clad concentricity error	< 1.0μm
Cladding non-circularity	< 1%
Cable Cut off Wavelength:	< 1260 nm
1550 loss performance	As per G.652D
Proof Test Level Attenuation coefficient	@1310nm < 0.35 dB/Km @1550nm < 0.21 dB/Km
Attenuation variation with wavelength 1285 nm - 1330 nm 1525 nm – 1575 nm	 Attenuation coefficient @1310 ± 0.05 dB Attenuation coefficient @1550 ± 0.05 dB
Point discontinuities	< 0.1dB
Chromatic Dispersion; Max.:	18.0 ps/ (nm x km) @ 1550 nm 3.5 ps/ (nm x km) @ 1288-1339nm 5.3 ps/ (nm x km) @ 1271-1360nm

Zero Dispersion Wavelength: Zero Dispersion Slope:	1300 to 1324nm 0.092 ps/(nm2xkm) maximum
Polarization mode dispersion coefficient	< 0.2 ps/km^1/2
Temperature Dependence:	Induced attenuation < 0.05 dB (-60 deg C - +85 deg C)
Bend performance:	@1310nm (75+2 mm dia Mandrel), 100 turns; Attenuation rise 0.05dB @1550nm (30+1 mm dia Mandrel), 100 turns; Attenuation rise 0.10dB @1550nm (32+0.5 mm dia Mandrel), 1 turn; Attenuation rise 0.50dB

14.2.2.4 Fibre Optic Link Lengths

The fiber optic route lengths are as specified in appendices. The lengths specified in Appendices are the transmission line route lengths; however, the actual fiber cable length shall exceed the route lengths on account of extra cable requirement due to sag, jointing & splicing, approach cabling etc. For bidding purposes, the Contractor may assume an additional cable length of 5% of given route length + 1Km towards approach cable for calculating the link length. The exact cable lengths shall be determined by the Contractor during the survey. The same shall be used by the Contractor for final link design during the detailed engineering of the project.

14.2.3 Fibre Optic Transmission System

The Fibre Optic Transmission System (FOTS) is defined herein to include ETSI digital optical line termination equipment. The FOTS shall be based on SDH technology. Minimum aggregate bit rate shall be STM-4 and equipped with 2 nos. of minimum 16 port E1 interface (G.703) card, one no. of minimum 8 port Ethernet interface (IEEE 802.3/IEEE 802.3u) card supporting layer 2 switching as tributaries. The Ethernet interfaces shall support VLAN (IEEE 802.1P/Q), spanning tree (IEEE 802.1D) quality of service. Protection scheme for Ethernet traffic should be ERPS based (Ethernet ring protection scheme) as per ITU-T G.8032.

The Contractor shall provide (supply and install) connectorized jumpers (patch cords) for ODF-to-equipment and equipment-to-equipment connection. Two number spare jumpers shall be provided for each equipment connection. Fiber jumpers shall be of sufficient lengths as to provide at least 0.5m of service loop when connected for their intended purpose.

The contractor shall provide **three** numbers of 8 port Ethernet **interface cards** for LDC (Load Dispatch Centre) and far end substations. It is the responsibility of contractor to design, supply and install the above-mentioned cards in the respective places without any cost to Employer.

14.2.3.1 SDH Equipment

14.2.3.1.1 Functional Requirement

There is a requirement for different types of equipment under this project which are described in this section. The Drawing is provided in the appendices. For the purpose of BOQ, the SDH Equipment is considered to be divided in three parts i.e. Optical interface/SFP, Tributary Cards (Electrical tributaries such as E1 & Ethernet 10/100 Mbps) and Base Equipment (Consisting of Common Cards, Control Cards, Optical base card, Power supply cards, sub-rack, cabinet, other hardware and accessories required for installation of equipment i.e. everything besides optical interface/SFP and tributary cards). If bidder is offering equipment with multifunction cards such as cross-connect or control card with optical interface/SFP or tributary interface, such type of multifunction card shall be considered as Common control card and shall be the part of base equipment. In case optical interface/SFP is embedded with control card, the adequate number of optical interface/SFPs shall be offered to meet the redundancy requirements of the specifications. Further, control card shall not be equipped with more than one optical interface/SFP and optical base card shall not be equipped with more than two optical interface/SFPs.

The equipment shall be configurable either as Terminal Multiplexer (TM) as well as ADM with software settings only.

14.2.3.1.2 Redundancy and Protection

Two fibre rings shall be implemented wherever the network permits. On linear sections of the network, protected links using 4 fibres shall be implemented.

14.2.3.1.3 Service Control

Service channels shall be provided as a function of the SDH equipment and shall be equipped with Service Channel Modems that shall provide at a minimum: One voice channel (order wire) with analog interface (0.3 to 3.4 kHz) and one data channel. Both omnibus and selective calling facilities shall be provided. There shall be a facility to extend the line system order-wire to any other system or exchange lines on 2W/4W basis.

14.2.3.1.4 Supervision and Alarms

ISM (In Service Monitoring) circuitry shall be provided as a function of the SDH equipment. Local visual alarm indicators shall be provided on the equipment, as a rack summary alarm panel. Alarms shall be as per ITU-T Standards G.774, G.783 and G.784. Additionally, F2/Q2 interfaces for a local craftsperson terminal interface and remote equipment monitoring is required. The Equipment shall support collection of at least four (4) external alarms for monitoring and control of station associated devices by the TMN.

14.2.3.1.5 Synchronization

The equipment shall provide synchronization as per Table given above. One 2MHz synchronization output from each equipment shall be provided.

14.2.3.1.6 Electrical and Optical I/O Characteristics and General Parameters

Table below provides the electrical and optical characteristics as well as other general parameters for SDH equipment.

Electrical and Optical I/O Characteristics and General Parameters

Optical Wavelength (Refer to Note 1)	1310/1550 nm
Optical Source (Refer to Note 2)	Laser
Optical Source Lifespan	Better than 5 x 10^5 hours
Optical Fibre Type	G.652D
Optical Connectors	Type FC-PC
Transmission Quality	Per ITU-T G.821, G.823, G.826
Source Primary Power	48 V DC
Equipment Specifications	Per ITU-T G.783
Tributary, Electrical Interface	Per ITU-T G.703, 75 O
Ethernet Interface	10/100 Mbps
SDH Bit Rates	Per ITU-T G.703
Optical Interfaces	Per ITU-T G.957, G.958
Frame and Multiplexing Structure for SDH	Per ITU-T G.707
Synchronization	Per ITU-T G.813
Management Functions	Per ITU-T G.774, G.784
Protection Architectures	Per ITU-T G.841
Built In Testing and Alarms	Per ITU-T G.774, G.783, G.784

Note 1: Optical wavelength shall be selected considering the characteristics of the optical fibre and the link budget.

Note 2: Eye Safety for Laser Equipment: To avoid eye damage, when a receiver detects a line interruption, it is required that the optical power of the laser shall be reduced to safe limits on the transmitter in the opposite direction as per ITU-T G.958.

Note 3: In case other than FC-PC connector is provided in the equipment, suitable patch cord with matching connector are to be provided to connect with FODP.

14.2.3.2 Optical Link Performance Requirements

The optical fibre link performance requirements are specified as follows:

14.2.3.2.1 Link Budget Calculations

The fibre optic link budget calculations shall be calculated based upon the following criteria:

i. Fibre attenuation: The fibre attenuation shall be taken to be the guaranteed maximum fibre attenuation i.e. 0.21 dB/Km @1550nm and 0.35 dB/km @1310nm.

ii. Splice loss: Minimum 0.05 dB per splice. One splice shall be considered for every 3 kms.

iii. Connector losses: Losses due to connectors shall be considered to be minimum 1.0 dB per link.

iv. Equipment Parameters: The equipment parameters to be considered for link budget calculations shall be the guaranteed "End of Life (EOL)" parameters. In case, the End of Life parameters are not specified for the SDH equipment, an End of Life Margin of at least 2 dB shall be considered and a similar margin shall be considered for optical amplifiers.

v. Optical path Penalty: An optical path penalty of at least 1 dB shall be considered to account for total degradations due to reflections, inter symbol interference, mode partition noise and laser chirp.

vi. Maintenance Margin: A maintenance margin of at least 2.5 dB/100Km shall be kept towards cabling, repair splicing, cable ageing and temperature variations etc.

vii. Other losses: Other losses, if any required specifically for system to be supplied shall also be suitably considered.

viii. Dispersion: The fibre dispersion shall be taken to be the guaranteed maximum dispersion i.e. 18 ps/nm. Km @1550 nm & 3.5 ps/nm.km @ 1310 nm for DWSM fibres.

ix. Bit Error Rate: The link budget calculations shall be done for a BER of 10 -10

The bidders shall determine the total link loss based on the above parameters and shall submit the system design (including link budget calculations) for each category of fibre optic link during detailed engineering. For finalizing the FOTS system design & BOQ, above methodology shall be adopted taking into account fibre attenuation, dispersion and splice loss determined during the detailed engineering. Accordingly, additions and deletions from the contract shall be carried out based on unit rates indicated in the contract.

14.2.3.2.2 Link Performance

The Link performance for ES, SES and BER for the fibre optic links shall correspond to National Network as defined in ITU-T G.826.

14.2.3.2.3 ODF to SDH Equipment

The Contractor shall be responsible for connectivity between the ODF and the SDH equipment.

The Contractor shall provide FC PC coupled patch cords. The patch-cord length between the ODF & equipment rack shall be suitably protected from rodents, abrasion, crush or mechanical damage.

14.2.4 Termination Equipment Subsystem

The Termination Equipment Subsystem is defined to include the equipment that interfaces (adapts) the subscriber (user) to the Fibre Optic Transmission System (FOTS). A Functional description of these equipments are as follows:

14.2.4.1 Functional Description

The transmission network node provides subscriber interface to the transmission network and/or switching/routing. For clarity, the basic functions accomplished at the network nodal points, are described briefly as follows:

Primary Multiplexer shall be used to accomplish subscriber connectivity to the Digital Communication Network. Subscriber Line Units shall provide analog to digital and direct digital conversion to 64 Kbps digital channel. In the CEPT standard hierarchy, thirty (30) such 64 Kbps digital channels shall be Time Division Multiplexed (TDM) resulting in a single 2.048 Mbps (E1 digital bit stream).

Digital Drop-Insert and Branching Equipment shall be used to digitally interface a small number of channels at spur locations without requiring successive D/A and A/D conversions of the throughput channels.

The equipment shall also have an interface for external 2048 kHz synchronization signal according to ITU-T Recommendation G.703.

14.2.4.2 First Order (Primary) Multiplexing

The Contractor shall be required to provide E-1 Drop & Insert Multiplexer and E-1 Channel Bank primary multiplexing in compliance with the electrical input-output characteristics provided in Table below.

14.2.4.2.1 Drop & Insert Primary Multiplexing

Drop & Insert primary multiplexing in conformance with CEPT E-1 characteristics shall be required at locations where the subscriber requirement is minimal. The drop and insertion of up to thirty 64 Kbps channels supporting subscriber line units (SLU) shall be required at intermediate locations. The Drop & Insert Muxes supplied shall be performance and card compatible with the Channel Bank Equipment provided so that all Subscriber Line Interface cards are interchangeable. **CEPT E-1 Standard First Order Multiplexing**

14.2.4.2.2 Channel Banks (Mux, Drop/Insert)

User voice and data equipment interfacing requirements are defined at the subscriber line level.

Primary multiplexing in conformance with CEPT E-1 characteristics shall be used to provide first order multiplexing of up to thirty 64 Kbps channels supporting Subscriber Line Units (SLUs).

14.2.4.2.3 Subscriber Line Units/Subscriber Line Interface Cards

The terms Subscriber Line Interface Cards and Subscriber Line Units have been used interchangeably throughout the specification. Multiple configurations of SLUs shall be required to provide subscriber to primary multiplexer Bank interfacing for a variety of voice and data communications. In case there are changes in number or type of cards because of changes in channel requirements, the contract price shall be adjusted accordingly.

The SLU interface requirements are discussed in the following subparagraphs:

(A) Voice Channels

The voice channel requirement is for (I) 4-Wire E&M trunking in support of PLC VF and (II) 2-Wire telephonic interfaces. 2 wire SLUs shall be DTMF/TP optioned for 2- wire loop start or 2-wire GND start. The voice cards shall utilize ITU.T A – law companded PCM G.711, 64 Kbits/s encoding. The voice card requirements are indicated in the BoQ in appendices.

(B) Sub-Channel Data Multiplexing

The Contractor shall provide a direct DTE interface for synchronous communications at speed of 64Kbps and compatible with CCITT G.703 Kbit/s, V.35 and X.21 interfaces. Data rate selection shall be switch selectable or programmable.

(C) Nx64 kbps Synchronous Data

There is also a requirement for N x 64 kbps V.35, X.21 interfaces. The tentative quantities have been identified in the appendices. However, the final BOQ shall be worked out during detailed design.

14.2.5 MDF, DDF and Cabling

For the purposes of the specification, the contractor shall provide cabling, wiring, DDF patching facilities and MDFs interfacing to the wideband telecommunications system. Equipment and material components for MDF, DDF and cabling are also part of this procurement. It shall be the

Contractor's responsibility to provide all cable support required for full supplied equipment interconnection with the MDF and shall be in accordance with communications industry standard practices and the requirements mentioned in the technical specifications.

14.2.5.1 Digital Distribution Frame Functional Requirements

The Contractor shall provide DDF for Digital Signal Cross connect (DSX) Broadband quality

(better than 20 MHz) patching facilities configured "normally-thru" with Equipment, Line and

Monitor Patch Jacks. DDFs shall provide the following basic functions:

i. "Normally thru" circuit routing
ii. Circuit rerouting via patch cord assemblies
iii. Circuit disconnect and termination

All DDFs shall be sized and equipped to support the offered configuration of the provided equipment. Independent Transmit and Receive patch jack assemblies (line and equipment) shall provide for separate transmit and receive single-plug patching. Transmit and receive patch jack assemblies shall be located side-by-side such that dual-plug patch cord assemblies may be used to route both transmit and receive for the same circuit.

14.2.5.2 Main Distribution Frames

The Contractor shall make provision for cross connection of subscriber services to the subscribers utilizing Krone type or equivalent and shall provide full connectivity up to and terminated on the equipment side of the appropriate DDFs and line side of MDFs. The Contractor shall terminate on the equipment side of patching facilities provided by other contracts and shall provide DSX type patching facilities supporting aggregate bit streams (i.e. dataplexers and E-1 Channel Banks).

Separate Patch panels or MDFs shall be provided for Data and Voice. All cross connects shall be accomplished utilizing one, two or three pair patch cords. Patch plugs are permissible for direct one-to-one circuit "cut-thru".

14.2.6 Patch Cords

The Contractor has to supply FC PC coupled Patch cords as described in BOQ. The Patch cord return loss shall be equal to or better than 40 dB and insertion loss equal to or less than 0.5 dB.

14.2.7 Telecommunication Management Network/ Network Management System (As applicable)

The Contractor shall provide a Telecommunications Management Network System (TMN) for operational support to the FOTS and associated Termination equipment subsystems. This TMN shall provide the capability to monitor, reconfigure, and control elements of the telecommunications network from a centralized location and at each node of the network where equipment is located. This TMN system shall assist Employer/Owner in the operations and maintenance of the wideband communication resources of the

including detection of degraded circuits, system performance, the diagnosis of problems, the implementation of remedial actions and the allocation or reallocation of telecommunications resources and addition/deletion of network elements.

The contractor shall supply preferably a single TMN for all the NEs (Network Elements) such as SDH equipment, Mux, Drop-Insert, DACS etc. In case a single TMN cannot be provided for all the NEs, the contractor may supply separate TMNs. Each of the offered TMN shall meet the requirements indicated in this section. The bidder shall provide details of the offered TMN in the bid.

14.2.7.1 Applicable Standards

The TMN design concept, functional and informational architecture and physical architecture, shall be in compliance with ITU-T Recommendation M.3010. The offered TMN system shall be capable of integration to other supplier's Network Management System (NMS) upwardly through North bound interfaces. The north bound interface in the EMS shall be CORBA/TMF-814 compliant.

14.2.7.2 TMN Architecture

The TMN shall provide

a) Collection of Management data from all Network Elements (NEs) supplied under this package. The minimum monitoring and control requirements for the communication equipment shall be as defined in this section.

b) Processing of above management data by using processor(s) located at control Centre and additional intermediate station processor(s), wherever required.

c) Monitoring and control of the NEs as defined below:

   i. TMN system at LDC (including local operator console, if applicable) shall support management of all equipments supplied and monitoring of the entire regional network supplied under this package. At a minimum functions of Network management layer (NML) and Element management layer (EML) as defined in CCITT M3010. The detailed functions are listed in TS.

   ii. Monitoring and control of NEs using Craft Terminals as defined in this Section.

d) Supervisory monitoring and control of the following station associated devices:

   i. Intrusion Detection Alarms

   ii. Power Failure

   iii. Fire and Smoke Detection

   iv. Environmental Control (Temperature, Humidity etc.)

e) Communication channel support for TMN System as specified in Technical Specifications (TS).

The supplied TMN system shall be capable of handling all management functions for at least 150% of the final network elements. Further, the centralised TMN system shall also have provision for addition of at least two remote operator consoles. The TMN hardware shall be so designed that failure of a single processor/component (router, switch, converter etc.) shall not inhibit any of the functionality of the TMN at control centre. The Contractor shall submit for Employer's approval the TMN architecture describing in detail the following subsystems/features:

a) Database used in TMN

b) Master Processor, server/workstation, LAN, Peripherals and hardware

c) Software and operating system

d) Local Consoles/remote consoles

e) Craft Terminals

f) Data communication between NEs, Remote/Local Consoles and TMN Processor(s) Routers/Bridges

g) Expansion Capabilities

14.2.7.3 Management Functions

The TMN shall support following management functions:

14.2.7.3.1 Configuration Management

Configuration management is concerned with management, display, and control of the network configuration. Minimum specific requirements that shall be satisfied include the following:

a) Provide tools to establish and maintain the backbone topology and configuration information and provide graphical maps depicting the configurations.

b) Gather descriptive information about the current configuration of the equipment, provide operator displays, and prepare reports.

c) Provide tools for planning, establishing, and changing the static equipment configuration Provide for changes to the equipment configuration in response to equipment failures, planned upgrades, and operator requests to take equipment offline for testing.

d) Provide verification testing to support new equipment installation.

14.2.7.3.2 Fault Management

Fault management is concerned with detecting, diagnosing, bypassing, directing service restoration, and reporting on all the backbone network equipment, systems, and links. Minimum specific requirements that shall be satisfied include the following:

a) Display equipment status in a consistent fashion regardless of the source of the data on a graphical topological, map-type display. Status shall be displayed through the use of colours on links and nodes as well as through text.

b) Obtain status and detect faults through periodic polling, processing of unsolicited alarms and error events, and periodic testing for connectivity.

c) Maintain an alarm summary of unacknowledged alarm events on the management station display and maintain a log of all received alarms. The operator shall be able to acknowledge and clear alarms individually and as a group. The use of alarm correlation techniques is encouraged to minimize the proliferation of alarms caused by a single, common event. All alarms shall be configurable as critical alarms, major alarms and minor alarms with different

d) colours.

e) Provide the capability to diagnose and isolate failures through analysis of error and event reports and through the use of both on-line and off-line diagnostic tests and display of monitored data.

f) The criteria for fail over shall be configurable as automatic fail over to redundant equipment wherever possible and through operator-initiated actions where automatic fail over is not possible. The status of fail over shall be reported to the NMS.

g) Track network equipment failure history.

14.2.7.3.3 Performance Management

Performance management is concerned with evaluation of the use of network equipments and their capability to meet performance objectives. Minimum specific requirements that shall be satisfied include the following:

a) Provide support for an operator to initiate, collect, and terminate performance metrics under both normal and degraded conditions. For example, BER of each link, together with other data measured at each node, shall be available on operator request (at least for SDH).

b) Monitor point to point & end to end signal quality and history. Provide operator controls to monitor performance of specified events, measures, and resources (at least for SDH). Specifically provide displays to permit the operator to:

i. Select/deselect network equipments, events, and threshold parameters to monitor

ii. Set monitoring start time and duration or end time

iii. Set monitoring sampling frequency

iv. Set/change threshold values on selected performance parameters

v. Generate alarm events when thresholds are exceeded.

vi. Set multiple thresholds on certain performance parameters. Alarm categories include as a minimum a warning and a failure.

vii. Calculate selected statistical data to measure performance on selected equipment based on both current and historical performance data maintained in performance logs. Performance data provided is limited to what is available from the equipment Contractors.

viii. Provide graphical displays of point to point and end to end current performance parameter values. Provide tabular displays of current, peak, and average values for performance parameters.

ix. Generate reports on a daily, weekly, monthly, and yearly basis containing system statistics.

14.2.7.3.4 Security Management

The TMN shall be provided with security features to limit access to monitoring and control capabilities to only authorized personnel. One access level of System Administrator and at least two levels of operator access shall be provided - read (view) only, and write (configure). The system administrator shall be able to create, define and modify operators with different access levels, network domains and perform all kind of maintenance and up gradation of the TMN system. With "read only" access level, network parameters should only be viewed. Access to database maintenance, command control and test functions shall be available with "write " access level. Means shall be provided to ensure only one authorized user has write capability for a selected domain of the network. It shall be possible to define multiple domains for purposes of monitoring and control.

Human error and conflict detection are also required. Such errors and access violations shall be reported to the offending user as error messages and warnings.

14.2.8 Communication Channel Requirements and Integration

Communication requirements for TMN system have not been considered in Appendices and the Contractor shall provide these as a part of TMN system. The Contractor shall provide all required interface cards / devices, LAN, routers/bridges, channel routing, cabling, wiring etc. and interfacing required for full TMN data transport.

The TMN data transport shall utilize the wideband communications transmission system service channel in the overhead whenever possible. This will provide inherent critical path protection should the configuration requirements dictate multiple TMN station processors, the TMN Master Station shall require bidirectional data transport with its station processor(s). This communications interfacing shall be via critically protected data channels. It shall be the Contractor's responsibility to provide for and equip all necessary critically protected TMN data channel support.

In case supervisory channels are not available, the Contractor shall provide suitable interfaces in their supplied equipment for transport of TMN data. The Contractor shall also be responsible for providing suitable channels with appropriate interfaces to transport the TMN data.

The NMS information of existing PDH & SDH system shall be transported through the new communication network, wherever required, up to the NMS location. The NMS information of the new SDH & PDH system being procured under the package shall be transported through the existing communication network using 64 kbps/2Mpbs (G.703) interfaces. Any hardware required for above interfacing shall be provided by the Contractor.

The bidders shall describe in the proposal the TMN data transport proposed to be used by the bidder in detail including capacity requirements and various components/equipment proposed to be used.

14.2.9 Craft Terminal

Each equipment (SDH equipment, Mux, Drop/Insert and DACS etc.) on the fibre optic communication network shall include provision for connecting a portable personal computer (PC) to be known as craft terminal to support local commissioning and maintenance activities.

Through the use of this PC and local displays/controls, the operator shall be able to:

a) Change the configuration of the station & the connected NEs.

b) Perform tests

c) Get detailed fault information

The craft terminal shall be connected to the interface available in the communication equipment. Portable (laptop) computers (Craft terminals), each complete with necessary system and application software to support the functions listed above, shall be supplied to the employer as per BOQ given in the appendices.

14.2.10 Hardware Requirements

14.2.10.1 Master Processor, Server/ Workstation and Craft Terminal

The server/workstation and craft terminal shall have suitable processor(s) which shall be sufficient to meet all the functional requirement and expansion capabilities stipulated in this specification. Only reputed make like Dell, IBM, HP, Compaq make shall be supplied.

The server shall have minimum configuration of 3GHz for CISC based or 1.6GHz for RISC based processor, 2GB RAM, DVD-ROM drive, redundant 80 GB internal Hard Disk Drive, 101Enhanced style keyboards, mouse, parallel, serial, USB(2.0) ports and hot swap redundant power supply VDUs shall be 17" TFT active matrix color LCD with a minimum resolution of 1024X 768.

Appropriate network drive card shall also be provided wherever required. However, the internal hard disk drive for the server shall be redundant and all the data shall be mirrored. Further, the TMN software shall support data mirroring on redundant disk drives. The workstation shall have minimum configuration of 2.4GHz for CISC or 1.4GHz for RISC based processor, 1GB RAM, DVD-RW drive, 160 GB Hard Disk Drive, 101-Enhanced style keyboards, mouse, parallel, serial and USB (2.0) ports. VDUs shall be 19" TFT active matrix color LCD with a minimum resolution of 1024 X 768. Appropriate network drive card shall also be provided wherever required. CPU enclosures shall be desktop type and shall include available expansion slots except for the Craft Terminal which shall be a laptop. The craft terminal shall have minimum configuration of 2.4 GHz, 2 GB RAM, 256 MB VRAM, DVD RW drive, 160 GB Hard

Disk Drive, keyboard, mouse/trackball etc., parallel, serial/USB (2.0) ports to accommodate printers, and Internal/external Data/Fax modem and a battery back-up of at least 60 minutes. VDUs shall be 15" TFT active matrix color LCD with a minimum resolution of 1024 X 768. TMN system shall be provided with laser printer. The laser printer shall have a minimum print speed of 17 pages per minute and a minimum resolution of 1200 x 1200 dpi. The laser printer shall have parallel and LAN ports for connecting to TMN system.

The laser printer under this specification shall be black & white and include print enhanced buffering to prevent loss of print data in the event of a print failure.

14.2.10.3 Local/ Remote Operator Consoles (As applicable)

The Contractor shall provide operator consoles sized and equipped to support the subsystem(s) furnished and in compliance with the specification. The console shall provide hardware interfacing for the TMN users to the software operating support systems. At a minimum, a console shall include the hardware similar to a workstation.

14.2.10.4 Power Supplies

The TMN system shall use 230 volts 50 Hz A.C or -48 volt D.C as available at site for its operation as available at site.

14.2.11 General Software/ Firmware Requirements

Due to various alternative design approaches, it is neither intended nor possible to specify all software and firmware characteristics. It is the intent herein to provide design boundaries and guidelines that help to ensure a demonstrated, integrated program package that is maintainable and meets both hardware systems requirements and the customer's operational requirements.

14.2.11.1 Operating System Software

Operating system software shall be provided to control the execution of system programs, application programs, management devices, to allocate system resources, and manage communications among the system processors. The contractor shall make no modifications to the OEM's operating system, except as provided as USER installation parameters.

14.2.11.2 Application Software

All applications software shall be written in a high-level programming language unless developed using industry proven application programs and development tools provided with the system. The contractor shall make no modifications to the applications program except as provided as USER development tools.

14.2.11.3 Software Utilities

A utility shall be provided to convert all reports into standard PC application formats such as excel.

14.2.11.4 Revisions, Upgrades, Maintainability

All firmware and software delivered under this specification shall be the latest field proven version available at the time of contract approval. Installed demonstration for acceptance shall be required. All firmware provided shall support its fully equipped intended functional requirements without additional rewrite or programming.

All software shall be easily user expandable to accommodate the anticipated system growth, as defined in this specification. Reassembly recompilation or revision upgrades of the software or components of the software, shall not be necessary to accommodate full system expansion.

Software provided shall be compliant with national and international industry standards

14.2.11.5 Database (s)

The contractor shall develop all the databases for final wideband network following the global acronyms for all stations. Database(s) to be provided shall contain all structure definitions and data for the integrated functional requirements of TMN system. TMN operator Groups shall share the same virtual database. This means that they shall share the same database and database manager, whether or not physically separate databases are maintained.

14.3 Inspection

Access to the Contractor's facilities during system manufacturing and testing and to any facility where systems/ equipment is being produced/ tested/ integrated for the fibre optic communication network, shall be available to the Employer. At all times the Employer shall have full facilities for unrestricted inspection of such material or equipment. To facilitate this, the Contractor shall submit for the Employer approval, a comprehensive Quality Assurance Plan using ISO 9000 as a general guideline. In addition, the Quality Assurance Plan shall satisfy the following:

a) Sufficient office facilities, equipment, and documentation necessary to complete all inspections and to verify that the equipment is being fabricated and maintained in accordance with the Specification shall be provided by the Contractor to the Employer.

b) Inspections to be performed by the Employer will include visual examination of hardware, cable dressings and labeling. Contractor's documentation will also be examined to verify that it adequately identifies and describes all offered items and spare parts.

c) Access to inspect the Contractor's standards, procedures, and records that are applicable to the supplied equipment shall be provided to the Employer. Documents will be inspected to verify that the Contractor has performed the required quality assurance activities.

d) The inspection rights described above shall also apply to sub-Contractors who are responsible for supplying major components described in this Specification. These items shall be inspected and tested at the sub Contractor's factory by the Employer's representatives prior to shipping this equipment to the Contractor's facility or directly to the Employer.

e) The above inspection rights shall also apply to sub-Contractors supplying assemblies, subassemblies and components. However, such items will normally be inspected and tested by the Employer's representatives at the Contractor's site before acceptance.

14.3.1 Test Plans and Procedures

Test plans and test procedures for both factory and site acceptance tests shall be provided by the Contractor. Test plans and test procedures shall ensure that each factory and site test is comprehensive and verify all the features of the equipment to be tested. Test plans and test procedures shall be modular to allow individual test segments to be repeated upon request.

The Contractor shall submit a Test Schedule for the Employer's approval within one (1) week after the award of contract for Type Tests and three (3) months after the award of contract for all other tests. The test schedule shall list the tests to be carried out, and the approximate test duration. The test periods shall also be indicated in the PERT chart or equivalent for the work.

The Contractor shall give the Employer twenty-one (21) days written notice of any material being ready for testing. Fifteen days prior to the scheduled testing, the Employer shall provide written notice to the Contractor of any drawings, equipment, material, or workmanship which, in the Employer's opinion, are not compliant to the specification. The Contractor shall give due consideration to such objections, if valid, effecting the corrections as necessary or shall prove, in writing, that said modifications are unnecessary for contract compliance.

14.3.1.1 Factory and Site Test Plans

A test plan for factory and site acceptance tests shall be submitted for approval, at least four (4) weeks before the start of testing. The test plan shall be a single overview document that defines the overall schedule and individual responsibilities associated with conducting the tests, documenting the test results, and successfully completing the test criteria. Test Plans shall include, at a minimum, the information contained in Table below.

Item	Description
1.0	Test Schedule
2.0	Record-keeping assignments, procedures and forms
3.0	Procedures for monitoring, correcting and retesting variances

4.0	Procedures for controlling and documenting all change made to the communications equipment after the start of testing

14.3.1.2 Test Procedures

Test procedures for factory and site testing shall be submitted for the Employer approval at least four (4) weeks before each individual test. Fully approved test procedures shall be submitted to the Employer at least four weeks prior to the commencement of testing. Testing shall not commence without approved test procedures. At a minimum, test procedures shall include the items listed in Table below.

All test equipment and/or instruments shall bear calibration stickers indicating valid calibration on and beyond the testing date. The time lapsed since last calibration shall not exceed the test equipment/ jig manufacturer recommended calibration interval or the interval recommended in the test lab's internal quality procedures.

The Contractor shall ensure that all testing will be performed by qualified testing personnel well experienced in performing such tests.

Item	Description
1.0	Test Title and Revision Level, if applicable
2.0	List of Standard(s) complied with
3.0	Function(s) / parameter(s) to be tested
4.0	Purpose of each test segment
5.0	List of required test equipment
6.0	Description of any special test conditions or special actions required. This includes complete descriptions, listings and user interface procedures for all special hardware and software tools and/or display formats to be used during the test.
7.0	Test setup including test configuration block diagrams and/or illustrations.
8.0	Test procedures to be followed.
9.0	Required inputs and expected outputs for each test segment
10.0	Acceptance criteria for each test segment.
11.0	List of test data to be supplied by the Contractor(s) and copies of any certified data to be used
12.0	Forma of test reports

14.3.1.3 Test Record

Complete and indexed records of all factory and site acceptance tests results shall be maintained and provided to the Employer by the Contractor in hardcopy. The records shall be keyed to the steps enumerated in the test procedures. The minimal items required in test records are described in Table below.

Item	Description
1.0	Test Title and Revision Level, if applicable

2.0	Date and time for test start and test completed
3.0	Test title and reference to the appropriate section of the test procedures
4.0	Description of any special test conditions or special actions taken (Includes test case data)
5.0	Test results for each test segment including an indication of Passed, Conditional Pass, Incomplete or Failed.
6.0	Test procedure modifications made during testing.
7.0	Variance Report(s) tracking information and copies (if variance(s) was detected).
8.0	Contractor's test engineer(s) identification, signature and remarks
9.0	Employer's test witness identification, signature and remarks
10.0	List of all attachments
11.0	Attachments (including system logs, printouts, variances, hard copies of visual test result displays, etc.)

All principle test records, test certificates and performance curves shall be supplied for all tests carried out as proof of compliance with the specifications and/or each and every specified test. These test certificates, records and performance curves shall be supplied for all tests, whether or not they have been witnessed by the Employer within the specified duration after the completion of test. Information given on such test certificates and curves shall be sufficient to identify the material or equipment to which the certificates refer, and shall also bear the Contractor's reference and heading.

14.3.1.4 Rejection of Elements

Any item or component which fails to comply with the requirements of this Specification in any respect, at any stage of manufacture, test, erection or on completion at site may be rejected by the Employer either in whole or part as considered necessary.

Material or components with defects of such a nature that do not meet the requirements of the Specification by adjustment or modification shall be replaced by the Contractor at his own expense. After adjustment or modification, the Contractor shall submit the items to the Employer for further inspection and/or tests.

14.3.1.5 Test Periods Defined

The terminology used in Volume I, General Conditions of Contract and their correlation with the test's requirements described within this section is as follows:

Pre-Commissioning & Commissioning Period - The Site Acceptance Test (SAT) Operational Acceptance - Successful completion of SAT.

14.3.2 Type Testing

"Type Tests" shall be defined as those tests which are to be carried out to prove the design, process of manufacture and general conformity of the materials to this Specification. Type Testing shall comply with the conditions specified in Chapter 2- GTR.

14.3.2.1 List of Type Tests

The type testing shall be conducted on the following equipment

a) SDH Equipment with all types of cards (optical card, Tributary card or any other equipment as part of repeater less links)

b) Primary Multiplexer & Drop – Insert Multiplexer with subscriber interface card

14.3.2.1.1 List of type tests to be conducted on Telecom Equipment

The type tests for SDH Equipment with all types of cards, Primary Multiplexer & Drop – Insert Mux with subscriber interface card are described below:

i) Temperature and Humidity Test

The tests listed below are defined in IEC Publication 60068.

(a) Low Temperature Test: Operation to Specifications

Low temperature tests shall be conducted as defined in IEC Publication 60068-2-1, test method and, with the following specifications:

- Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for sixteen (16) hours. Its performance is checked during the test.
- Degree of Severity: Test shall be done at 0°C
- Acceptance Criteria: No degradation of performance during and after the test.

(b) Low Temperature Test: Operation without Damage

Low temperature tests shall be conducted as defined in IEC Publication 60068-2-1, test method and, with the following specifications:

- Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 72 hours. Its performance is checked during the test and after the test as soon as the thermal equilibrium is reached at the room temperature (Post-test).
- Degree of Severity: Test shall be done at -10° C
- Acceptance Criteria: Degradation of performance is allowable during the test, however there shall be no degradation of performance in the post-test.

(c) **Dry Heat Test: Operation to Specifications**

Dry heat test shall be done as defined in IEC Publication 60068-2-2, test method Bd, with the following specifications:

- Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 96 hours. Its performance is checked during the test.
- Degree of Severity: As per operation to specification range.
- Acceptance Criteria: No degradation of performance during and after the test.

(d) **Dry Heat Test: Operation without Damage**

Dry heat tests shall be done as defined in IEC Publication 60068-2-2, test method Bd, with the following specifications:

- Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 96 hours. Its performance is checked during the test and after the test as soon as the thermal equilibrium is reached at the room temperature (Post-test).

- Degree of Severity: Test shall be done at 55ºC.
- Acceptance Criteria: Degradation of performance is allowable during the test, however there shall be no degradation of performance in the post-test.

(e) Damp Heat Test

Damp heat testing reveals aging with respect to the humidity level and applies basically to electronic equipment. This test shall be done as defined in IEC Publication 60068-2-3 with the following specifications:

- Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 10 days. Its performance is checked during the test.
- Acceptance Criteria: The equipment shall meet the specified requirement and there shall not be any degradation in BER.

(f) Temperature Variation Test

Temperature variation testing shall be as per IEC Publication 60068-2-14 (Gradual Variations, Method Nb). The equipment shall be powered on and various parameters shall be monitored continuously during the test period.

- Number of cycles required is five (5)
- The degree of severity: temperature TL:0°C, TH: As per operation to specification range
- Cycle duration for each temperature is three (3) hours.
- Ramp: 1o C/minute.
- Acceptance Criteria: The equipment shall meet the specified requirement and there shall not be any degradation in BER.

ii) Power Supply and EMI/EMC tests

The test procedure and acceptance criteria shall be as defined in IEC 60870-2-1.

(a) **Immunity Test**

The list of immunity test are specified below in given table:

Recommended Immunity Test

S. No:	Immunity Test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Parameters
1	Voltage Fluctuations	Yes	Yes	NA	NA	Table 11 of IEC 60870-2-1: 1995 – Level: 1
2	Voltage dips and interruptions	Yes	Yes	NA	NA	
3	1.2/50 - 8/20 μs surges	Yes	Yes	Yes	NA	Table 12 of IEC
4	Fast transient bursts	Yes	Yes	Yes	Yes	

5	Damped oscillatory waves	Yes	Yes	Yes	Yes	60870-2-1: 1995 - Level: 4
6	10/700 µs surges					
7	Electrostatic Discharge	Yes				Table 13 of IEC 60870-2-1: 1995 - Level: 4
8	Power frequency magnetic field	Yes				Table 14 of IEC 60870-2-1: 1995 - Level: 4
9	Damped oscillatory magnetic field	Yes				Table 14 of IEC 60870-2-1: 1995 - Level: 4
10	Radiated electromagnetic field	Yes				Table 15 of IEC 60870-2-1: 1995 - Level: 4
11	Power Frequency voltage on control and signal lines	NA	NA	Yes	Yes	IEC 61000-4-16 : 2002-07 Level: 4
12	DC voltage on control and signal lines	NA	NA	Yes	NA	IEC 61000-4-16 : 2002-07 Level: 4

(b) **Emission Tests**

The list of Emission tests is specified below in Table

S. No:	Immunity Test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Parameters
1	LF disturbance voltages CCITT	NA	Yes	NA	NA	

	recommendation P.53					Table 17 of IEC 60870-2-1: 1995 - Class**: B**
2	RF disturbance voltages CISPR 22	Yes	Yes	NA	NA	
3	RF disturbance currents CISPR 22	NA	NA	NA	Yes	
4	RF radiated fields CISPR 22	Yes	Yes	Yes	Yes	

(c) **Insulation Withstand Voltages**

As per section 6 of IEC 870-2-1. Recommended class: VW1 of Table 18.

(iii) Mechanical Tests

(a) Mechanical Vibration Test

The procedure for this test is described in IEC Publication 60068-2-6. The testing procedure shall be carried out in the sequence 8.1 + 8.2.1 + 8.1 as described in document 60068-2-6.

For the vibration response investigation (clause 8.1 of 60068-2-6), the test shall be carried out over a sweep cycle under the same conditions as for the endurance test (described later), but the vibration amplitude and the sweep rate may be decreased below these conditions so that the determination of the response characteristics can be obtained.

The endurance test conditions are selected according to the vibration withstand requirements.

Transportation tests shall be performed with the equipment packed according to the Contractor's specifications.

(b) **Shock Test**

The procedure of this test is defined in IEC Publication 60068-2-27 (each test) with a semi sinusoidal

Shape (clause 3.1.1.2).

The recommended severity shall be

A=294m/s2, D = 18 ms.

Three shocks per axis per direction shall be applied to the equipment packed according to the Contractor's specifications.

Or Free Fall Test

This test could be performed as an alternative to the shock or Bump test. The procedure is defined in IEC publication 60068-2-32. The equipment shall be packed according to the Contractor's specifications. The drop height shall be defined in accordance with IEC 68-2-32. The surface of the packing case which comes into contact with the ground is the surface on which the packing case normally rests; if the packing does not have any features (inscription, special shape, etc.) identifying this surface, the test is carried out successively on all the surfaces of the packing.

Or Bump Test

This test could be performed as an alternative to Shock test or Free Fall test. The procedure is defined in IEC 60068-2-29.

14.3.3 Factory Acceptance Test

Factory acceptance tests shall be conducted on randomly selected final assemblies of all equipment to be supplied. Factory acceptance testing shall be carried out on SDH Equipments, associated line & tributary cards, Termination Equipments (Primary Mux, Drop/Insert, associated Subscriber Line Interface Cards etc) and all other items for which price has been identified separately in the Bid Price Schedules.

Equipment shall not be shipped to the Employer until required factory tests are completed satisfactorily, all variances are resolved, full test documentation has been delivered to the Employer, and the Employer has issued Material Inspection & Clearance Certificate (MICC). Successful completion of the factory tests and the Employer approval to ship, shall in no way constitute final acceptance of the system or any portion thereof. These tests shall be carried out in the presence of the Employer's authorized representatives unless waiver for witnessing by Employer's representatives is intimated to the contractor.

Factory acceptance tests shall not proceed without the prior delivery to and approval

of all test documentation by the Employer.

The factory acceptance test shall demonstrate the technical characteristics of the equipment in relation to these specifications and approved drawings and documents. List of factory acceptance tests for Fibre Optic Transmission system, Termination Equipment Sub-system and NMS are given in specified Tables in this section. This list of factory acceptance tests shall be supplemented by the Contractor's standard FAT testing program. The factory acceptance tests for the other items shall be proposed by the Contractor in accordance with technical specifications and Contractor's (including Sub-Contractor's / supplier's) standard FAT testing program. In general, the FAT for other items shall include at least: Physical verification, demonstration of technical characteristics, various operational modes, functional interfaces, alarms and diagnostics etc.

For Test equipment & clock, FAT shall include supply of proper calibration certificates, demonstration of satisfactory performance, evidence of correct equipment configuration and manufacturer's final inspection certificate/ report.

Factory Acceptance Testing Requirements for Termination Equipment (MUX)

Item	Description
1.0	Physical Inspection for conformance to DRS, BOQ, drawings and appearance of equipment
2.0	Performance of supervision, alarm, control and switching systems, diagnostics, loopbacks, Craftsperson interface etc.
3.0	Electrical interface tests which include: output and input jitter, bit error rate, pulse shape, cable compensation, and line rate tolerance for the channel banks/low-level multiplexers
4.0	Framing, signaling, and operational and maintenance tests consistent with applicable ITU-T requirements
5.0	Simulation of failure conditions and failover of each redundant unit
6.0	Test of spare card slots and test of spare parts/modules/cards as per applicable tests

7.0	Checks of power supply/converter voltage margins and short circuit and overvoltage protection
8.0	Random inspections to verify the accuracy of documentation

FAT on Craft Terminal

Item	Description
1.0	Physical inspection of Craft Terminal hardware for conformance to approved BoQ, DRS & drawing
2.0	Testing of Craft Terminal to demonstrate proper operation of all functions

14.3.4 Site Acceptance Test

The Contractor shall be responsible for the submission of all equipment & test equipment supplied in this contract for site tests and inspection as required by the Employer. All equipment shall be tested on site under the conditions in which it will normally operate.

The tests shall be exhaustive and shall demonstrate that the overall performance of the contract works satisfies every requirement specified. At a minimum Site Acceptance Testing requirement for Telecom equipment. is outlined in following section. This testing shall be supplemented by the Contractor's standard installation testing program, which shall be in accordance with his quality plan(s) for Telecom equipment installation.

During the course of installation, the Employer shall have full access for inspection and verification of the progress of the work and for checking workmanship and accuracy, as may be required. On completion of the work prior to commissioning, all equipment shall be tested to the satisfaction of the Employer to demonstrate that it is entirely suitable for commercial operation.

14.3.4.1 Phases for Site Acceptance Testing

The SAT shall be completed in following phases:

(a) Installation testing

The field installation test shall be performed for all equipment at each location. If any equipment has been damaged or for any reason does not comply with this Specification, the Contractor shall provide and install replacement parts at its own cost and expense.

In the installation test report, the Contractor shall include a list of all hardware or components replaced or changed between the completion of factory tests and the start of field tests and show that documentation and spare parts have been updated.

The minimal installation testing requirements for fiber optic transmission subsystem, Termination equipment sub-system are provided in respective Tables in this section.

(b) Link Commissioning Tests

The commissioning tests shall verify that communication can be performed over the fiber optic link under test. Delay measurement, Bit Error measurements & service channel performance monitoring shall be made on the fibre optic links to verify compliance with designed link performance.

For Ethernet interface: At a minimum the following test requirement shall be demonstrated as per RFC 2544:

i. Ping test
ii. Throughput test
iii. Latency test
iv. Packet Loss

10% of the total links (Chosen by the Employer, generally to cover links from all configurations used) shall be tested for a duration of 12 Hours. Rest of the links shall be tested for 1 Hour. In case a link does not meet the performance requirements during 1 hour, then the duration of the test shall be increased to 12 hours. In case any link does not meet the performance requirements during 12 hours, then the cause of failure shall be investigated and the test shall be repeated after rectifying the defects.

This phase of testing shall be conducted by the Contractor and witnessed by the Employer. Field adjustments shall be made to meet established standard, however if the field adjustments fail to correct the defects the equipments may be returned to the Contractor for replacement at his own expense. In case any adjustments are required to be made during the interval of the test then the test shall be repeated.

(c) Integrated Testing

Prior to commencement of integrated testing the overall system shall be configured a required to provide all the data and voice channel required to interconnect the various User's interfaces. The integrated testing for a batch shall include end-to-end testing of back-bone network included in that batch. Integrated testing for last batch shall include testing of the entire back-bone. The intent of integrated testing is to demonstrate that the equipment is operational end to end under actual conditions, that all variances identified during factory and field installation and communications testing have been corrected, and that the communication equipment is compatible with other equipment at all locations. The Integrated System Test shall include all fibre optic transmission equipment, termination equipment, the network management subsystem and other components.

At a minimum the following tests shall be included in the integrated testing:

i. Equipment configuration shall be checked to establish that it supports the channel routing.
ii. End to end testing of all individual voice circuits
iii. End-to-end testing of all individual Data Circuits.
iv. Demonstration of Protection switching and synchronization of equipment as per synchronization plan.

Fibre Optic Transmission System Installation Testing

Item	Description
1.0	Physical Inspection for conformance to drawings, rack elevations and appearance of equipment and cabling

2.0	Station power supply input and equipment power supply (DC-DC converter) output voltage measurements
3.0	Terminal transceiver performance testing (Tx power, Tx spectrum, receive signal strength, connector losses etc.)
4.0	Service channel performance
5.0	Craftsperson interface, alarm and control functional performance
6.0	Rack and local alarms: No alarms shall be present and all alarms shall be demonstrated to be functional
7.0	Network management interface and supervision performance
8.0	Correct configuration, level setting & adjustments and termination of Input/ output interfaces
9.0	Proper establishment of Safety and signaling earthing system and resistance to ground to be checked.
10.0	Simulation of failure conditions and failover of protected components.

Termination Equipment Sub-System Installation Testing

Item	Description
1.0	Physical Inspection for conformance to drawings, rack elevations and appearance of equipment and cabling
2.0	Power supply/converter voltage measurements
3.0	Muldem performance testing
4.0	Craftsperson interface, alarm and control functional performance
5.0	Rack and Local alarms
6.0	Network management interface and supervision performance
7.0	Channel performance
8.0	Safety and signaling earthing system
9.0	Simulation of failure conditions and failover of protected components.

NMS Installation Testing (if applicable)

Item	Description
1.0	Physical Inspection for conformance to drawings, rack elevations and appearance of equipment and cabling

2.0	Workstation hardware inventory, configuration and characteristics
3.0	Demonstration of proper operation of all hardware, including workstations peripherals

14.4 Training for Operational Staffs

On the job training: Contractor personnel who are experienced instructors and who speak understandable English shall conduct 5 days training for five RPGCL staffs on the site for FOCE operation and maintenance. The contractor shall arrange on its own cost all hardware training platform required for successful training and understanding in Nepal. Each trainee shall receive individual copies of all technical manuals and all other documents used for training. These materials shall be sent to Employer at least one month before the scheduled commencement of the training course. Class materials, including the documents sent before the training courses as well as class handouts, shall become the property of Employer. Employer reserves the right to copy such materials, but for in-house training and use only. Hands-on training shall utilize equipment identical to that being supplied to Employer. Training at manufacturer's premises: It shall be as specified in SCC, Vol-I.

Chapter 15: Switchyard Erection

15.1 General

The detailed Scope of work includes design, engineering, manufacture, testing at works, supply at site basis, insurance, handling, storage erection, testing and commissioning of various items and works as details herein.

This chapter covers the description of the following items.

A. Supply of

- String insulators and hardware
- ACSR conductor
- Galvanized Steel Earthwire
- Aluminium Tubular Bus Bars
- Bus post insulators
- Earthing & earthing materials
- Lightning protection materials
- Cabling material
- Other items

B. Erection of all items

15.1.1 String Insulators & Hardware

The insulators for suspension and tension strings shall conform to IEC-60383 and long rod insulators shall conform to IEC-60433. Insulator hardware shall conform to equivalent international standard. Composite long rod insulator shall conform to IEC: 61109.

15.1.1.1 Constructional Features

(a) For Porcelain Insulators

i. Suspension and tension insulators shall be wet process porcelain with ball and socket connection. Insulators shall be interchangeable and shall be suitable for forming either suspension or tension strings. Each insulator shall have rated strength markings on porcelain printed and applied before firing.

ii. Porcelain used in insulator manufacture shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

iii. Glazing of the porcelain shall be uniform brown colour, free from blisters, burrs and other similar defects.

(b) For Glass Insulators

i. It shall be made of toughened glass. Glass used for the shells shall be sound, free from defects, flows bubbles, inclusions, etc and be of uniform toughness over its entire surface. All exposed glass surfaces shall be smooth.

ii. When operating at normal rated voltage there shall be no electric discharge between conductor and insulator which would cause corrosion or injury to conductors or insulators by the formation of substances due to chemical ion. No radio interference shall be caused when operating at normal rated voltage.

iii. The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. All ferrous parts shall be hot dip galvanized. The zinc used for galvanizing shall be of grade Zn-99.95. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains bulky white deposits and blisters.

iv. Bidder shall make available data on all the essential features of design including the method of assembly of discs and metal parts, number of discs per insulator string insulators, the manner in which mechanical stresses are transmitted through discs to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

v. Clamps for insulator strings and Corona Control rings shall be of aluminium alloy as stipulated for clamps and connectors.

vi. Insulator hardware shall be of forged steel. Malleable cast iron shall not be accepted except for insulator disc cap. The surface of hardware must be clean, smooth, without cuts, abrasion or projections. No part shall be subjected to excessive localized pressure. The metal parts shall not produce any noise generating corona under operating conditions.

vii. The tension Insulator hardware assembly shall be designed for minimum 12000 kg tensile load for below 765kV. Earth wire tension clamp shall be designed for minimum 1000 kg tensile load with safety of two (2).

viii. The tension string assemblies shall be supplied along with suitable turn buckle. Sag compensation springs if required may also be provided.

ix. All hardware shall be bolted type.

(c) Long Rod Porcelain Insulators

i. As an alternative to disc insulator, Bidder can offer long rod porcelain insulators strings, with suitable hardware. The combination should be suitable for application specified and should offer the identical/equivalent parameters as would be available from insulator string comprising disc insulators and hardware combination.

ii. All constructional features specified in above clause of this Chapter shall also apply to the long rod insulator string.

(d) Composite Long Rod Insulators

Contractor shall offer such composite insulators which have proven use under foggy/ humid operational conditions in polluted industrial environment combined with smoke and dust particles. The Bidder shall furnish evidence in the form of certification from the power utilities that the similar type of product supplied to them had been performing satisfactorily. The Bidder shall also submit certified test report for an

accelerated ageing test of 5000 hours such as that described in Appendix-C of IEC-61109 or test at multiple stresses of 5000 hrs. as described in annexure –B of IEC-62217.

Insulators shall have sheds of the "open aerodynamic profile without any under ribs" with good self-cleaning properties. Insulator shed profile, spacing projection etc. shall be strictly in accordance with the recommendation of IEC-60815.

Ball and socket shall be 20 mm designation for 120 kN & 24 mm designation for 210 kN Insulators in accordance with the standard dimensions stated in IEC: 60120. Insulators shall be interchangeable and shall be suitable for forming either suspension or tension strings. Each insulator shall have rated strength markings on each composite insulator rod unit. No negative tolerance shall be applicable to creepage distance of composite insulators

All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/sq.m. and shall be in accordance with the latest edition of equivalent International standard. The zinc used for galvanizing shall be of purity of 99.95%. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash rust stains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand at least six successive dips each lasting for one (1) minute duration under the standard Preece test. The galvanizing shall be carried out only after any machining.

Core

It shall be a glass-fiber reinforced (FRP rod) epoxy resin rod of high strength. The rod shall be resistant to hydrolysis. Glass fibers and resin shall be optimized. The rod shall be electrical grade corrosion resistant (ECR), boron free glass and shall exhibit both high electrical integrity and high resistance to acid corrosion.

Housing & Weather sheds

The FRP rod shall be covered by a sheath of a silicone rubber compound of a thickness of minimum 3mm. The housing & weathersheds should have silicon content of minimum 30% by weight. It should protect the FRP rod against environmental influences, external pollution and humidity. It shall be extruded or directly molded on the core. The interface between the housing and the core must be uniform and without voids. The strength of the bond shall be greater than the tearing strength of the polymer. The manufacturer shall follow non-destructive technique (N.D.T.) to check the quality of jointing of the housing interface with the core.

The weathersheds of the insulators shall be of alternate shed profile. The weathersheds shall be vulcanized to the sheath (extrusion process) or molded as part of the sheath (injection moulding process) and free from imperfections. The vulcanization for extrusion process shall be at high temperature and for injection moulding shall be at high temperature & high pressure. Any seams/ burrs protruding axially along the insulator, resulting from the injection moulding process shall be removed completely without causing any damage to the housing. The track resistance of housing and shed material shall be class 1A4.5 according to IEC60587. The strength of the weathersheds to sheath interface shall be greater than the tearing strength of the polymer. The composite insulator shall be capable of high pressure washing.

End Fittings

End fittings transmit the mechanical load to the core. They shall be made of malleable cast iron/ spheroidal graphite or forged steel. They shall be connected to the rod by means of a controlled compression technique. The manufacturer shall have in-process Acoustic emission arrangement or some other arrangement to ensure that there is no damage to the core during crimping. This verification shall be in process and done

on each insulator. The system of attachment of end fitting to the rod shall provide superior sealing performance between housing and metal connection. The gap between fitting and sheath shall be sealed by a flexible silicone rubber compound. The sealing shall stick to both housing and metal end fitting. The sealing must be humidity proof and durable with time.

End fittings shall have suitable provisions for fixing grading rings at the correct position as per design requirements.

Grading Rings

Grading rings shall be used at both ends of each composite insulator unit for reducing the voltage gradient on and within the insulator and to reduce radio and TV noise to acceptable levels. The size and placement of the metallic grading rings shall be designed to eliminate dry band arcing/corona cutting/ exceeding of permissible electrical stress of material.

15.1.2 Tests

In accordance with the stipulations of the specification, the suspension and tension strings, insulator and hardware shall be subjected to the following type tests, acceptance tests and routine tests:

15.1.2.1 Type tests on Insulator String

The test reports for following type tests shall be submitted for approval as per Chapter 2 - GTR.

a) Power frequency voltage withstand test with corona control rings under wet condition as per IEC-60383.

b) Lightning Impulse voltage withstand test with corona control rings under dry condition as per IEC-60383

c) Voltage distribution test (Dry)

   The voltage across each insulator unit shall be measured by sphere gap method. The result obtained shall be converted into percentage. The voltage across any disc shall not exceed 20% and 22% for 132 KV suspension and tension insulator strings respectively.

d) Mechanical strength test

   The complete insulator string along with its hardware fitting excluding arcing horn, corona control ring, grading ring, tension/suspension clamps 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 dismantle them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS and held for one minute. No failure should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

15.1.2.2 Type Test on Insulators

Type test report for Thermal Mechanical Performance tests as per IEC - 60575, Clause 3 / IEC: 61109, clause 5.1 (for composite long rod insulators) shall be submitted for approval as per clause 9.2 of Chapter 2 - GTR.

15.1.2.3 Acceptance Tests for Insulators

a) Visual examination as per IEC-60383/ IEC-61109 clause no. 7.2 (for composite long rod insulators).

b) Verification of Dimensions as per IEC- 60383.

c) Temperature cycle test as per IEC- 60383.

d) Puncture Test as per IEC-60383 (Applicable only for porcelain insulators).

e) Galvanizing Test as per IEC- 60383.

f) Mechanical performance test as per IEC-60575 Cl. 4 / IEC-61109 clause no. 7.2 (for composite long rod insulators).

g) Test on locking device for ball and socket coupling as per IEC- 60372(2).

h) Porosity test as per IEC- 60383 (Applicable only for porcelain insulators).

i) Thermal shock test as per IEC-60383 (Applicable only for glass insulators)

15.1.2.4 Acceptance Test for Hardware Fitting

a) Visual Examination as per relevant international standard.

b) Verification of Dimensions as per relevant international standard.

c) Galvanising/Electroplating tests as per relevant international standard.

d) Slip strength test as per relevant international standard.

e) Shore hardness test for the Elastometer (if applicable as per the value guaranteed by the Bidder).

f) Mechanical strength test for each component (including corona control rings and arcing horns).

The load shall be so applied that the component is stressed in the same way as it would be in dual service and the procedure as given in 1.2.13.1 (g) above should be followed.

g) Test on locking devices for ball and socket coupling as per IEC -60372(2).

15.1.2.5 Routine Test on Insulator

a) Visual Inspection as per IEC-60383

b) Mechanical Routine Test as per IEC-60383

c) Electrical Routine Test as per IEC-60383

15.1.2.6 Routine test on hardware fittings

a) Visual examination as per IEC-61109 (for composite long rod insulators)

b) Mechanical strength Test as per IEC-61109 (for composite long rod insulators).

15.1.2.7 Test during manufacture on all components as applicable on insulator

a) Chemical analysis of zinc used for galvanising:

b) Samples taken from the zinc ingot shall be chemically analyzed. The purity of zinc shall not be less than 99.95%.

Chemical Analysis, mechanical hardness tests and magnetic particle inspection for malleable casting:

c) The chemical analysis, hardness tests and magnetic particle inspection for malleable casting 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 tests will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Program.

15.1.2.8 Test during manufacture on all components as applicable on hardware fittings

a) Chemical analysis of zinc used for galvanising:

Samples taken from the zinc ingot shall be chemically analyzed. The purity of zinc shall not be less than 99.95%

b) Chemical analysis, hardness tests and magnetic particle for forgings:

The chemical analysis, hardness tests and magnetic particle inspection for forgings will be as per the internationally recognized procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding tests will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Programme.

c) Chemical analysis and mechanical hardness tests and magnetic particle inspection for fabricated hardware:

The chemical analysis, hardness tests and magnetic particle inspection 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 tests will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance programme.

15.1.3 Parameters

15.1.3.1 Disc Insulators

Item	Description	For 132 kV
1.0	Type of insulators	Anti-Fog type
2.0	Size of insulator units (mm)	255 x 145 Or 280 x 145
3.0	Electro mechanical strength	120 kN
4.0	Creepage distance of individual insulator units (minimum and as required to meet total creepage distance	430 mm
5.0	Markings	
i)	For Porcelain Insulators	Markings on porcelain
ii)	For toughened glass insulators	Marking shall be done on initial parts
iii)	Power frequency puncture withstand voltage	1.3 times the wet flashover voltage

15.1.3.2 Insulator String

Item	Description	For 132 kV

1.0	Power frequency withstand voltage of the complete string with corona control ring (wet) – KV rms	275
2.0	Lightning impulse withstand Voltage of string with corona control rings (dry) - kVp	+/- 650
3.0	Switching surge withstand voltage of string with corona control rings (wet) - kVp	NA
4.0	Minimum total creepage distance of the insulator string (mm)	3625
5.0	Total no. of discs per strings	Markings on porcelain

For tension application, single insulator strings (But at road crossing side, double insulator strings shall be used) and for suspension purpose single suspension insulator string shall be used for 132 kV systems.

15.1.4 Routine Tests

15.1.4.1 For Composite Long Rod Insulator Units

1.0	Visual Examination	As per IEC 61109-2008
2.0	Mechanical Routine Test	As per IEC 61109-2008

15.1.5 Guaranteed Technical Particulars

15.1.5.1 Electrical System Data

S. No:	Parameters	Unit	System Voltage
1.0	Nominal Voltage	kV	132
2.0	Maximum system voltage	kV	145
3.0	BIL (Impulse)	kV (peak)	+/- 650
4.0	Power frequency withstand voltage (Wet)	kV (rms)	275
5.0	Switching surge withstand voltage (Wet)	kV (rms)	NA
6.0	Minimum Corona extinction voltage at 50 Hz AC system under dry condition	kV (rms) phase to phase	NA
7.0	Radio interference voltage at one MHz for phase to earth voltage of 508 KV under dry condition.	Micro Volts	NA
8.0	Minimum creepage distance.	Mm	3625
9.0	Electromechanical strength of Insulator Unit.	KN	120

15.2 ACSR Conductor

15.2.1 Details of ACSR Conductor

The details of the ACSR Cardinal conductors for 132 kV, when used for jumpers, shall be as per the standard guaranteed technical particulars as tabulated below:

1.0	Designation as per BS-215(Part-2)	
2.0	Stranding and wire diameter	54/3.38 mm Aluminium +7/3.38 mm steel
3.0	**Number of Strands**	
3.1	Steel core	1
3.2	1st steel layer	6
3.3	1st Aluminium layer	12
3.4	2nd Aluminium layer	18
3.5	3rd Aluminium layer	24
4.0	Sectional area of Aluminium	484.5 sq. mm
5.0	Total sectional area	547.3 sq. mm
6.0	Overall diameter	30.42 mm
7.0	Approximate mass	1833 (Kg/ KM)
8.0	Calculated D.C. resistance at 20 ® C	0.05979 Ohm/KM
9.0	Minimum UTS	15,381 kg
10.0	Modulus of Elasticity	7,036 kg/Sq mm
11.0	Co-efficient of Linear Expansion	19.3 x 10-6 per ^{0}C
12.0	Standard Un jointed length on reel	2,000 m

15.2.2 Workmanship

The finished conductor shall be smooth, comp, uniform and free from all imperfections including kinks (protusion of wires), wire cross over, over riding, looseness (wire being dislocated by finger/hand pressure and/or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black spot (on account of region with trapped rain water etc.), dirt, grit etc.

All the Aluminium and steel strands shall be smooth, uniform and free from all imperfections, such as spills and splits, diemarks, scratches, abrasions, etc., after drawing.

The steel strands shall be hot dip galvanised and shall have a minimum zinc coating of 260 gms/sq.m. after stranding of the uncoated wire surface. The zinc coating shall be smooth, continuous and of uniform thickness, free from imperfections and shall withstand minimum three dips in standard Preece test. The finished strands and the individual wires shall be of uniform quality and have the same properties and characteristics as prescribed in ASTM designation: B 498-74.

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. Care shall be taken to avoid, damages to galvanisation during pre-forming and post-forming operation.

15.3 Joint in wires

15.3.1 Aluminium Wires

Joints in aluminium wires shall be as per relevant International standard.

15.3.2 Steel Wires

There shall be no joint of any kind in the finished wire entering into the manufacture of the strand. There shall also be no strand joints or strand splices in any length of the completed stranded steel core of the conductor.

15.4 Tolerances

The manufacturing tolerances shall be as per relevant International standard.

15.5 Materials

15.5.1 Aluminium

The aluminium strands shall be hard drawn from electrolytic aluminium rods having purity not less than 99.5% and a copper content not exceeding 0.04%.

15.5.2 Steel

The steel wire strands shall be drawn from high carbon steel wire rods and shall conform to the following chemical composition:

Element	% Composition
Carbon	0.50 to 0.85
Manganese	0.50 to 1.10
Phosphorous	Not more than 0.035
Sulphur	Not more than 0.045
Silicon	0.10 to 0.35

15.5.3 Zinc

The zinc used for galvanising shall be electrolytic High-Grade Zinc of 99.95% purity.

15.6 Standard Length

The conductor shall be supplied as required. No joint shall be allowed within a single span of stringing, jumpers and equipment interconnection.

15.7 Tests

The following type (if required), acceptance & routine tests and tests during manufacturing shall be carried out on the conductor in presence of the Employer.

15.7.1 Type Tests

In accordance with the stipulation of specification, the following type tests reports of the conductor shall be submitted for approval as per clause 9.2 of Chapter 2 -GTR.

a) UTS test on stranded conductor.

b) Corona extinction voltage test (dry)

c) Radio Interference voltage test (dry)

d) DC resistance test on stranded conductor

15.7.2 Acceptance Test

a) Visual check for joints, scratches etc. and lengths of conductor

b) Dimensional check on steel and aluminum strands

c) Check for lay ratios of various layers

d) Galvanising test on steel strands

e) Torsion and Elongation test on steel strands

f) Breaking load test on steel and aluminum strands

g) Wrap test on steel and aluminum strands

h) DC resistance test on aluminum strands

i) UTS test on welded joint of aluminum strands

Note: All the above tests except test mentioned at (a) shall be carried out on aluminium and steel strands after stranding only.

15.7.3 Routine Test

a) Check to ensure that the joints are as per specification.

b) Check that there are no cuts, fins etc. on the strands.

c) All acceptance test as mentioned in Clause 19.7.2 above to be carried out on each coil.

15.7.4 Test during manufacturer

a) Chemical analysis of zinc used for galvanizing

b) Chemical analysis of aluminum used for making aluminum strands

c) Chemical analysis of steel used for making steel strands

15.7.5 Sample batch for type testing

The Contractor shall offer material for selection of samples for type testing, only after getting quality assurance plans approved from Owner's Quality Assurance Department. The sample shall be manufactured strictly in accordance with the Quality Assurance Plan approved by Owner.

15.8 Galvanised Steel Earth Wire

15.8.1 Details of earth wire

The contractor shall supply the earthwire as per the standard guaranteed technical particulars enclosed in Annexure-B of the technical specification, Chapter 19 – Switchyard Erection and separate approval is not required during detailed engineering.

Owner has also standardized the guaranteed technical particulars for the earthwire which are enclosed in Annexure-B of the technical specification.

The basic details of the earth wire are tabulated below:

Item	Description	Unit	Value
1.0	Stranding & Wire diameter	Mm	7/3.35 (steel)
2.0	Strands		
a)	Steel core	No.	1 (one)
b)	Outer Layer	No.	6 (six)
3.0	Total sectional area	Sq.mm	61.7

15.8.2 Workmanship

All steel strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die marks, scratches, abrasions and kinks after drawing and also after stranding.

The finished material shall have minimum brittleness as it will be subjected to appreciable vibration while in use.

The steel strands shall be hot dip qalvanised (and shall have minimum Zinc coating of 275 gms/sq.m) after stranding of the uncoated wire surface. The zinc coating shall be smooth, continuous, of uniform thickness, free from imperfections and shall withstand three and a half

dips after stranding in standard Preece test. The steel wire rod shall be of 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 prescribed in ASTM designation B498-74.

The steel strands shall be preformed and post formed in order to prevent spreading of strands while cutting of composite earth wire. Care shall be taken to avoid damage to galvanisation during preforming and post forming operation.

To avoid susceptibility towards wet storage stains (white rust), the finished material shall be provided with a protective coating of boiled linseed oil.

15.8.3 Joint 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.

15.8.4 Tolerances

The manufacturing tolerances shall be as per relevant International standard.

The manufacturing tolerances shall be as per relevant International standard.

15.8.5 Steel

The steel wire strands shall be drawn from high carbon steel wire rods and shall conform to the following chemical composition:

Element	% Composition
Carbon	Not more than 0.55
Manganese	0.4 to 0.9
Phosphorous	Not more than 0.04
Sulphur	Not more than 0.04
Silicon	0.15 to 0.35

15.8.6 Zinc

The zinc used for galvanising shall be electrolytic High-Grade Zinc of 99.95% purity.

15.8.7 Standard Length

The conductor shall be supplied as required. No joint shall be allowed within a single span of stringing, jumpers and equipment interconnection.

15.8.8 Tests

The following type (if required), acceptance & routine tests and tests during manufacturing shall be carried out on the conductor in presence of the Employer.

15.8.8.1 Type Tests

In accordance with the stipulation of specification, the following type tests reports of the conductor shall be submitted for approval as per clause 9.2 of Chapter 2 -GTR.

e) UTS test on stranded conductor.

f) Corona extinction voltage test (dry)

g) Radio Interference voltage test (dry)

h) DC resistance test on stranded conductor

15.8.8.2 Acceptance Test

j) Visual check for joints, scratches etc. and lengths of conductor

k) Dimensional check on steel and aluminum strands

l) Check for lay ratios of various layers

m) Galvanising test on steel strands

n) Torsion and Elongation test on steel strands

o) Breaking load test on steel and aluminum strands

p) Wrap test on steel and aluminum strands

q) DC resistance test on aluminum strands

r) UTS test on welded joint of aluminum strands

Note: All the above tests except test mentioned at (a) shall be carried out on aluminium and steel strands after stranding only.

15.8.8.3 Routine Test

d) Check to ensure that the joints are as per specification.

e) Check that there are no cuts, fins etc. on the strands.

f) All acceptance test as mentioned in Clause 19.7.2 above to be carried out on each coil.

15.8.8.4 Test during manufacturer

d) Chemical analysis of zinc used for galvanizing

e) Chemical analysis of aluminum used for making aluminum strands

f) Chemical analysis of steel used for making steel strands

15.8.9 Sample batch for type testing

The Contractor shall offer material for selection of samples for type testing, only after getting quality assurance plans approved from Owner's Quality Assurance Department. The sample shall be manufactured strictly in accordance with the Quality Assurance Plan approved by Owner.

15.9 Aluminium Tubular Bus

15.9.1 General

The contractor shall supply the aluminum tubes as per the standard guaranteed technical particulars enclosed in Annexure- B of the technical specification, Chapter 19 – Switchyard Erection and separate approval is not required during detailed engineering.

Owner has also standardized the guaranteed technical particulars for the aluminium tube which are enclosed in Annexure- B of the technical specification, Chapter 19 – Switchyard Erection. The contractor shall supply the aluminium tube as per the standard guaranteed technical particulars.

15.9.2 Constructional Features

For outside diameter (OD) & thickness of the tube there shall be no minus tolerance, other requirements being as per relevant International standard.

The aluminum tube shall be supplied in suitable cut length to minimize wastage.

The welding of aluminum tube shall be done by the qualified welders duly approved by the owner.

15.9.3 Tests

In accordance with stipulations of the specification, Routine tests shall be conducted on tubular bus conductors. Also, the wall thickness and ovality of the tube shall be measured. In addition to the above tests, 0.2% proof tests on both parent metal and Aluminium tube after welding shall be conducted.

15.9.4 Technical Parameters

Item	Description	3" Al. Tube
1.0	Size	3" IPS (EH Type)
2.0	Outer diameter	100mm for 132 kV
3.0	Thickness	7.62 mm
4.0	Cross-sectional area	1945.80 sq.mm.
5.0	Weight	5.27 kg/m

15.9.5 Main Bus Bars (Applicable for Aluminium Bus)

Both 132 kV and 33 kV bus bar must be tubular aluminum bars adequately supported by the insulator posts. The brief description of the bus switching scheme, bus bar layout and equipment connection to be adopted are indicated elsewhere in the specification. The bus bar arrangements are shown in drawings enclosed with the bid documents. After each two bay a bus bar expansion joint shall be provided. *The size of tubular aluminum bus bars must be adequate to comply thermal and ampere rating required for the maximum possible current flow in the network, including the factor of safety of at least 1.5.*

The Contractor shall furnish supporting calculations where applicable for the bus bars/conductors to show adequacy of design parameters for:

a) Fibre-stress

b) Cantilever strength of post insulators

c) Aeolian vibrations

d) Vertical deflection of bus bars

e) Short circuit forces in bundle conductor and spacer location for each span of ACSR conductor stringing as per layout drawings.

The weld in the aluminium tubes shall be kept to the minimum and there shall not be more than one weld per span. The procedure and details of welding shall be subject to Owner's approval. Material for welding sleeve shall be same as that of Aluminium tube. Welding sleeve shall be of 600 mm length

Corona bells shall be provided wherever the bus extends beyond the clamps and on free ends, for sealing the ends of the tubular conductor against rain and moisture and to reduce the electrostatic discharge loss at the end points. There shall be a small drain hole in the corona bell. The material of Corona bell shall be Aluminium alloy similar to that of clamps & connectors.

To minimize the vibrations in the aluminium tubes, damping conductor shall be provided inside the aluminium tubes. For this purpose, the cut pieces of ACSR conductor which otherwise are considered wastages, shall be used as damping conductor.

Details of past experience of the persons proposed to be employed for Aluminium tube welding and the test reports of the welded pieces to prove the electrical and mechanical characteristics shall also be furnished along with the bid. Welding at site shall be done by adopting a qualified procedure and employing qualified welders as per ASME-Section IX.

15.10 Earthing Conductors

15.10.1 General

All conductors buried in earth and concrete shall be of copper. All conductors above ground level and earthing leads shall be of copper including for cable trench earthing.

15.10.2 Constructional Features

15.10.2.1 Galvanised Steel

The minimum weight of the zinc coating shall be 618 gm/sq. m. and minimum thickness shall be 85 microns.

The galvanised surfaces shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surfaces of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

15.10.3 Tests

In accordance with stipulations of the specifications galvanised steel shall be subjected to four one-minute dips in copper sulphate solution as per relevant international standard.

15.11 Bus Post Insulators

The post insulators shall conform in general to latest IEC-60168, IEC 60273 and IEC-60815.

15.11.1 Constructional Features

Post type insulators shall consist of a porcelain part permanently secured in a metal base to be mounted on the supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators will be acceptable.

Porcelain used shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

Glazing of the porcelain shall be of uniform brown in colour, free from blisters, burrs and other similar defects.

The insulator shall have alternate long and short sheds with aerodynamic profile, the shed profile shall also meet the requirements of IEC-60815 for the specified pollution level.

When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or insulators by the formation of substance produced by chemical ion.

The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

All ferrous parts shall be hot dip galvanised. The zinc used for galvanising shall be grade Zn 99.95. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux ash, rust stains, bulky white deposits and blisters. The metal parts shall not produce any noise generating corona under the operating conditions.

a) Every bolt shall be provided with a steel washer under the nut so that part of the threaded portion of the bolts is within the thickness of the parts bolted together.

b) Flat washer shall be circular of a diameter 2.5 times that of bolt and of suitable thickness. Where bolt heads/nuts bear upon the beveled surfaces they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the bolt.

c) All bolts and nuts shall be of steel with well formed hexagonal heads forged from the solid and shall be hot dip galvanised. The nuts shall be good fit on the bolts and two clear threads shall show through the nut when it has been finally tightened up.

Bidder shall make available data on all the essential features of design including the method of assembly of shells and metals parts, number of shells per insulator, the manner in which mechanical stresses are transmitted through shells to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

15.11.2 Tests

In accordance with the stipulations of the specification, the post insulators shall be subject to type, acceptance, sample and routine tests as per IEC-60168.

In addition to acceptance/sample/routine tests as per IEC-60168, the following tests shall also be carried out.

a) Ultrasonic test as an acceptance test

b) Soundness test, metallurgical tests and magnetic test on MCI caps and pedestal tests as acceptance test.

c) All hot dip galvanised components shall be subject to check for uniformity of thickness and weight of zinc coating on sample basis.

d) The bending test shall be carried out at 50% minimum failing load in four directions as a routine test and at 100% minimum failing load in four directions as an acceptance test.

e) Acceptance norms for visual defects allowed at site and also at works shall be agreed in the Quality plan.

In accordance with the stipulation of specification, the following type tests reports of the post insulators shall be submitted for approval as per clause 9.2 of Chapter 2 - GTR.

a) Power frequency withstand test (dry & wet)
b) Lightning impulse test (dry)

c) Measurement of R.I.V (Dry)

d) Corona extinction voltage test (Dry)

e) Test for deflection under load

f) Test for mechanical strength.

Technical Parameters of Bus Post Insulators

S. No:	Description	145 kV
1.0	Type	Solid Core
2.0	Voltage Class (kV)	145
3.0	Dry and wet one-minute power frequency withstand voltage (kV rms)	275
4.0	Dry lightning impulse withstand Voltage (kVp)	+/- 650
5.0	Wet switching surge withstand voltage (kVp)	-
6.0	Max. radio interference voltage (in microvolts) at voltage of 508 kV (rms) , 305 kV (rms) and 156 (rms) for 765 kV, 400 kV &220 kV respectively between phase to ground.	500
7.0	Corona extinction voltage (kV rms) (min.)	105
8.0	Cantilever Strength	
a)	Total minimum cantilever strength (Kg)	600
b)	Total minimum breaking strength (Kg)	720
9.0	Minimum torsional moment	As per IEC – 273
10.0	P.C.D Top (mm)	127
11.0	Bottom (mm)	254
12.0	No. of bolts	
a)	Top	4
b)	Bottom	8
13.0	Diameter of bolt/holes (mm)	
a)	Top	M16
b)	Bottom dia	18
14.0	Pollution level as per IEC – 815	Heavy (III)
15.0	Minimum total creepage distance for Heavy Pollution (mm)	3625

If corona extinction voltage is to be achieved with the help of corona ring or any other similar device, the same shall be deemed to be included in the scope of the Contractor. Material of Corona ring shall be aluminium/aluminium alloy of 63401W grade or equivalent.

15.12 Grounding System

15.12.1 General

This specification covers the design, supply, delivery, installation and testing of the complete grounding system as described below.

The complete station grounding work shall be in accordance with the recommendation in the "Guide for Safety in Substation Grounding" IEEE No. 80 and the requirements of this section.

15.12.2 Grounding Installation Features

The installation shall be complete in all respects for efficient and trouble-free service. All work shall be carried out in a first-class neat workman like manner. Grounding conductors shall be handled carefully to avoid kinking and cutting of the conductors during laying and installation. All exposed ground conductors runs shall be taken in a neat manner, horizontal, vertical and parallel to building walls or columns and shall not be laid haphazardly.

For all connections made to equipment or to the structures, the grounding conductor, connectors and equipment enclosures shall have good clean cont surfaces. Grounding conductor connection to all electrical equipment, switchgear, transformers, motors, panels, conduit system, equipment enclosures, cable trays, distribution boards, equipment frames, bases, steel structure, etc. shall be by pressure type or bolting type connectors.

All lap, cross and tee connections between two grounding conductors shall be made by thermo welding process or compression type connector. The various joints shall have adequate mechanical strength as well as necessary electrical conductivity not less than that of the parent conductors of the joints. All accessories for grounding installation shall be of quality and design approved by the Employer. The earthing connection between earthing pad of equipment/structures shall be made by two earthing leads.

Ground conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 300mm below the bottom elevation of such trenches/pipes.

The maximum size of each grid of grounding mat shall not exceed 4X4 meters. The terminals for connecting ground mat and equipment shall be terminated whenever necessary.

15.12.3 Grounding Conductor

Main Ground Grid

The main ground system shall consist of a grounding grid buried minimum 0.6 meter below grade level. The grounding grid shall consist of copper flat conductor cable or stranded copper wire of minimum size (cross sectional area) 120 sq. mm.

Ground Electrodes

The ground electrodes shall be 16mm diameter and 3.0-meter-long (min.) copper clad steel. These shall be driven into ground and connected to the main ground grid.

Risers

The risers shall consist of copper conductor of adequate size (but not less than 120 sq. mm.) connected at one end to the main ground mat and at the other end to the equipment.

15.12.4 Design Requirements

The Contractor shall measure the soil resistivity in presence of the Employer. Based on the resistivity the contractor shall calculate the total length of buried ground conductor, number of grounding electrode and their depth and spacing to achieve a grounding system resistance of less than 1.0 (One) Ohm.

The Contractor shall calculate the cross-section considering the maximum fault level of 40 kA.

The Contractor shall submit the details of calculations of the grounding system for the Employer's approval. The earthing system shall be of single earthing system for the whole substation i.e. all earthing shall be connected to main earthing grid.

15.12.5 Tests

On completion of the installation, either wholly or in sections, it shall be tested in compliance with relevant Code by the Contractor in presence of the Employer. The cost of any test including labor, material and equipment charges shall be borne by the Contractor. If the ground grid resistance cannot be obtained as per his design, then additional grounding conductors shall be buried in the earth, or if necessary, buried in treated soil to obtain the required low ground resistance without any additional cost.

15.12.6 Lightning Protection

The outdoor equipment of the substation and the substation building shall be protected against lightning. The lightning protection shall be achieved by an overhead lightning shield system of galvanized steel wire of 7/3.35 mm, which shall be connected to the main grounding grid by steel conductor of 7/3.35 mm. Lighting mast with electrode length of 2.5mtr (maximum) may be used in switchyard area for lighting protection as per requirement. The above electrode may be connected to the main grounding grid by steel conductor of 7/3.35 mm. The design of the lightning protection system shall be subject to the approval of the Employer.

If the lightning protection is not achieved by galvanized steel wire, then adequate number of lightning mast tower with required height satisfying the design requirement shall be constructed at appropriate locations. The price for lightning mast tower shall be quoted in unit price bid as provisioned in Price Schedule.

15.13 Bay Equipment

The disposition of various bay equipments shall be as per single line diagrams and layout drawings.

Bay Marshalling Kiosk

One no. of bay marshalling kiosk shall be provided for each 132 kV bay under present scope. In addition to the requirements specified elsewhere in the specification, the bay marshalling kiosk shall have two distinct compartments for the following purpose.

a) To receive two incoming 400V, 3 phase, 63Amps, AC supply with auto changeover and MCB unit and distribute minimum six outgoing 400V, 3 phase, 16 Amps AC supplies controlled by MCB.

b) To distribute minimum ten outgoing 230V, 10 Amps single phase supplies to be controlled by MCB to be drawn from above 3 phase incomers.

c) 200 nos. terminal blocks in vertical formation for interlocking facilities for substations without automation system.

d) Necessary Terminal Blocks for terminating cables from ACDB and switchyard panel rooms.

15.14 Equipment Erection Details

For equipment interconnection, the surfaces of equipment terminal pads, Aluminium tube, conductor & terminal clamps and connectors shall be properly cleaned. After cleaning, cont grease shall be applied on the cont surfaces of equipment terminal pad, Aluminium

tube/conductor and terminal clamps to avoid any air gap in between. Subsequently bolts of the terminal pad/terminal connectors shall be tightened and the surfaces shall be cleaned properly after equipment interconnection.

Muslin or leather cloth shall be used for cleaning the inside and outside of hollow insulators.

All support insulators, circuit breaker interrupters and other fragile equipment shall preferably be handled with cranes having suitable booms and handling capacity.

Bending of Aluminum tube and compressed air piping if any should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced.

Cutting of the pipes wherever required shall be such as to avoid flaring of the ends. Hence only a proper pipe cutting tool shall be used. Hack saw shall not be used.

Handling of equipment shall be done strictly as per manufacturer's/supplier's instructions/ instruction manual.

Handling equipment, sling ropes etc. should be tested periodically before erection for strength.

The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc.

15.15 Junction Box

The Contractor shall supply and install junction boxes complete with terminals as required. The brackets, bolts, nuts, screws etc required for erection are also included in the scope of the Contractor.

Junction boxes having volume less than 1600 cubic centimeters may be installed without any support other than that resulting from connecting conduits where two or more rigid metallic conduits enter and accurately position the box. Boxes shall be installed so that they are level, plumb and properly aligned to present a pleasing appearance.

Boxes with volumes equal to or greater than 1600 cubic cm, and smaller boxes terminating on less than two rigid metallic conduits or for other reasons not rigidly held, shall be adequately supported by auxiliary steel of standard steel shapes or plates to be fabricated and installed. The Contractor shall perform all drilling, cutting, welding, shimming and bolting required for attachment of supports.

15.16 Storage

The Contractor shall provide and construct adequate storage shed for proper storage of equipments, where sensitive equipments shall be stored indoors. All equipments during storage shall be protected against damage due to s of nature or accidents. The storage instructions of the equipment manufacturer/Owner shall be strictly adhered to.

15.17 Cabling Material

15.17.1 Cable Tags and Markers

Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

The tag shall be of aluminium with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.

Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanised iron plate.

Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable joints".

The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.

Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry and at each end & turning point in cable tray/trench runs. Cable tags shall be provided inside the switchgear, motor control centres, control and relay panels etc., wherever required for cable identification, where a number of cables enter together through a gland plate.

Cable Supports and Cable Tray Mounting Arrangements

The Contractor shall provide embedded steel inserts on concrete floors/walls to secure supports by welding to these inserts or available building steel structures.

The supports shall be fabricated from standard structural steel members.

Insert plates will be provided at an interval of 750 mm wherever cables are to be supported without the use of cable trays, such as in trenches, while at all other places these will be at an interval of 2000 mm.

Vertical run of cables on equipment support structure shall be supported on perforated cable trays of suitable width which shall be suitably bolted/clamped with the equipment support structure.

Cable Termination and Connections

The termination and connection of cables shall be done strictly in accordance with cable and termination kit manufacturer's instructions, drawing and/or as directed by the Owner.

The work shall include all clamping, fittings, fixing, plumbing, soldering, drilling, cutting, taping, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job.

Supply of all consumable material shall be in the scope of Contractor.

The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for drilling of gland plates, painting and touching up. Holes shall not be made by gas cutting.

Control cable cores entering control panel/switchgear/MCCB/MCC/ miscellaneous panels shall be neatly bunched, clamped and tied with nylon strap or PVC perforated strap to keep them in position.

The Contractor shall tag/ferrule control cable cores at all terminations, as instructed by the Owner. In panels where a large number of cables are to be terminated and cable identification may be difficult, each core ferrule may include the complete cable number as well.

Spare cores shall be similarly tagged with cable numbers and coiled up.

All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.

Double compression type nickel plated (coating thickness not less than 10 microns) brass cable glands shall be provided by the Contractor for all power and control cables to provide dust and weather proof terminations.

They shall comprise of heavy-duty brass casting, machine finished and nickel plated, to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and of tested quality. Cable glands shall be of approved make.

The cable glands shall also be suitable for dust proof and weather proof termination. The test procedure, if required, has to be discussed and agreed to between Owner and cable gland manufacturer.

If the cable-end box or terminal enclosure provided on the equipment is found unsuitable and requires modification, the same shall be carried out by the Contractor, as directed by the Owner.

Crimping tool used shall be of approved design and make.

Cable lugs shall be tinned copper solderless crimping type conforming to relevant international standard. Bimetallic lugs shall be used depending upon type of cables used.

Solderless crimping of terminals shall be done by using corrosion inhibitory compound. The cable lugs shall suit the type of terminals provided.

15.17.2 Storage and Handling of Cable Drums

Cable drums shall be unloaded, handled and stored in an approved manner and rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum.

15.17.3 Directly Buried Cables

The Contractor shall construct the cable trenches required for directly buried cables. The scope of work shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or concrete protective covers, back filling and ramming, supply and installation of route markers and joint markers. The Bidder shall ascertain the soil conditions prevailing at site, before submitting the bid.

The cable (power and control) between LT station, control room and fire lighting pump house shall be laid in the buried cable trenches. In addition to the above, for lighting purpose also, buried cable trench can be used in outdoor area.

Cable route and joint markers and RCC warning covers shall be provided wherever required. The voltage grade of cables shall be engraved on the marker.

15.17.4 Installation of Cables

Cabling in the control room shall be done on ladder type cable trays for vertical runs while cabling in switchyard area shall be done on angles in the trench.

All cables from bay cable trench to equipment's including and all interpole cables (both power and control) for all equipment, shall be laid in PVC pipes of minimum 50 mm nominal outside diameter which shall be buried in the ground at a depth of 250mm below finish formation level. Separate PVC pipes shall be laid for control and power cables. Cable pull boxes of adequate size shall be provided if required.

Cables shall be generally located adjoining the electrical equipment through the pipe insert embedded in the floor. In the case of equipments located away from cable trench either pipe inserts shall be embedded

in the floor connecting the cable trench and the equipment or in case the distance is small, notch/opening on the wall shall be provided. In all these cases necessary bending radius as recommended by the cable manufacturer shall be maintained.

Cable racks and supports shall be painted after installation with two coats of metal primer (comprising of red oxide and zinc chromate in a synthetic medium) followed by two finishing coats of aluminium paint.

Suitable arrangement should be used between fixed pipe / cable trays and equipment terminal boxes, where vibration is anticipated.

Power and control cables in the cable trench shall be laid in separate tiers. The order of laying of various cables shall be as follows, for cables other than directly buried.

a) Power cables on top tiers.
b) Control instrumentation and other service cables in bottom tiers.

Single core cables in trefoil formation shall be laid with a distance of three times the diameter of cable between trefoil centre lines. All power cables shall be laid with a minimum centre to centre distance equal to twice the diameter of the cable of higher size of cables.

Trefoil clamps for single core cables shall be of pressure die cast aluminium (LM-6), Nylon -6 or fibre glass and shall include necessary fixing GI nuts, bolts, washer etc. These are required at every 2 metre of cable runs.

Power and control cables shall be securely fixed to the trays/supports with self-locking type nylon ties with de-interlocking facility at every 5 metre interval for horizontal run. Vertical and inclined cable runs shall be secured with 25 mm wide and 2 mm thick aluminium strip clamps at every 2m.

Cables shall not be bent below the minimum permissible limit. The permissible limits are as follows:

Table of Cable and	Minimum bending radius
Power cable	12 D
Control cable	10 D

D is overall diameter of cable

Where cables cross roads, drains and rail tracks, these shall be laid in reinforced spun concrete or steel pipes buried at not less than one metre depth.

In each cable run some extra length shall be kept at a suitable point to enable one (for LT cables)/two (for H.T. cables) straight through joints to be made in case the cable develop fault at a later date.

Selection of cable drums for each run shall be so planned as to avoid using straight through joints. Cable splices will not be permitted except where called for by the drawings, unavoidable or where permitted by the Owner. If straight through joints are unavoidable, the Contractor shall use the straight through joints kit of reputed make.

Control cable terminations inside equipment enclosures shall have sufficient lengths so that changing of termination in terminal blocks can be done without requiring any splicing.

Metal screen and armour of the cable shall be bonded to the earthing system of the station, wherever required by the Owner.

Rollers shall be used at intervals of about two metres while pulling cables.

All due care shall be taken during unreeling, laying and termination of cable to avoid damage due to twist, kinks, sharp bends, etc.

Cable ends shall be kept sealed to prevent damage. In cable vault, fire resistant seal shall be provided underneath the panels.

Inspection on receipt, unloading and handling of cables shall generally be in accordance with relevant international standard.

Wherever cable pass through floor or through wall openings or other partitions, GI/PVC wall sleeves with bushes having a smooth curved internal surface so as not to damage the cable, shall be supplied, installed and properly sealed by the Contractor at no extra charges.

Contractor shall remove the RCC/Steel trench covers before taking up the work and shall replace all the trench covers after the erection-work in that particular area is completed or when further work is not likely to be taken up for some time.

Contractor shall furnish three copies of the report on work carried out in a particular week, indicating cable numbers, date on which laid, ual length and route, testing carried out, terminations carried out, along with the marked-up copy of the cable schedule and interconnection drawing wherever any modifications are made.

Contractor shall paint the tray identification number on each run of trays at an interval of 10 m.

In case the outer sheath of a cable is damaged during handling/installation, the Contractor shall repair it at his own cost to the satisfaction of the Owner. In case any other part of a cable is

damaged, the same shall be replaced by a healthy cable at no extra cost to the Owner, i.e. the Contractor shall not be paid for installation and removal of the damaged cable.

All cable terminations shall be appropriately tightened to ensure secure and reliable connections. The Contractor shall cover the exposed part of all cable lugs whether supplied by him or not with insulating tape, sleeve or paint.

15.17.5 Cable Trays

The cable trays shall be of G.S. sheet and minimum thickness of sheet shall be 2mm.

The Contractor shall perform all tests and inspection to ensure that material and workmanship are according to the relevant standards.

A 2.5 metre straight section of 300mm, 600mm wide cable tray shall be simply supported at two ends. A uniform distributed load of 76 kg/m shall be applied along the length of the tray. The maximum deflection at the mid-span shall not exceed 7mm.

15.18 Conduits, Pipes and Duct Installation

Contractor shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes etc. including all necessary sundry materials such as tees, elbows, check nuts, bushing, reducers, enlargers, coupling cap, nipples, gland sealing fittings, pull boxes etc as specified and to be shown in detailed drawing. The size of the conduit/pipe shall be selected on the basis of 40% fill criterion.

Contractor shall have his own facility for bending, cutting and threading the conduits at site. Cold bending should be used. All cuts & threaded ends shall be made smooth without leaving any sharp edges. Anticorrosive paint shall be applied at all field threaded portions.

All conduit/pipes shall be extended on both sides of wall/floor openings. The fabrication and installation of supports and the clamping shall be included in the scope of work by Contractor.

When two lengths of conduits are joined together through a coupling, running threads equal to twice the length of coupling shall be provided on each conduit to facilitate easy dismantling of two conduits.

Conduit installation shall be permanently connected to earth by means of special approved type of earthing clamps. GI pull wire of adequate size shall be laid in all conduits before installation.

Each conduit run shall be painted with its designation as indicated on the drawings such that it can be identified at each end.

Embedded conduits shall have a minimum concrete cover of 50 mm.

Conduit run sleeves shall be provided with the bushings at each end.

Metallic conduit runs at termination shall have two locknuts and a bushing for connection. Flexible conduits shall also be suitably clamped at each end with the help of bushings. Bushings shall have rounded edges so as not to damage the cables.

Where embedded conduits turn upwards from a slab or fill, the termination dimensions shown on the drawings, if any, shall be taken to represent the position of the straight extension of the conduit external to and immediately following the bend. At least one half of the arc length of the bend shall be embedded.

All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed in an approved manner to prevent damage to threaded portions and entrance of moisture and foreign material.

For underground runs, Contractor shall excavate and back fill as necessary.

Contractor shall supply, unload, store and install conduits required for the lighting installation as specified. All accessories/fittings required for making the installation complete, including but not limited to pull out boxes, ordinary and inspection tees and elbow, checknuts, male and female bushings (brass or galvanised steel), caps, square headed male plugs, nipples, gland sealing fittings, pull boxes, conduits terminal boxes, gaskets and box covers, saddle terminal boxes, and all steel supporting work shall be supplied by the Contractor. The conduit fittings shall be of the same material as conduits.

All unarmored cables shall run within the conduits from lighting panels to lighting fixtures, receptacles etc.

Size of conduit for lighting shall be selected by the Contractor during detailed engineering.

Exposed conduits shall be run in straight lines parallel to building columns, beams and walls. Unnecessary bends and crossings shall be avoided to present a neat appearance.

Conduit supports shall be provided at an interval of 750mm for horizontal runs and 1000mm for vertical runs.

Conduit supports shall be clamped on the approved type spacer\ plates or brackets by saddles or U- bolts. The spacer plates or brackets in turn, shall be securely fixed to the building steel by welding and to concrete or brick work by grouting or by nylon rawl plugs. Wooden

plug inserted in the masonry or concrete for conduit support is not acceptable.

Embedded conduits shall be securely fixed in position to preclude any movement. In fixing embedded conduit, if welding or brazing is used, extreme care should be taken to avoid any injury to the inner surface of the conduit.

Spacing of embedded conduits shall be such as to permit flow of concrete between them.

Where conduits are placed alongwith cable trays, they shall be clamped to supporting steel at an interval of 600mm.

For directly embedding in soil, the conduits shall be coated with an asphalt-base compound. Concrete pier or anchor shall be provided wherever necessary to support the conduit rigidly and to hold it in place.

Conduit shall be installed in such a way as to ensure against trouble from trapped condensation.

Conduits shall be kept, wherever possible, at least 300mm away from hot pipes, heating devices etc. when it is evident that such proximity may reduce the service life of cables.

Slip joints shall be provided when conduits cross structural expansion joints or where long run of exposed conduits are installed, so that temperature change will cause no distortion due to expansion or contraction of conduit run.

For long conduit run, pull boxes shall be provided at suitable intervals to facilitate wiring.

Conduit shall be securely fastened to junction boxes or cabinets, each with a lock nut inside and outside the box.

Conduits joints and connections shall be made thoroughly water-tight and rust proof by application of a thread compound which insulates the joints. White lead is suitable for application on embedded conduit and red lead for exposed conduit.

Field bends shall have a minimum radius of four (4) times the conduit diameter. All bends shall be free of kinks, indentations of flattened surfaces. Heat shall not be applied in making any conduit bend. Separate bends may be used for this purpose.

The entire metallic conduit system, whether embedded or exposed shall be electrically continuous and thoroughly grounded. Where slip joints are used, suitable bounding shall be provided around the joint to ensure a continuous ground circuit.

After installation, the conduits shall be thoroughly cleaned by compressed air before pulling in the wire. Lighting fixtures shall not be suspended directly from the junction box in the main conduit run.

15.19 Testing and Commissioning

An indicative list of tests for testing and commissioning is given below. Contractor shall perform any additional test based on specialties of the items as per the field Q.P./instructions of the equipment Contractor or Owner without any extra cost to the Owner. The Contractor shall arrange all equipments instruments and

auxiliaries required for testing and commissioning of equipments alongwith calibration certificates and shall furnish the list of instruments to the Owner for approval.

15.20 General Checks

a) Check for physical damage.

b) Visual examination of zinc coating/plating.

c) Check from name plate that all items are as per order/specification.

d) Check tightness of all bolts, clamps and connecting terminals using torque wrenches.

e) For oil filled equipment, check for oil leakage, if any. Also check oil level and top up wherever necessary.

f) Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanised surfaces.

g) Check cleanliness of insulator and bushings.

h) All checks and tests specified by the manufacturers in their drawings and manuals as well as all tests specified in the relevant code of erection.

i) Check for surface finish of grading rings (Corona control ring).

j) Pressure test on all pneumatic lines at 18.5 times the rated pressure shall be conducted.

15.21 Station Earthing

a) Check soil resistivity

b) Check continuity of grid wires

c) Check earth resistance of the entire grid as well as various sections of the same.

d) Check for weld joint and application of zinc rich paint on galvanised surfaces.

e) Dip test on earth conductor prior to use.

15.22 ACSR Stringing Work, Tubular Bus Work and Power Connectors

a) Physical check for finish

b) Electrical clearance check

c) Testing of torque by torque wrenches on all bus bar power connectors and other accessories.

d) Millivolt drop test on all power connectors.

e) Sag and tension check on conductors.

15.23 Aluminium Tube Welding

a) Physical check

b) Millivolt drop test on all joints.

c) Dye penetration test & Radiography test on 10% sample basis on weld joints.

d) Test check on 5% sample joints after cutting the weld piece to observe any voids etc.

15.24 Insulator

Visual examination for finish, damage, creepage distance etc.

All pre/commissioning invitees and works for substation equipment shall be carried out in accordance with "Pre- Commissioning procedures and formats for substation bay equipments" prepared by the contractor where the formats must be initially approved by the Employer.

Chapter 16: Substation Structures

16.1 Scope

These specifications are intended to cover the design, fabrication, trial assembly, galvanizing, testing at manufacturer's works, inspection before dispatch, packing, transportation, storage and handling at site, erection etc. of substation galvanized steel structures like towers/columns, lightening/lighting masts, beams, equipment supporting structures etc. and any other structure which may be required for receiving the line with all necessary accessories as required for successful commissioning of 132 kV substation at Dhungesaghu Substation (Taplejung District) in Nepal as per tentative layout drawings of these substations appended with these specifications conforming to relevant Indian Standards/ equivalent International Standards.

The scope shall also include supply and installation of all types of galvanized structures including bolts, nuts, plain/tapered/spring washers, step bolts, ladders, all necessary inserts in concrete, gusset plates, base plates, foundation bolts, equipment mounting bolts, structure earthing bolts, fixing plates, necessary angles & bolts for structure or ground mounted marshaling kiosks/boxes (AC/DC Marshalling box & equipment control cabinets) and any other item as required to complete the job.

It is the intent of the Employer to provide structures which allow interchangeability of equipment at a later stage. Accordingly, Contractor is expected to design the equipment support structures with the provision of stool. Stools shall be provided by the Contractor between the equipment and its support structure to match the bus bar height. The top of stool shall be connected to the equipment and the bottom of the stool shall be connected to the Base support structure.

The connection of all structures to their foundations shall be with base plates and embedded anchor/foundation bolts. All steel structures and anchor/foundation bolts, fasteners (Nuts, bolts & washers) shall be fully galvanized as per relevant Indian Standards / equivalent International Standards. The weight of the zinc coating shall be at least 610 gram/m^2 for structural members as well as for anchor bolts and foundation bolts. One additional nut shall be provided in each foundation bolt below the base plate which may be used for the purpose of leveling.

Contractor shall provide suitable arrangement on the equipment supporting structures wherever required to suit fixation of accessories such as marshaling boxes, MOM boxes, Control Cabinets, Junction box, surge counter etc and incorporate the details in the fabrication drawings of equipment supporting structures.

The lightening/lighting mast shall be designed suitably so as to have illumination platforms for installing the luminaries to obtain prescribed/desired illumination intensity.

The contractor shall furnish all materials, labour, plant and erection equipment required for the completion of the job.

The line diagrams of all structures of 132kV substations shall be prepared by the contractor based on their design during detailed engineering stage. The fabrication drawings, proto corrected drawings along with Bill of Material (BOM) for all the structures including equipment supporting structures shall be prepared

by the contractor during detailed engineering for submission to Employer for their approval. Support structure for circuit breaker shall also be designed and supplied by the Equipment Manufacturer or Contractor.

The Contractor shall be fully responsible for designing and detailing of the steel structures as per these specifications, testing as per relevant Indian Standards/ equivalent International Standards and for their satisfactory performance. All designs/ drawings and details shall be subject to approval of the Employer/PMC who shall have the right to instruct the contractor to make changes in designs/drawings and details necessary to make the designs conform to these specifications and relevant Indian Standards/ equivalent International Standards. The contractor shall be required:

(a) To submit the detailed design calculations for all steel structures including gantry towers/columns, beams, lightening/lighting masts, equipment supporting structures etc required at each substation as per the layout drawings, to be developed by the Contractor and approved by the Employer, taking into consideration all the applicable and prescribed loads.

(b) To submit designs and fabrications drawings of all structures including equipment supporting structures required for each substation for the approval of Employer.

(c) Testing of structures as per relevant codes and standards.

(d) To furnish all materials, tools and plants required for successful completion of job whether specified or not.

(e) To suitably mark and transport all steel structures and accessories to the site and their proper and safe storage at site.

(f) To carry out erection/assembling of all structures and accessories at site for the purpose for which structures have been designed, fabricated and supplied.

The bidder shall quote lump sum price for all the substation structures including all necessary hardware for installation and successful testing & commissioning thereof. The rates to be quoted shall also include the fee for the preparation of designs, design/fabrication drawings, furnishing the required number of copies of all design & drawings including soft copies, manuals, supply of all materials, fittings & fixtures, hardware, transportation charges, octopi & tolls, labour, freight insurance including arranging all erection plant and equipment, etc. and all temporary and permanent works necessary for satisfactory completion of job in all respects.

16.2 Substation Layout and Section Drawings

The preliminary layout plan and sectional elevations drawings of Dhungesaghu substation is appended to these specifications for the information and guidance of bidders.

The drawings are purely tentative and for tender purpose only and in no way final drawing. The contractor shall be required to prepare substation layout and sectional elevation drawings to meet the requirements of these specifications and get them approved from Employer. The design of substation steel structures shall

be based on approved layout & section drawings and shall be suitable for specified loadings and loading combinations.

16.3 Sublet Orders

No sublet orders shall be placed by the Contractor with any manufacturer or supplier without prior written approval of the Employer and when such approval is given, the copies of all drawings/specifications referred to in the sublet orders shall be furnished to the Employer for information.

16.4 Codes and Standards

All works shall be carried out strictly in accordance with these specifications and relevant Indian/Nepalese Standards or equivalent International Standard Codes of Practices whether mentioned in the specification or not as existing one month prior to date of submission of price bid.

Except where otherwise specified or implied, the design, manufacturing, fabrication and galvanization of switchyard steel structures shall conform to the provisions of IS: 802(Part-I/Sec-1)-1992, IS: 802(Part-I/Sec-2)-1995 and IS: 802(Part-II)-1978.

Unless otherwise stated, the Indian/ Nepalese/ International standards and some handy codes as given in Table 16.1 below shall be applicable.

Table - 16.1

Indian Standards & Codes

Sl. No.	Standard No.	Title
1	IS:800	Code of practice for use of structural Steel in general building construction.
2	IS:802 (Part-I/Sec-2)-1992	Use of structural steel in Overhead Transmission Line Towers – Code of Practice: Part-1 Material, Loads and Permissible Stresses
3	IS:802 (Part-II)-1992	Code of Practice for Use of structural Steel in Overhead Transmission Line Towers: Part-II Fabrication, Galvanizing, Inspection and Packing
4	IS:808	Specification for Rolled Steel Beams, Channels and Angle Sections.
5	IS:813	Scheme of symbols for welding
6	IS:814	Covered electrodes for metal arc welding of structural steel

Sl. No.	Standard No.	Title
7	IS:815	Classification coding of covered electrodes for metal arc welding of structural steels
8	IS:816	Code of Practice for use of material arc welding for general construction in mild steel
9	IS:817	Code of practice for training and testing metal arc welders
10	IS:822	Code of practice for inspection of welds
11	IS:823	Code of practice for manual metal arc welding of mild steel
12	IS:875	Code of practice for structural safety of buildings: loading standards
13	IS:919	ISO System of Limits and Fits
14	IS:1364	Specification for hexagonal bolts, screws, nuts and lock nuts
15	IS:1367	Technical supply conditions for threaded steel fasteners
16	IS:1573	Specification for electroplated coatings of zinc on iron and steel
17	IS:1730	Dimensions for steel plate, sheet and strip for structural and general engineering purposes.
18	IS:1731	Dimensions for steel flats for structural and general engineering purposes
19	IS:1893	Criterion for earthquake resistant design of structures
20	IS:2016	Specification for plain washers
21	IS:2062	Specification for structural steel fusion welding quality
22	IS:2633	Method of testing uniformity of coating of zinc coated articles
23	IS:4759	Specification for hot-dip zinc coatings on structural steel and other allied products
24	IS:6639	Specification for hexagonal bolts for steel structures.
25	IS:7215	Tolerance for fabrication of steel structures

Sl. No.	Standard No.	Title
26	IS:7318	Approved tests for welders when welding procedure approval is not required
27	IS:2363	Black hexagonal bolts, nuts and lock nuts and hexagonal screws
28	IS:2629	Recommended practice for hot dip galvanizing of iron and steel
29	IS:1978	Specification for line pipe
30	IS:3063	Specification for spring washers
31	IS:806	Code of practice for use of steel tubes in general building construction
32	IS:1161	Specification for steel tubes for structural purposes
33	IS:209	Specification for zinc
35	IS:6610	Specification for heavy washer for steel structures
36	IS:5358	Specification for hot dip galvanized coatings on fasteners
37	IS:6745	Specification for methods of determination of weight of zinc coating on zinc coated iron and steel articles
38	IS:228	Method of chemical analysis of pig iron, cast iron, plain carbon & low alloy steel
39	IS:406	Specification for Method of CHEMICAL Analysis for slab zinc
40	IS:1083	Precision hexagonal bots, screws and nuts (BSW & BHF threads).
41	IS:1181	Qualifying tests for metal arc welders (engaged in welding structures other than pipes).
42	IS:1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
43	IS:1363	Specification for block hexagonal bolts, nuts and locks nuts and block hexagonal screws
44	IS:1477	Code of practice for finishing of ferrous metal in buildings – painting and allied finishers – Part-I (Operation and workmanship).

Sl. No.	Standard No.	Title
45	IS:1599	Method of bend tests for steel products other than sheet, wire & tubes
46	IS:1608	Method of tensile testing of steel products other than sheet strip wire & tube
47	IS:1852	Specification for rolling and cutting tolerance for hot rolled steel products
48	IS:2074	Ready mix paint, red oxide zinc chromate primer
49	IS:2551	Danger notice plates
50	IS:2595	Code of practice for radiographic testing
51	IS:3502	Steel for checked plates
52	IS:3613	Acceptance tests for wire flux combination for metal arc welding for mild steel
53	IS:3658	Code for practice for liquid penetrant flow detection
54	IS:3664	Code of practice for ultrasonic testing by pulse echo method
55	IS:4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners
56	IS:5334	Code of practice for magnetic practice flow detection of welds
57	IS:5613	Code of practice for design, installation and maintenance of overhead power lines
58	IS:5624	Foundation bolts
59	SP:6(4)	Use of high strength frication grip bolts (IS Publication)
60	IS:10238	Step bolts for steel structures
61	IS:12427	Transmission tower bolts

The above list of Standards is not exhaustive but indicative only. All other relevant International/Nepalese Standard not mentioned in the list shall also be applicable.

The equipment/materials meeting the requirement of any other Indian/Nepal standard or equivalent International standards which ensure a quality equal or better than the standard mentioned above shall also be acceptable.

Where any equipment/material conforms to any other standard other than mentioned above is offered by the bidder, then the salient points of difference between the standards adopted and those prescribed in these specifications shall be clearly brought out in the bid and a copy of the applicable standards shall also be enclosed by the bidder with his bid. It shall, however, be subject to the acceptance and the approval of Employer.

16.4 Material and Workmanship

All materials used in the manufacture of the substation steel structures shall be of tested and best quality conforming to relevant Indian standards and workmanship shall be of the high order in accordance with best engineering practices.

The materials, for which no Indian/ Nepalese Standards exist, shall be in accordance with any other International Standard subject to the approval of the Employer.

16.4.1 Structural Steel Sections and Plates

Structural steel of tested quality conforming to IS: 2062-2011 shall be used for the fabrication of steel structures, base plates, foundation bolts etc. The structural steel sections and plates shall be hot rolled manufactured either using mild steel of Grade E250 (Designated Yield Strength 250 MPa) or high tensile strength steel of Grade E350 (Designated Yield Strength 350 MPa).

Structural Steel Sections used for the fabrication of structures shall conform to IS: 808-1989.

Structural Steel plates shall also be of Grade E250 (Designated Yield Strength 250 MPa) or Grade E350 (Designated Yield Strength 350 MPa) of tested quality conforming to IS: 2062-2011.

Other equivalent grade of structural steel angle sections and plates conforming to International Standards can also be used if approved by the Employer. The steel sections as per any other international standards, if used, shall be of equal or superior quality with corresponding Indian Standards. However, the use of steel grade having designated yield strength of more than 350 MPa shall not be permitted.

Steel plates of thickness of less than 6.0 mm exclusively used for packing plates or packing washers produced as per IS: 1079-1994 are acceptable. However, if plates of thickness of less than 6.0 mm are used as load bearing plates viz. gusset plates, joint splices etc., the same shall conform to IS:2062 or equivalent International Standard meeting mechanical strength and metallurgical properties corresponding to steel of Grade E250 or Grade E350 depending upon the type of grade of steel incorporated into design. Flats of equivalent grade meeting mechanical strength and metallurgical properties may also be used in place of plates for packing plates and packing washers.

All steel sections and plates supplied shall be free from all imperfections, mill scales, slag intrusion, laminations, pitting, rusts etc that may impair their strength, durability and appearance. All materials shall be of tested quality and the test certificates from Manufacturer in respect of each consignment shall be submitted by the contractor to employer in triplicate.

Samples of all materials procured by the Contractor and workmanship proposed to be employed in the execution of the works may be inspected, at any time, by the employer. In case such samples are found to

be of substandard/unacceptable quality, the Contractor shall immediately discontinue use of such materials and workmanship and get fresh samples approved by the employer. Nothing shall affect the liberty of the employer to reject portions of the structures where defective materials and/or workmanship has already been used before detection.

16.4.2 Bolts, Nuts and Washers

The bolt conforming to IS: 12427 and of property class 5.6 as per IS: 1367(Part-III) and matching nut of property class 5.0 as per IS: 1367(Part-VI) shall be provided.
Flat and tapered washers shall be mild steed conforming to relevant Indian Standard.
Spring washers conforming to IS: 3063 shall be provided.
Foundation bolts shall be of mild steel of Grade E250 (Designated Yield Strength 250 MPa) conforming to IS: 2062.

16.5 Storage of Materials

All materials shall be stored in such a manner so as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material which has deteriorated or has been damaged shall be removed from Contractor's yard or site stores immediately.

Steel sections for fabrication of structures shall be stored in separate stacks above ground, section wise and length wise so that they can be easily inspected at any time.

Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments in accordance to diameter, length and quality.

16.6 General Design Requirements

The Contractor shall furnish the most economical design for substation steel structures conforming to these specifications, relevant Indian Standards/ equivalent International Standards and as per best engineering practices.

No welding shall be allowed in case of lattice structures except for connecting the base plates & stiffeners to the legs of structures.

Except where otherwise specified or implied, the design, manufacturing, fabrication, galvanizing etc of steel structures shall conform to the provisions of IS: 802 (Part-I/Sec-1)-1992, IS: 802 (Part-I/Sec-2)-1995 and IS: 802(Part-II)-1978.

Fully galvanized lattice type self-supporting steel structures with bolted connections shall be provided for the main substation structures comprising gantry towers/ columns, beams, lightening/lighting masts etc and shall be designed to carry the load of conductors with the necessary insulators, earth wire, hardware and all fittings & fixtures, wind load, earthquake loads, short circuit forces etc as applicable under specified loading conditions. The gantry towers/columns and lightening/lighting masts shall be connected to the foundation through base plate and foundation bolts. The portion of anchor bolts above concrete level and 300 mm below concrete level shall be galvanized.

The equipment supporting structures shall be either pipe type or lattice type as per the support requirement of equipments and fully galvanized and shall be designed to carry the weight of equipments, conductors, all fittings & fixtures, wind loads, earthquake load, short circuit forces, operational loads etc. The equipment supporting structures shall also be connected to the foundation through base plates and foundation bolts. The portion of foundation/anchor bolts projecting above concrete level and 300 mm length below concrete level shall be galvanized.

Grounding of all steel structures shall be done as specified in these specifications.

Lightening masts, if provided, shall cater to the station lighting purposes also. It shall be provided with structural steel ladder within its base upto the highest platform. The ladder shall be provided with safety cage. The platforms shall be provided at heights required for mounting of lighting fixtures. Size of platforms shall be adequate for mounting a minimum of four lighting fixtures on each side. Provision shall be made for tilting the lighting fixtures to suitable angle. The platforms shall also have protection railing.

While designing gantry towers/columns, beams, lightening/lighting masts, equipment supporting structures etc, the contractor shall ensure adequate electrical clearances as specified in these specifications, relevant Indian Standards/ equivalent International Standards and statuary rules and regulations of the country, whichever is more stringent.

All the structures shall be so designed that only the rationalized ISI metric hot rolled sections of tested quality conforming to IS: 2062 are used in fabrication of substation steel structures.

The Contractor, while designing substation structures, shall use only such sizes of steel sections which are easily procurable. If for any reason, the sections approved are not easily procurable, it is the Contractor's responsibility to procure the alternative sizes which are satisfactory from the point of view of design, fabrication, and galvanization and supply the same at no additional cost to the Employer.

The analysis of structures shall be done with well-established modern computer software programme like STAAD PRO. The computer software programme to be employed should have been prepared or approved by a recognized institution. The contractor shall submit the particulars and name of the computer programme as well as names of the customers to whom the substation steel structures have been supplied based on the above computer programme and also the structures test results providing the efficacy of the programme to the Employer for approval before taking up the design.

All gantry towers and beams shall be designed as dead-end structures i.e. all the balancing conductors on one side of gantry shall be assumed broken. The Contractor can rationalize the designs and reduce the varieties if it is economical. All gantry towers and beams of same designation shall be interchangeable.

The base width of gantry towers and size of beams shall be so chosen so that there is no hindrance to various electrical clearances.

Hard copy of all designs along with soft copy of input files of the computer software used for analysis of various structures (i.e. gantry towers & beams, lightening/ lighting masts, equipment supporting structures etc) shall be submitted by the contractor to Employer for approval. The contractor shall also submit manual calculations, if required by the Employer, for verifying the analysis and design results of the structures

obtained using software. The Employer shall check the design of structures submitted by the Contractor and if any modifications/changes are necessitated consequent to the checking, the same shall be incorporated by the contractor without any additional cost to the Employer.

16.7 Design Loads

The substation steel structures shall be designed to withstand the following loads as applicable to respective structure:

(a) Dead loads, tension in conductors under various climatic conditions, service loads etc.;

(b) Live Loads;

(c) Wind loads;

(d) Seismic loads;

(e) Short Circuit Forces;

(f) Erection loads;

(g) Operational loads;

(h) All secondary effects due to temperature, shrinkage etc; and

(i) Any other special load during erection or the service period of structures.

All structures shall be designed for the worst combination of dead loads, live loads, wind loads, Seismic forces, short circuit forces etc as per relevant Indian Standards / equivalent International Standards. The loads due to deviation of conductor, load due to unbalanced tension in conductor, torsional load due to unbalanced vertical and horizontal forces, erection loads, operational loads including 'snatch' in the case of bundled conductors etc shall also be considered in the design.

Wind and Seismic Loads shall not be considered acting simultaneously on structures i.e. only one load out of two shall be considered at a time in the design of structures in combination of other loads.

The gantries and equipment supporting structures shall be designed for the two conditions i.e. normal condition and abnormal condition. In abnormal condition, short circuit forces or earthquake loads whichever is more critical shall be combined with loads under normal condition. The earthquake loads and wind loads shall not be considered together i.e. one load shall be considered at a time. In both conditions, the design of all structures shall be based on the assumption that stringing is done only on one side i.e. all the three conductors broken on the other side.

Short Circuit Forces: Short circuit forces shall be estimated as specified in IEC 865 or relevant Indian Standard/ equivalent International Standard and shall be subject to the approval of Employer. Short circuit forces shall be calculated considering a fault level of 31.5KA for 132kV and 25KA for 11kV or as applicable and directed by the Employer.

Wind Loads: Wind pressure on steel structures, rigid bus bar tubes, conductors, ground/shield wires, insulator strings and other fittings/hardware shall be considered as per IS:802(Part-I/Sec-1)-1995 for specified wind zone.

Earthquake Forces: Earthquake/Seismic Forces shall be estimated as per IS: 1893 for specified seismic zone. The appropriate inertia loadings on various structures shall be assessed depending upon individual responses of the structures and as stipulated in IS: 1893. The vertical seismic co-efficient, where applicable, shall be taken as half of the horizontal seismic co-efficient. In important structures wherever there is a possibility of amplification of vertical seismic co-efficient, the stipulations of IS: 1893 shall be followed.

Vertical Loads

The vertical loads shall comprise the following loads:

(i) Weight of rigid bus bar, conductor, shield wire, jumpers etc;

(ii) Weight of insulators, hardware and other fittings & fixtures;

(iii) Self-weight of structure and respective equipment;

(iv) Weight of under hung connectors where applicable; and

(v) Weight of man with tools at each conductor point or any location of structure critical for a particular member.

The vertical loads due to the weight of bus bars, approach span conductors, shield wires, insulator strings, equipment if supported on the beam/gantry towers shall be considered in the design of beams & gantry towers/columns.

A provision of a load of 1500 N shall be made for a lineman with tools in the design of substation structures. The weight of man with tools may also be assumed to act anywhere on the horizontal members and members with inclination up to 15^0.

The self-weight of the beam shall be considered in the design of beams. In case of the design of gantry towers, lightening/lighting mast, equipment supporting structures, the weight of superincumbent portion of the structure shall be considered in the design.

Conductor/ Wire Tension Loads

The maximum working tension for bus bars, conductors and shield wires shall be considered as specified.

The loads due to wire tensions shall be calculated along and transverse to the beam axis at the points of attachment of conductor/wires. In case of gantry towers and lightening masts, the wire tensions shall be resolved in the direction of its adjacent faces.

The worst condition of unbalanced conductors and shield wire loads, with all balancing conductor/wire on the opposite side of the structure shall be assumed to be broken for the design of structures.

Terminal Gantries

Terminal/line take off gantries shall be designed for a minimum conductor tension of 1.0 ton per phase for 132 kV or as per requirement whichever is higher.

The distance between terminal gantry and dead-end tower shall be taken as 150m for 132kV or as actual whichever is more. The design of these terminal gantries shall also be checked considering $\pm$ 30^0 deviation

of conductor in both vertical and horizontal planes. For other gantries, the structural layout requirements shall be adopted in the design.

The maximum stringing tensions in the approach spans shall be taken as per design of dead-end towers and actual site conditions.

16.7.1 COMBINATION OF LOADS

The combination of loads shall be made under the normal and abnormal conditions for wind blowing either normal to beam (longitudinal direction) or parallel to beam (transverse direction). In case of equipment supporting structures and standalone structures like lighting masts, wind shall be assumed acting normal to two adjacent faces of structure, one at a time as well as in diagonal direction. Loads shall be resolved into transverse, longitudinal and vertical directions for the purpose of design. All balancing conductors/wires shall be considered broken on one side in Normal Condition as well as in Abnormal Condition.

16.7.1.1Normal Condition

(i) Wind loads on bus bars, conductors, shield wires, insulator string, jumpers, other hardware, equipments, members of structure etc.

(ii) Winds on approach span conductors and ground wire.

(iii) Unbalanced loads due to conductor/wire tensions considering all the conductor/wires on one side being broken;

(iv) Deviation loads due to wire tensions;

(v) Dead loads of wires, insulators, hardware fittings, equipment, structural members, weight of lineman with tools etc.

The above loads shall be resolved in transverse, longitudinal and vertical directions as under:

(a) **Wind Loads**: Wind load on gantry towers, Lightening/Lighting Mast, beams, bus bar, conductors, shielding wire, jumpers, connectors, insulators, equipment, other hardware etc with wind blowing either in Transverse or Longitudinal direction;

(b) **Transverse Loads**: Component of Mechanical Tension due to conductor and shielding wire deviation in Transverse direction;

(c) **Longitudinal Loads**: Component of Mechanical Tension due to conductor and shielding wire deviation in Longitudinal direction;

(d) **Vertical Loads**: Load due to weight of conductor, shielding wire, insulator strings, jumpers, connectors, accessories, self-weight of structure, component of Mechanical Tension of conductor and shielding wire in vertical direction.

16.7.1.1.1 **Abnormal Conditions**

Either of the two conditions viz. short circuit condition or earthquake condition, whichever is more stringent, shall be considered for the design of substation steel structures as described below:

(a) **Short Circuit Condition**: Where short circuit loads are specified, these shall be considered in addition to the combination of loads as stipulated in Normal Condition.

(b) **Earthquake Condition**: Earthquake/Seismic forces as specified shall be considered in addition to the combination of loads as stipulated in Normal Condition excluding the wind loads.

16.7.1.2 **Safety & Maintenance Condition:** All bracing and redundant members of the gantry towers, beams, lightening/lighting masts and equipment supporting structures which are horizontal or inclined up to 15^0 from horizontal shall be designed to withstand an ultimate vertical load of 1500 N considered acting at the center of the member independent of all other loads but including self-weight of member. All gantry towers, beams and masts shall also be designed to withstand a wire peak independent of all other loads but considering self-weight of structure. ultimate vertical load of 1500 N as a weight of Lineman with tools and an additional load of 3500 N acting at each conductor attachment point of beam and earth

16.7.1.3 The Substation steel structures shall be designed for the most stringent combinations of loadings as specified above in Normal and Abnormal conditions and checked under safety & maintenance condition and shall be able to withstand these loads without exceeding the minimum guaranteed yield stress of material as per IS:802(Part-1/Sec-1)-1995 without any injury or permanent deflection.

16.7.2 **Sag Tension Calculations**

16.7.2.1 Sag tension calculations for conductor and shielding/ground wire shall be made for the following combinations:

(i) Full wind pressure on conductor/ground wire at every day temperature;

(ii) 36 % of full design wind pressure on conductor/ground wire at minimum temperature;

(iii) Every day temperature and nil wind (Initial condition);

(iv) 85^0 C temperature for ACSR conductor (95^0 C temperature in case of AAAC 0r AA conductor) and nil wind; and

(v) Minimum temperature and nil wind.

16.7.2.2 The sag of ground wire shall be maintained within 90% of the conductor sag. The effect of insulator string on calculation of conductor sag shall also be considered.

16.7.2.3 Initial tension under every day temperature and 'nil' wind as applicable for conductor/ground wire shall be such that maximum sag at maximum temperature is within permissible limits keeping in view the electrical clearances required from ground/ equipments / structures. Final sag shall be maintained considering the effect of insulator string.

16.7.3 Computation of Wind Loads

16.7.3.1 The wind pressure shall be assumed as acting horizontally.

16.7.3.2 Wind Load shall be corresponding to Wind Zone 4 of IS: 802 (Part-1/Section-1)-1995. The relevant design parameters for Wind Zone 4 shall be as under:

(a) Basic wind speed 'V_b' = 47 m/s [which is peak gust velocity averaged over a short time interval of about 3 seconds at mean height of 10 meter above ground level in an open terrain (Terrain Category 2) and has been worked out for a return period of 50 years]

(b) Reliability Level: 1

(c) Terrain Category: 2

(d) Reference Wind Speed 'V_R' = V_b/K_0[V_R is extreme value of wind speed over an averaging period of 10 minutes duration and K_0 is factor to convert 3 seconds peak gust speed into average speed of wind during 10 minutes period at a level of 10 meters above ground. The value of K_0 is 1.375.

'V_R' = 47/1.375 = 34.18 m/s

(e) Design Wind Speed 'V_d' = VR x K_1 x K_2

Where K1 is Risk Coefficient & K_2 is Terrain Roughness Coefficient;

K_1 = 1.0 (For Reliability Level 1)

K_2 = 1.0 (For Terrain Category 2)

Thus, Design Wind Speed V_d = 1.0 x 1.0 x 34.18 = 34.18 m/s

(f) Design Wind Pressure P_d = 0.6 x V_d^2

= 0.6 x 34.18 x 34.18 = 701 N/m^2

16.7.3.3 Gantry towers, beams, Lightening/Lighting Masts and equipment supporting structures etc. shall be designed for Design Wind Pressure of 701 N/m^2.

16.7.3.4 The wind load on structures shall be determined assuming the specified wind pressure to be acting on the projected area of the members on the windward face in accordance with IS:802 (Part-I/Sec-1)-1995 considering applicable Drag Coefficient, Gust Response Factor etc.

16.7.3.5 The wind load on bus bars, approach span conductors and shield wires shall be determined in accordance with IS:802 (Part-I/Sec-1)-1995 assuming the specified wind pressure to be acting on full projected area. In case of bundle conductors (more than one conductor per phase), the wind pressure shall be assumed as acting on full projected area of each sub-conductor in the bundle.

16.7.3.6 The wind load on insulator string shall be calculated in accordance with IS:802 (Part-I/Sec-1)-1995 by taking the effective projected area of the cylinder with diameter equal to that of the insulator skirt and length based on the number of discs and hardware in the insulator string. The wind load shall be computed corresponding to wind pressure for bus bars.

16.7.3.7 The wind load on equipment shall be calculated based on the design wind pressure in accordance with IS: 802(Part-I/Sec-1)-1995 considering projected area of equipment perpendicular to wind direction.

16.7.3.8 The direction of the wind shall be assumed so as to produce the maximum stress in any member for the combination of wind loads and other loads. For this condition, wind shall be assumed

acting in two directions at right angles to each other and critical wind load shall be considered for the design of structures. The diagonal wind shall also be considered for standalone structures like equipment supporting structures, lighting masts etc.

16.7.3.9 Substation Steel Structures shall be designed for the maximum tension in conductor and shielding/ground wire (Normal) corresponding to any of the following conditions whichever is more critical:

(i) Full design wind pressure and every day temperature;

(ii) 36% of full design wind pressure and minimum temperature.

Provided that the ultimate tension in wires under any of the above conditions does not exceed 70% of ultimate tensile strength of conductor/ ground wire.

16.7.3.10 **Wind Load on Structure:** In order to determine the wind load on Gantry Tower, Beam, Lightening/Lighting Masts, Equipment Supporting Structure, it shall be divided into different panels having a height/length 'h'. These panels are normally taken between the intersections of the legs and bracings. For a lattice structures of square cross section, the resultant wind load F_{wt} in Newton, for wind normal to the panel, on a panel under consideration of height/length 'h' applied at the center of gravity of this panel shall be as under:

$F_{wt} = P_d \times C_{dt} \times A_e \times G_t$

Where

P_d= Design wind pressure in N/m^2;

C_{dt} = Drag coefficient for panel under consideration against which the wind is blowing. Values of C_{dt} for the different solidity ratio shall be as per Table-5 of IS: 802(Part-1/Sec-1)-1995.

A_e = Total net surface area of members in the panel under consideration projected normal to the face in sq m.

G_t = Gust response factor, peculiar to the ground roughness and depends on the height above ground. Values of G_t shall be as per Table-6 of IS: 802(Part-1/Sec-1)-1995.

16.7.3.11 **Wind Load on Conductor, Ground/Shielding Wire and Jumpers etc: T**he load due to wind on each conductor and ground/shielding wire, F_{wc} in Newton applied at supporting point normal to the conductor/earth wire shall be determined by the following expression:

$F_{wc} = P_d \times C_{dc} \times L \times d \times G_c$

Where:

P_d = Design wind pressure in N/m^2;

C_{dc} = Drag coefficient, taken as 1.0 for conductor and 1.2 for earth wire;

L = Wind span, being sum of half the spans on either side of supporting Structures, in meters;

d = Diameter of conductor/earth wire, in meters

G_c = Gust response factor, takes into account the turbulence of the wind and the dynamic response of the conductor. Values of $G_c$shall as per Table-7 of IS:802 (Part-1/Sec-1)-1995 for the average height of conductor / ground wire above ground.

The average height of conductor shall be taken up to clamping point of conductor less two-third sag at minimum temperature and no wind. The average height of the ground wire shall be taken up to clamping point less two-third sag at minimum temperature and 'nil' wind.

16.7.3.12 **Wind Load on Insulator Strings:** Wind load on insulator strings 'F_{wi}' shall be determined on insulator length from the attachment point to the center line of the conductor in case of suspension insulators string and up to the end of clamp in case of tension insulators string, in the direction of the wind as follows:

$$F_{wi} = C_{di} x P_d \times A_i \times G_i$$

Where,

C_{di} = Drag coefficient of insulators taken as 1.2;

P_d = Design wind pressure in N/ m^2;

A_i = Area of insulator string projected horizontally on a vertical plane parallel to the axis of the string. In the absence of actual value, it may be taken as 50% of the gross projected area of the cylinder with diameter equal to that of the insulator skirt; and

Gi = Gust response factor, peculiar to the ground roughness and depends on the height of insulator attachment point above ground. Values of Gi shall be as per Table-6 of IS:802 (Part-1/Sec-1)-1995.

16.7.4 Computation of Wires Tension Loads

16.7.4.1 The maximum tension (Normal) for conductors and shield wires shall be based on Sag Tension Calculations as per following conditions whichever is more stringent:

(i) Full design wind pressure on conductor / ground wire at every day temperature; and

(ii) 36% of full design wind pressure on conductor / ground wire at minimum temperature.

16.7.4.2 The maximum tension to be considered for the design of structures shall be subject to the approval of the Employer.

16.7.4.3 The loads due to wire tensions shall be resolved along three perpendicular directions to the beams and gantry towers and considered accordingly in the design.

16.7.4.4 The worst condition of unbalanced conductors and shielding wire loads, with all balancing conductor/wire on the opposite side of the structure assumed broken shall be considered for the design of structures.

16.7.5 Strength Factors Related to Quality

16.7.5.1 The design of substation steel structures shall be carried out in accordance with the provisions covered in IS: 802(Part-1/Sec-2)-1992. However, to account for the reduction in strength due

to dimensional tolerances of the structural sections, the following strength factors shall be considered depending upon the yield strength of steel:

(i) If steel with minimum guaranteed yield strength is used for fabrication of substation structures, the estimated loads shall be increased by a factor of 1.02 to account for dimensional tolerances.

(ii) If steel of minimum guaranteed yield strength is not used for fabrication of substation structures, the estimated loads shall be increased by a factor of 1.05, in addition to that mentioned in (i) above.

16.8 Design of Structures

16.8.1 The design of lattice type of steel structures for gantries, masts and equipment supporting structures shall be carried out in accordance with procedure and guidelines specified in IS:802(Part-1/Sec-1)-1995, IS:802(Part-1/Sec-2)-1992 and IS:802(Part-II)-1978 and as given herein under or as per relevant international standard. Indian Standard IS :800 shall be referred to and used for any aspect of design not covered in IS :802. All structures shall be designed for normal condition and under short circuit condition as well as for earthquake loads considering all the three wires on one side being broken. The sequence of applying tension during stringing shall also be taken care of in the design of structures and specified by the contractor on the drawings.

16.8.2 The structural design of pipe type equipment supporting structures shall be carried out in accordance with IS: 806 'Code of Practice for Steel Tubes in General Building Construction'.

16.8.3 Minimum Thickness of Members

16.8.3.1 The minimum thickness of angle section used in the design of substation steel structures, unless otherwise specified elsewhere in this specification, shall be kept not less than the following values:

(a) Main leg members of gantry towers, Beams, lightening/lighting masts, and equipment supporting structures : 5 mm

(b) For all other members : 4 mm

(c) The thickness for gusset plate shall not be less than 6.0 mm. Where a gusset plate is required to transmit stress, it shall not be less than thickness of the thickest bracing member connected plus 2.0 mm.

16.8.4 Allowable Stress

16.8.4.1 Axial Stress in Tension

The estimated tensile stress on the net effective sectional area in various members shall not exceed 250 N/mm^2 for mild steel sections or the specified yield stress of steel for high tensile steel sections (if proposed to be used in the fabrication of substation steel structures and agreed to by Employer) as per IS: 2062-2011 or any other equivalent to International Standards.

16.8.4.2 Axial Stress in Compression

(A) The estimated compressive stress in various members shall not exceed the value given by the formulae in clause 5.2 of IS: 802 (Part-I/Sec-2). As per said formula, the allowable unit stress Fa, in Mpa on the gross cross-sectional area of the axially loaded compression members shall be calculated as under:

(a) $F_a = \left[1 - 1/2\left(\frac{Kl/r}{Cc}\right)^2\right] \times F_y$

Where $Kl/r \leq C_c$

and,

(b) $F_a = \frac{\pi^2 \times E}{Kl/r^2}$

When $Kl/r > C_c$

Where,

C_c = $\pi \times \sqrt{\frac{2E}{F_y}}$

F_y = minimum guaranteed yield stress of the material, Mpa

E = modulus of elasticity of steel that is $2x10^5$Mpa,

Kl/r = largest effective slenderness ratio of any unbraced segment of the member,

L = un-braced length of the compression member in cm, and

r = appropriate radius of gyration in cm.

(B) The formulae given in **(A)** above are applicable provided the largest width thickness ratio 'b/t' is not more than the limiting value given by:

$$\left(\frac{b}{t}\right)_{Lim} = \left(210/\sqrt{F_y}\right)$$

Where

b = distance from edge of fillet to the extreme fibre in mm, and

t = thickness of flange in mm.

(C) Where the width to thickness ratio exceeds the limit given in **(B),** the formulae given in **(A)** shall be used substituting for F_y the value F_{cr} given by:

a) $F_{cr} = 1.677 - \frac{6.77 \times b/t \times F_y}{b/t_{lim}}$

When $b/t_{lim} \leq b/t \leq 378/\sqrt{F_y}$

And,

b) F_{cr} = $65550/(b/t)^2$

When $b/t > 378/\sqrt{F_y}$

Note: - The maximum permissible value of b/t for any type of steel section shall not exceed 25.

16.8.5 Redundant Members

16.8.5.1 The redundant members shall be checked individually for 2.5 percent of axial load carried by the member to whom it supports.

16.8.6 Stresses in Bolts

16.8.6.1 The estimated stresses in bolts shall not exceed the values given in IS :802 (Part-1/ Sec-2) which is reproduced in Table – 16.2 below.

TABLE – 16.2

ULTIMATE STRESSES IN BOLTS in MPa

Nature of stress	Permissible Stress For Bolts of Property Class 5.6	Remarks
Shear Stress on Gross Area of bolts	310	For bolts in double shear, the area to be assumed shall be twice the area defined. For gross area of bolts, refer item (a) below.
Bearing Stress on Gross Diameter of Bolts	620	For the bolt area in bearing, see item (b) below
Axial Tensile Stress	250	

16.8.6.2 Gross area and Bearing area of bolts shall be considered as under:

(a) Gross area of Bolt: For the purpose of calculating the shear stress, the gross area of bolts shall be taken as the nominal area of the bolt.

(b) Bearing Area of Bolt:- It shall be taken as 'd x t' where 'd' is the nominal diameter of the bolt and 't' is the thickness of the thinner of the parts jointed.

(c) Where the material of bolt and the structural members are of different grades, the bearing strength of the joint shall be governed by the lower of two.

16.8.7 Slenderness Ratio

16.8.7.1 Slenderness ratios of compression and redundant members shall be computed in accordance with clause 6 of IS: 802 (Part-1/sec-2) as reproduced in Table – 16.3 below:

Table – 16.3

Permissible Slenderness Ratio

Sl. No.	Type of Members	Value of KL/r
1.	**Compression Members**	

(i)	Leg sections or joint members bolted in both faces at connections for) $0 < L/r \leq 120$	L/r
(ii)	Members with concentric loading at both ends of the unsupported panel for $0 < L/r \leq 120$	L/r
(iii)	Member with concentric loading at one end and normal framing eccentricity at the other end of the unsupported panel for $0 < L/r \leq 120$	30+0.75 L/r
(iv)	Member with normal framing eccentricities at both ends of the un-supported panel for $0 < L/r \leq 120$	60+0.50 L/r
(v)	Member unrestrained against rotation at both ends of the unsupported panel for $120 \leq L/r \leq 200$	L/r
(vi)	Member partially restrained against rotation at one end of the unsupported panel for $120 < L/r < 225$	28.6+0.762 L/r
(vii)	Member partially restrained against rotation at both ends of the unsupported panel for $120 < L/r < 250$	46.2+0.615 L/r
2.	**Redundant Members**	
(i)	For $0 < L/r < 250$	L/r

16.8.7.2 For the values of 'KL/r' corresponding to 1(vi) and 1(vii) in above table, the following procedure of evaluation shall be adopted:

(a) The restrained member must be connected to the restraining member with at least two bolts.

(b) The restraining member must have a stiffness factor 'I/L' in the stress plane (I=Moment of inertia and L=Length) that equals or exceeds the sum of the stiffness factors in the stress plane of the restrained members that are connected to it.

(c) Angle members connected by one leg should have the holes located as close to the outstanding leg as feasible. Normal framing eccentricities at load transfer connection imply that connection holes are located between the heel of the angle and the center line of the framing leg.

16.8.7.3 In calculating the slenderness ratio of the members, the Length 'L' shall be the distance between the intersections of the center of gravity lines at each end of the member.

16.8.7.4 The following maximum limit of the effective slenderness ratio i.e. the ratio of unsupported length of the section in any plane to the appropriate radius of gyration shall not exceed value specified herein under: -

(a) For main leg members of gantry towers, beams, lightening/lighting masts, and equipment supporting structures in compression : 120

(b) For the members having computed stresses : 200

(c) For redundant members : 250

(d) For members having axial tensile stress only : 400

16.8.8 Erection Stresses

16.8.8.1 Where erection stresses combined with other possible co-existent stresses could produce a working stress in any member above the permissible stress, such additional strengthening of the member shall be affected or such other provision made as is necessary to bring the stress within the permissible limit.

20.10 Fasteners: Bolts, Nuts and Washers

16.9.1 All substation steel structure members shall have bolted connections. All bolts and nuts shall conform to IS: 12427. Bolts shall have hexagonal head, the heads being forged out of the solid, truly concentric, and square with the shank, which must be perfectly straight. All bolts and nuts shall be galvanized as per IS: 367 (Part-13)/IS: 2629.

16.9.2 The bolt shall be of 16 mm in diameter of property class 5.6 as specified in IS: 1367(Part-III) and matching nut of property class 5.0 as specified in IS: 1367 (Part-VI).

16.9.3 Bolts up to 16 mm diameter and having length up to 10 times the diameter of the bolt shall be manufactured by cold forging and thread rolling process to obtain good and reliable mechanical properties and effective dimensional control.

16.9.4 The shear strength of bolts for property class 5.6 shall be not less than 310 MPa as specified in IS :12427. Bolts shall be provided with washer face in accordance with IS: 1363 (Part-I) to ensure proper bearing.

16.9.5 Nuts for hexagonal bolts shall be double chamfered as specified in IS: 1363 (Part-III). It shall be ensured by the manufacturer that nuts shall not be over tapped beyond 0.40 mm oversize on effective diameter for size up to 16 mm. Nuts for anti-theft bolts shall be round tapered with hexagonal shear nuts. The hexagonal portion of shear nuts shall break away at specified torque recommended by the supplier to ensure proper tightening of members so that fasteners are not opened subsequently with tools. The tightening torque and shearing of anti-theft nuts shall be verified during proto-assembly.

16.9.6 Fully threaded bolts shall not be used. The length of bolts shall be such that the threaded portion shall not extend into the place of contact of the members.

16.9.7 All bolts shall be threaded to take the full depth of the nuts and threaded for enough to permit firm gripping of the members, but not further. It shall be ensured that the threaded portion of each bolt protrudes not less than 3.0 mm and not more than 8.0 mm when fully tightened. All nuts shall fit tight to the point where the shank of the bolt connects to the head.

16.9.8 Flat and tapered washers shall be provided wherever necessary.

16.9.9 Spring washers shall be provided for insertion under all nuts. These washers shall be electro-galvanized, positive lock type and 3.5mm in thickness for 16mm diameter bolts.

16.9.10 To avoid bending stress in bolts or to reduce it to minimum, no bolt shall connect aggregate thickness of members more than three times its diameter.

16.9.11 The bolt positions in assembled structures shall be as per approved structural drawings. Bolts at the joints shall be so staggered that nuts shall be tightened with spanners without fouling.

16.9.12 To ensure effective quality control during manufacturing process, the manufacturer shall have in house testing facility for all tests like weight of zinc coating, shear strength and other tests etc. The manufacturer should also have proper Quality Assurance System which should be in line with the requirement of this specification and IS: 14000 series Quality System Standard.

16.9.13 The bolt positions in assembled structures shall be as per IS: 5613(Part-3/Section-2)-1989.

16.10 Design and Drawings

16.10.1 After the award of contract, the contractor shall submit to the Employer, for his approval, the detailed design calculations, drawings for each type of gantry tower, beams, lightening/lighting masts and equipment supporting structures etc. The design of structures shall be accompanied with the following drawings:

(a) Loading diagrams of structures; and

(b) Single line diagram of structures.

16.10.2 The contractor shall submit the following designs and also all necessary drawings as may be required for approval of Employer:

(a) Design of gantry towers, beams, lighting/lightening masts, equipment supporting structures etc.

(b) Design drawings of structures with the size of the various members and location of joints etc.

(c) Detailed fabrication drawings indicating the erection mark assigned to various sections, size of the members, details of joints, details of stringing points etc. The details of joints, stringing points etc. shall be furnished separately in the drawing on a larger scale.

(d) Four set of hard copies and soft copies of all the approved design calculations, drawings and bill of materials.

(e) Results of any test as & when conducted and as required by the employer and report thereof.

(f) Any other design or drawing or document as desired by Employer.

16.11 Fabrication

Except where here-in-after modified, the details of fabrication shall, in general, conform to IS: 802(Part-II), other relevant Indian Standards or equivalent International Standards.

16.11.1 General Requirements

16.11.1.1 Members of the structures shall be fabricated as per the approved fabrication drawings in accordance with the best engineering practice and shall conform to the provisions of relevant Indian Standard/ or equivalent International Standard.

16.11.1.2 Structures shall be of bolted construction unless otherwise stated. Welding at any point shall not be permitted except for connection of base plates & stiffeners with leg member of structure.

16.11.1.3 No individual members shall be longer than 6000 mm.

16.11.1.4 The fabrication wastages, if any, shall not be paid for separately and deemed to be included in quoting rates. Employer shall not accept any liability in connection with wastage of steel during fabrication or otherwise.

16.11.1.5 Substitution, if any, of steel sections of the structures by higher sizes, due to non-availability or on account of any other reasons, shall be to the Contractor's account without any liability to Employer.

16.11.1.6 All structural members, bolts, nuts and fittings shall be hot dip galvanized. Spring Washers shall be Electro galvanized.

16.11.1.7 Normally bolted butt joint shall be used to connect the parts of structures. The thickness of inside angle cleat shall not be less than that of the heavier member connected. The lap splices may be used for connecting members of unequal thickness and the inside angle of lap splices shall be rounded at the heel to fit the fillet of the outside angle. All splices shall develop full stress in the members connected through bolts.

16.11.1.8 Joints shall be so designed so as to avoid eccentricity, as far as possible. However, where the connections are such that the elimination of the guest plates and spacer plates are not possible, the gusset/spacer plates may be used in conformity with modern engineering practice.

16.11.1.9 Members of the structures shall be accurately fabricated, so that the same can be assembled at site without any strain on members of structure or in bolts.

16.11.1.10 The Contractor during fabrication of structure members shall ensure that mild steel and high tensile steel sections don't get mixed up and as such identification mark shall be embossed on each and every H.T. Steel section at the time of shearing of members. The bidder in his bid shall clearly bring out the means proposed to be adopted to identify the mild steel and high tensile steel sections during fabrication.

16.11.1.11 All members of the structures shall be cut to correct lengths and fabricated in accordance with the shop drawings approved by the Employer. Welding of two or more pieces to obtain the specified length of member shall not be allowed. Members shall be straight to the permissible tolerances or better when required to ensure proper fit before being laid off or worked and after galvanizing.

16.11.1.12 The use of fillers in the connections shall be avoided as far as possible. The diagonal web members in tension may be connected entirely to the gusset plate where necessary to avoid the use of fillers. Each diagonal shall be in one piece without splices or centre gusset and it shall be connected at the point of intersection by one or more bolts.

16.11.1.13 No angle member shall have its two leg flanges brought together by closing the angle.

16.11.1.14 All parts of the structures shall be accessible for inspection and cleaning. Drain holes shall be provided at all points where pockets or depressions are likely to hold water.

16.11.1.15 All similar parts of structures shall be made strictly interchangeable. No rough edges shall be permitted anywhere throughout the work.

16.11.1.16 Structural members shall be so fabricated as to be bolted together easily at site. Preference shall be given to the design with least number of parts and the one which offers best facilities for transport, erection and maintenance. In designing the structures for minimum number of parts, the Contractor shall not however employ parts of such dimensions as will prove difficult to handle. The length of the longest piece shall not exceed 6 meters.

16.11.1.17 Workmanship and finish shall correspond to the modern engineering practice. All steel sections before any work is done on them, shall be carefully leveled, straightened and made true by a method which shall not injure the material so that, when assembled, the adjacent surfaces are in close contact.

16.11.2 Straightening

16.11.2.1 All steel sections, before any cutting is done, shall be carefully straightened and made true by pressure. Hammering shall not be permitted for straightening or flattening of members. All sheared edges shall be free from burrs and no rough edges from shears shall be left. Straightening shall be so done that it does not injure the material. Sharp bends shall be a cause for rejection.

16.11.3 Cutting

16.11.3.1 Cutting may be affected by shearing, cropping, sawing or by gas cutting by mechanically controlled torch. Gas cutting by hand shall only be used when specifically authorized in writing by the Employer. Shearing, cropping and gas cutting shall be clean, square and free from distortions and burns, and should the Employer find it necessary, the edges shall be ground afterwards by the Contractor without any additional cost. The cut surfaces shall be clean, smooth, reasonably square and free from any distortion. The cut edges of all plates shall be perfectly straight and uniform throughout.

16.11.4 Bending

16.11.4.1 Mild steel angle sections of size upto 75x75 mm (thickness up to and including 6.0 mm) shall be bent cold up to and including bend angles of 10^0. Mild steel angle sections of size above 75x75 mm (thickness upto and including 6.0 mm) and upto and including 100x100mm (thickness upto 8.0 mm) may also be bent cold upto bend angles of 5^0. All other angle sections and bend angles not covered above shall be bent hot.

16.11.4.2 All plates upto 12.0 mm thickness shall be bent cold upto a maximum bend angle of 15^0. Hot bending shall be employed for greater bend angles and thicker plates. Bends on all high tensile steel sections shall be done hot.

16.11.4.3 The bends shall be of even profile and free from any surface damages. All hot bent material shall be air-cooled.

16.11.5 Holing

16.11.5.1 Holes for bolts in the members shall either be punched or drilled to jig but drilled holes are preferred. Holes shall not be formed by flame cutting process. All burrs left by punching or drilling shall be completely removed.

16.11.5.2 Members shall be straightened again after being punched and drilled.

16.11.5.3 Punching may be adopted for mild steel sections with thickness upto 16.0 mm. For thicker sections, drilling shall be done.

16.11.5.4 The holes near the bend line of a bent member on both sides of bend line shall be punched/drilled after bending and relative positions of those holes shall be maintained with the use of proper templates/jigs and fixtures.

16.11.5.5 The limit of punching for high tensile Steel sections shall be indicated by the contractor and shall be in accordance with relevant Indian Standard/ equivalent International Standard.

16.11.5.6 Punched/drilled holes shall be at right angle to the surface and walls of holes shall be parallel. Holes shall be perfectly circular unless specified otherwise in the approved drawings.

16.11.6 Spacing of Bolts and Edge Distance

16.11.6.1 The minimum spacing of bolts and edge distances shall be as given Table – 16.4 below:

Table – 16.4

Spacing of Bolts and Edge Distance

Bolt Diameter (mm)	Hole Diameter (mm)	Minimum Bolt Spacing (mm)	Minimum Edge Distance of Hole Centre to Rolled or Sawn cut edge (mm)	Distance of Hole centre to sheared or flame cut Edge (mm)
16	17.5	40	20	23
20	21.5	48	25	28
24	25.5	60	33	38

16.11.7 Locking Devices

16.11.7.1 Electro-galvanized spring washers of type 'B' of thickness indicated in the Table – 16.5 below corresponding to respective bolt diameter shall be provided for insertion under all nuts.

Table – 16.5

Diameter of Bolt and Thickness of Spring Washer

F Diameter (mm)	Thickness of spring washer (mm)

16	3.5
20	4.0
24	4.5

16.11.8 Welding

16.11.8.1 The welding shall be done as per approved fabrication drawings which shall clearly indicate various details of joints to be welded, type of weld, length & size of weld, weather shop weld or site weld etc. Symbols for welding on erection and shop drawings shall be according to IS: 813. Welding shall be done before galvanizing. No welding after galvanizing shall be allowed.

16.11.8.2 Welding of structural steel shall be done by an electric arc process. The procedure to be followed, materials, plant and equipment to be used and testing and inspection procedures to be applied shall be to the satisfaction of the Employer/PMC and shall, in general, conform to relevant Indian standards viz. IS: 816, IS: 823, IS: 814 and Indian Standards Hand Book for metal arc welding.

16.11.8.3 All the welders to be employed for the job shall have to qualify the appropriate tests laid down in IS: 1811 and IS: 817.

16.11.8.4 100 per cent welds shall be inspected visually for external defects. Dimensions of welds shall be checked. The length and size of weld shall be as per approved fabrication drawings. It may be slightly over sized but shall not be under sized. The profile of weld is affected by the position of the joint but it shall be uniform. In case of butt and corner welds, the profile shall be convex and in case of submerged arc fillet weld, it shall be slightly concave.

16.11.8.5 The welds shall have regular height and width of heads. The height and spacing of ripples shall be uniform. The joints in the weld run where welding has been recommended shall as far as possible be smooth and should not show any humps or creaters in the weld surface. Welds shall be free from unfilled creaters on the surface, under cuts, slag on the surface and visible cracks. After such inspection, further radiographic/ultrasonic examination shall be undertaken if found necessary and directed by the Employer. In case of any defect, the work shall be dismantled and redone duly replacing the defective materials including basic members. Weld gauges shall be used to measure the size of the welds.

16.11.9 Step Bolts & Ladders

16.11.9.1 Each gantry tower, lightening/lighting mast and equipment supporting structure shall be provided with step bolts of not less than 16.0 mm diameter and 175 mm long, spaced not more than 450 mm apart and extending from about 0.5 meter above the ground level to the top of the structure at two diagonally opposite legs. These shall be provided as per IS: 5613 (Part-2/Sec-1)-1985

16.11.9.2 Each step bolts shall be provided with two nuts on one end to fasten the bolt securely to the structure and button head at the other end to prevent the feet from slipping away. The step bolts shall be capable of withstanding a vertical load not less than 1500 N.

16.11.10 ERECTION MARK

16.11.10.1 Each member of the structure shall have a unique erection mark conforming to component number given to it in the fabrication drawings. This mark shall be punched with marking dies of 16 mm size before galvanizing and shall be legible after galvanizing.

16.11.10.2 Erection Mark shall be in format A-BB-CC-DDD where:

A	=	Employer's Code assigned by the Contractor – Alphabet;
BB	=	Contractor's Mark – Numerical;
CC	=	Structure Type – Alphabet; and
DDD	=	Member Number assigned by the Contractor – Numerical

16.11.10.3 The proposal of Erection Mark shall be prepared by the Contractor and got approved from Employer before starting any fabrication work.

16.11.11 Fabrication Tolerances

16.11.11.1 The fabrication tolerances in general shall conform to IS: 7215-1974 unless otherwise specified here-in-under.

16.11.11.2 Tolerance on the overall length of a member shall be within $\pm$ 1.6 mm.

16.11.11.3 No bolt hole shall be more than 1.5 mm larger than the corresponding bolt diameter. The threaded portion of each bolt shall project out through the nut at least one thread.

16.11.11.4 The maximum allowable difference in diameter of the holes on the two sides of the angle or plate shall be $\pm$0.8 mm i.e. the allowable taper in a punched hole shall not exceed 0.8 mm on diameter.

16.11.11.5 Tolerance cumulative and between consecutive holes shall be within $\pm$1.6 mm.

16.11.11.6 Tolerance on gauge distance shall be within $\pm$ 0.5 mm so that structure could be assembled at site without any undue strain on structure members or in bolts.

16.11.11.7 The gap between the ends of two connected members in a butt splice shall not be more than 6.0 mm and less than 4.0 mm.

16.11.12 Proto Types

16.11.12.1 The Contractor, after the approval of designs & fabrication drawings, offer the proto type of each structure for Employer's inspection at his works or works of manufacturer.

16.11.12.2 Before proceeding with the bulk fabrication of any of structure i.e. gantry towers, beams, lightening/lighting masts and equipment supporting structures etc, the Contractor shall fabricate and assemble in his works for inspection by the Employer or his authorized representative, one structure of each type as finally approved by the Employer for checking the fabrication accuracy and workmanship. The check assembly shall be in a horizontal position. Proto assembly made on ground in horizontal position shall be adequately supported to prevent distortion and overstressing of members to ensure proper fit and shall be

accomplished without extraordinary effort to align bolt holes or to force pieces into position. For the check assembly, bolts and nuts shall be not more than finger tight.

16.11.12.3 Any changes pointed out by Employer's representative during inspection shall be incorporated by the contractor.

16.12 Galvanizing

16.12.1 All members of structures shall be fully galvanized. Galvanizing of the member of the structures shall conform to IS: 2629-1966 and IS: 4759-1968. All galvanized members shall withstand tests as per IS: 2633-1972.

16.12.2 For fasteners, the galvanizing shall conform to IS: 5358-1969.

16.12.3 The Galvanizing shall be done after all fabrication work is completed except that the nuts may be tapped or re-run after galvanizing. Threads of bolts and nuts shall have a neat fit and shall be such that they can be turned with finger throughout the length of the threads of bolts and they shall be capable of developing full strength of the bolts.

16.12.4 Spring washers shall be electro-galvanized as per Grade 4 of IS: 1573-1970.

16.12.5 Pickling shall be carried out by immersing the steel members in an acid bath containing either sulfuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and temperature of the bath can be varied, provided, the pickling time is adjusted accordingly. The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

16.12.6 Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements, when tested in accordance with IS: 2633 – 'Methods of Testing Weight, Thickness and Uniformity of Coating on Hot Dipped Galvanized Articles'. The zinc coating shall be uniform, clean and of a standard thickness on the entire surface of the material galvanized.

16.12.7 Galvanizing of each member shall be carried out in one complete immersion. Double dipping shall not be permitted. When the steel member is removed from the galvanizing kettle, excess spelter shall be removed by 'bumping'. The process known as 'wiping' or 'scrapping' shall not be used for this purpose.

16.12.8 All bolts, nuts, locknuts, washers etc shall also be hot dip galvanized. Excess spelter from bolts, nuts etc. shall be removed by centrifugal spinning of bolts or nuts. Threading after galvanizing, shall not be permitted. Nuts, however, may be tapped, but not to cause appreciable racking of the nut on the bolts.

16.12.9 The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized.

16.12.10 Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after having under gone re-galvanization once, the same shall be rejected.

16.12.11 Special care shall be taken not to injure the galvanized surfaces during transport, handling and erection. Damages, if any, shall be made good in accordance with the provisions of this specification or as directed by the Employer.

16.12.12 All steel structures and accessories after galvanizing shall be treated by dipping them in Sodium Dichromate solution or treated with approved inhibitor (the details of which shall be given by the contractor before starting the galvanizing) for protection against white rust formation during transportation.

16.12.13 Employer's approval shall be obtained if galvanizing is done outside the Contractor's fabrication plant.

16.12.14 **Adverse Atmospheric Conditions**: Low temperature coupled with high humidity (RH approaching 80%) causes fast rusting to steel parts. The Contractor, therefore, shall be required to give special attention to galvanizing for ensuring that it is of superior quality and not less than specified. Items not properly galvanized or getting rusted shall be rejected at the cost and risk of Contractor.

16.12.15 The acceptable values of the coating of zinc on the steel members, bolts, nuts and washers shall be not less than specified in Table – 16.6 below:

TABLE - 16.6

Sl. No.	Item	Zinc Coating
1.	Structural steel members except bolts, nuts and washers	Over 610 gm/m^2
2.	Bolts, nuts and washers	Over 450 gm/m^2

16.12.16 Members embedded in concrete shall be galvanized from the top to a point at least 300 mm below the proposed elevation of the concrete foundation. Utmost care shall be taken in not galvanizing the portion to be embedded in concrete below this stipulated level.

16.12.17 The Contractor shall furnish sufficient quantity of zinc paint of approved quality, free of cost, for repairing damages of minor nature in galvanized surfaces in transit or during handling.

16.13 Quality Assurance Plan and Quality Control

A Quality Assurance Plan including customer's hold points covering the design, fabrication and manufacturing of the material and galvanizing activities shall be submitted by the contractor to Employer immediately after award of work. The Quality Assurance Plan shall be examined by the Employer and if found to be acceptable, the same shall be approved by the Employer subject to compliance to observations, if any. The Contractor shall follow the approved Quality Assurance plan in true spirit. If desired by the Employer, the contractor shall give access to all the documents and materials to satisfy the Employer that the Quality Assurance Plan is being strictly followed.

16.13.1 The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent deems necessary to ensure that all works are performed in

accordance with this specification. In addition to the Contractor's quality control procedure, the materials and workmanship shall be subject to inspection by the employer or his authorized representative.

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

(i) **Steel:** Manufacturer's Test Certificates and Test Reports of representative samples of materials.

(ii) **Bolts, Nuts & Washers:** Manufacturer's certificates, dimensional check for bolts, nuts & washers.

(iii) **Galvanizing:** Tests for weight, thickness and uniformity of zinc coating in accordance with IS: 2633.

(iv) **Paints:** Manufacturer's test certificates, test physical inspection reports.

16.14 Quantities

The quantities of substation structures including all hardware and accessories have been specified as a LOT in Price Schedule. Bidders shall ensure that they quote for full scope of work.

16.15 Bill of Materials

16.15.1 Based on the approved designs & fabrication drawings and after successful assembly of proto type, the bill of materials shall be submitted separately for each type of structure to the Employer for approval.

16.15.2 The bill of materials shall contain the erection mark of each member, dimensions, weight and total weight. Weight of bolts, nuts & washers shall be indicated separately. Total weight of the structure shall be indicated in the last page of bill of materials.

16.15.3 At no stage, mass manufacture of structures shall be taken up without the clear approval of prototype structure and bill of materials.

16.16 Inspection, Testing and Acceptance Criteria

16.16.1 Employer/PMC or his representative shall have free access to manufacturer's works to satisfy that the fabrication is being done in accordance with the provisions of this specification.

16.16.2 Unless otherwise specified, the inspection shall be conducted on the materials prior to dispatch.

16.16.3 The tests as specified in this specification and/or in the relevant Indian Standard shall be conducted on the material before dispatch.

16.16.4 The Contractor shall provide all materials, stores, labour, tools and plant, apparatus and instruments, electricity, fuel, water, transport, accommodation etc as may be required by the Employer to carry out inspection and/or tests in accordance with this specification.

16.16.5 The Contractor shall guarantee compliance with the provisions of this specification and he shall carry out sampling and necessary tests in accordance with the relevant Indian Standards and as supplemented herein at his own cost, unless otherwise specified in the contract. The

Contractor shall get the specimens tested in a laboratory approved by the employer and submit to the employer three copies of the test results within five days after completion of the test.

16.16.6 Only tested quality steel conforming to IS: 2062 having mill test reports shall be used in fabrication of structures.

16.16.7 All bolts, nuts and washers shall be procured from reputed manufacturers and shall conform to the relevant Indian Standards.

16.16.8 The weight, thickness and uniformity of zinc coating on hot dipped galvanized members shall be tested in accordance with IS: 2633 for ensuring the compliance with the requirements specified in specification.

16.16.9 The finished surfaces of steel structures shall be visually examined for defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel, globules, spiky deposits, blistered surface, flaking or peeling off etc. There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The presence of any of these defects noticed on visual microscopic inspection shall render the material liable to rejection.

16.16.10 Defects in galvanizing in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications, or lack of quality control in any manner in the galvanizing plant shall render the entire production in the relevant shift liable to rejection.

16.16.11 The galvanized steel member shall withstand minimum four, one-minute dips in copper sulfate solution as per IS: 2633.

16.16.12 Should any structure or part of a structure be found not to comply with any of the provisions of this specification, the same shall be liable for rejection. No structure or part of the structure, once rejected, shall be offered again, except in cases where the employer considers the defects rectifiable. The employer may, at his discretion, check the test results obtained at the Contractor's works by independent tests at an approved laboratory and should the items, so tested, be found to be unsatisfactory, the same shall be rejected. The cost of tests shall be borne by the Contractor.

16.16.13 To ascertain the quality of the steel used, the Employer reserves the right to get the material tested at an approved laboratory.

16.16.14 When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steel work shall be accepted forthwith and the employer shall issue an acceptance certificate, upon receipt of which, the items shall be dispatched. No item shall be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of prescribed tests or the issue of the dispatch certificates shall not bind the employer to accept the work, should it, on further tests before or after erection be found not in compliance with the specification

16.17 Packing

16.17.1 The material shall be boxed or bundled for transport in the following manner: -

16.17.1.1 Angles shall be packed in bundles securely wrapped four times around at each end and in the middle and at every meter with No.9-gauge galvanized steel wire with ends twisted tightly. Gross weight of any bundle shall not exceed approximately 450 kg.

16.17.1.2 Cleat angles, brackets, fillet plates and similar small loose pieces shall be nested and bolted together in multiples and securely wired together through holes, wrapped round at least four times with No.9-gauge galvanized steel wire and ends twisted tightly. Gross weight of each bundle shall not exceed approximately 70kg.

16.17.1.3 The correct quantity of bolts, nuts and washers plus 2.50 percent extra for each type of gantry tower, beam, lighting/lightening mast, equipment supporting structure etc. shall be packed in gunny bags, accurately & securely tagged in accordance with the contents and a number of bags packed in wooden box tightly wrapped with 25 mm wide x 18 gauge iron band stretched entirely around the box with end overlapping at least 150 mm. Gross weight of each box shall not exceed approximately 70 kg.

16.17.1.4 All packing shall be subject to the approval of the Employer, or his appointed representatives. The packing shall be carried out with caution to protect the material from moisture, salt or any impurities which may cause rusting or harmful effects. The packages shall be new and sufficiently sturdy in construction to withstand normal handling during transportation and at site.

16.17.2 MARKING OF PACKING

The packing shall be marked in the following manner:

16.17.2.1 The bundles and the packages shall be clearly marked with the consignee and destination by indelible ink.

16.17.2.2 Erection mark of the members of gantry towers, beams, lighting/lightening masts and equipment supporting structures etc shall be indicated on the bundles or packages of gusset plates, bolts & nuts, cleats etc.

Chapter 17: Civil, Architectural and Building

17.1 General

The intent of specification covers the following: Design, engineering, drawing and construction of all civil works at sub-station. All civil works shall also satisfy the general technical requirements specified in other Sections of Specification and as detailed below. They shall be designed to the required service conditions/loads as specified elsewhere in this Specification or implied as per relevant British standard codes (BS Codes)/ equivalent International Standards. All civil works shall be carried out as per applicable Standards and Codes.

All materials shall be of best quality conforming to relevant International Standards and Codes. In case of any conflict between Standards/ Code and Technical Specification, the provisions of Technical Specification shall prevail. The Contractor shall furnish all design, drawings, labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with approved drawings, specifications and direction of RPGCL.

The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the RPGCL. For all buildings, structures, foundations etc. necessary layout and details shall be developed by the Contractor keeping in view the functional requirement of the substation facilities and providing enough space and access for operation, use and maintenance. Certain minimum requirements are indicated in this specification for guidance purposes only. However, the Contractor shall quote according to the complete requirements.

The Contractor shall perform all the works to meet the requirements of these Specifications, the attached drawings and all the relevant Articles in these Contract Documents.

Contractor shall make the arrangement of water supply for construction work as well as for future use also.

17.2 Standard and References

All equipment, materials, fabrication and tests under these Specifications shall conform to the latest applicable standards, manuals and Specifications contained in the following list or, to equivalent applicable standards, manuals and Specifications, established and approved in the country of manufacturer, and approved as equal by Employer.

IS	Bureau of Indian Standard
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standard Institute
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing Materials
AWS	American Welding Society
JIS	Japanese Industrial Standards
DIN	Deutsches Institute für Normung

Any details not specifically covered by these standards and specifications shall be subject to approval of Employer. In the event of contradictory requirements between the standards and these Specification requirements, the terms of the Specifications shall apply.

Unless specifically mentioned, reference to standards and specifications or to equipment and materials of the particular manufacture shall be considered as followed by "or equivalent". The Contractor may propose equivalent specifications, materials or equipment, which shall be equal in every respect to that specified. If the Contractor, for any reason, proposes equivalents to or, deviates from, the above standard, he shall state the exact nature of the change and shall submit complete specifications of the materials, as well as copies of pertinent standards, for the approval of Employer and decision of Employer in the matter of quality shall be final.

17.3 Scope of Works

The following works shall be carried out at Dhungesangu substation so as to complete the Civil, Architectural and Structural steel works in all respects, as required for the proper functioning of the substation.
Exploration works for soil strength for foundations of steel structures, equipment's.
All equipment, temporary structures and works, temporary construction and access roads and everything else which will be used or needed for the performance of the works shall be considered part of the Contract.
Together with the bid, the Bidder shall submit a drawing showing the overall layout of the proposed site installation. A final layout for site installation shall be prepared by the Contractor and approved by Employer before any construction work takes place at the site, including but not limited to the following:

- Site clearing and stripping
- Geotechnical Investigation including soil resistivity testing
- Site grading
- Design, manufacture, supply, installation and testing of substation steel structures,
- Design of Reinforcement Cement Concrete Foundations of steel structures, equipment, building and lighting poles
- Design and construction of internal roads
- Construction of cable trench system, conduit, duct bank and hand hole
- Construction of crushed rock surfacing
- Construction of drainage system
- Supply and construction of water supply and sanitary system
- Design, supply and installation of Illumination systems.
- Design and supply of furniture and miscellaneous indoor facilities
- Supply and installation of miscellaneous outdoor facilities for control building
- Design and construction of slope protection works and retaining walls
- Design and construction of switchyard fence and gates
- All associated and necessary civil and architectural works to complete the specified scope of work

17.4 General Official Accessories

Office Accommodation

The contractor shall provide at his own expense adequate temporary accommodation and toilet facilities for his worker as well as working office space for his staffs and Employer/ Engineer on duty for construction supervision and keep the same in good order. This may be done to suit site conditions with the approval of

the Employer / Engineer. The above-mentioned temporary structures shall be removed on the completion of works at contractor's own cost.

Boards

A board of size of 1.5m x 1.0m shall be made and put at an approved place on the site. This board shall be painted in approved colour with names of (a) The proposed construction (b) The Contractor (c) The Employer and other details as directed by the Employer/ Engineer.

Working Schedule

A binding graphical working schedule with an explanatory report shall be submitted before the construction period. The working schedule and any amendments to it during the construction period will require Employer's approval.

17.5 Design of Civil Works

The Contractor shall conduct the detail survey of proposed site and prepare site contour plan. The Contractor shall conduct Geotechnical Investigation including soil resistivity test as required for design work and the report should be submitted to Employer for review and approval. On the basis of the geotechnical survey report and soil study carried out by him-self, the Contractor shall perform detailed design for each structure and foundation described in Clause 17.3 on the basis of the design criteria and codes or regulations of international standards or equivalent Indian standards.

17.5.1 Exploration Works for Soil Strength

The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate, general as well as specific information about the soil profile and the necessary soil parameters of the site in order that the foundation of the various structures can be designed and constructed safely and rationally. A detailed soil report including field data duly certified by site engineers of RPGCL will be submitted by the Contractor for specific approval of RPGCL. The report shall contain all soil parameters for type of foundation i.e. pile or open type, soil treatment if any etc to be used for the design of civil foundations.

The Contractor may visit the site to ascertain the soil parameters. ***Any variation in soil data shall not constitute a valid reason for any additional cost & shall not affect the terms & conditions of the contract.*** Field tests must be conducted covering entire substation area including all the critical locations i.e. Control Room and other Buildings, Lightning Mast, Towers, transformers etc.

i) Scope of Works

This specification covers all the work required for detailed soil investigation and preparation of a detailed report. The work shall include mobilisation of necessary equipment, providing necessary engineering supervision and technical personnel, skilled and unskilled labour etc. as required to carry out field investigation as well as, laboratory investigation, analysis and interpretation of data and results, preparation of detailed Geo-technical report including specific recommendations for the type of foundations and the allowable safe bearing capacity for different sizes of foundations at different founding strata for the various structures of the substation. The Contractor shall make his own arrangement for locating the co-ordinates and various test positions in field as per the information supplied to him and also for determining the reduced level of these locations with respect to the benchmark indicated by the RPGCL.

All the work shall be carried out as per latest edition of the corresponding relevant British standard codes (B S Codes)/ equivalent International Standards. The Agency carrying out the soil investigation work must have the experience of carrying out soil investigation successfully in the relevant field. RPGCL shall assess the capability of the agency for soil investigation work for which technical inputs may be furnished to RPGCL.

ii) **Bore Holes**

Boreholes shall be made to obtain information about the subsoil profile, its nature and strength and to collect soil samples for strata identification and for conducting laboratory tests. The minimum diameter of the borehole shall be 150 mm and boring shall be carried out in accordance with the provisions of IS: 1892 and this specification:

All boreholes shall be minimum 7m deep for normal open cast type foundations. If the strata with Standard Penetration Test – N value measured greater than 100 with characteristics of rock is met, the borehole shall be advanced by coring at least 3m further, limited to total 7m depth, with prior approval of the Employer.

Casing pipe shall be used when collapse of a borehole wall is probable. The bottom of the casing pipe shall at all times be above the test of sampling level but not more than 15 cm above the borehole bottom. In case of cohesion less soils, the advancement of the casing pipe shall be such that it does not disturb the soil to be tested or sampled. The casing shall preferably be advanced by slowly rotating the casing pipe and not by driving.

In-situ tests shall be conducted and undisturbed samples shall be obtained in the boreholes at intervals specified hereafter. Representative disturbed samples shall be preserved for conducting various identification tests in the laboratory. Water table in the borehole shall be carefully recorded and reported following IS: 6935.

No water or drilling mud shall be used while boring above ground water table. For cohesionless soil below water table, the water level in the borehole shall at all times be maintained slightly above the water table

The borehole shall be cleaned using suitable tools to the depth of testing or sampling, ensuring least or minimum disturbance of the soil at the bottom of the borehole. The process of jetting through an open tube sampler shall not be permitted. In cohesive soils, the borehole may be cleaned by using a bailer with a flap valve. Gentle circulation of drilling fluid shall be done when rotary mud circulation boring is adopted.

On completion of the drilling, the Contractor shall backfill all boreholes as directed by the Employer.

iii) Standard Penetration Test (SPT)

This test shall be conducted in all types of soil deposits encountered within a borehole, to find the variation in the soil stratification by correlating with the number of blows required for unit penetration of a standard penetrometer. Structure sensitive engineering properties of cohesive soils and sifts such as strength and compressibility shall not be inferred based on SPT values.

No extra payment shall be made for carrying out Standard Penetration Tests.

The test shall be conducted at depths as follows:

Location	Depths (m)
Normal Soils	2.0, 3.0, 5.0, 7.0

The spacing between the levels of standard penetration testing and next undisturbed sampling shall not be less than 1.0 m. The Equipments, other accessories, procedures for conducting the test and collection of the disturbed soil samples shall conform to IS: 2131 and IS: 9640. The rods shall be straight, tightly coupled

and the air release valve shall be checked. The test shall be conducted immediately after reaching to the test depth and cleaning of bore hole.

The test shall be carried out by driving a standard split spoon sampler in the borehole by means of a 650N hammer falling freely from a height of 750mm for 450mm depth, recording the number of blows for every 75mm. The number of blows for the last 300mm drive shall be reported as measured N value.

This test shall be discontinued when blow count has reached 100 or the penetration is less than 25 mm for 50 blows, whichever is earlier, or sampler starts jumping. At the level where the test is discontinued, the number of blows and the corresponding penetration shall be reported. Sufficient quantity of disturbed soil samples shall be collected from the split spoon sampler for identification and laboratory testing. The sample shall be visually classified and recorded at the site as well as properly preserved without loss of moisture content and labelled.

Undisturbed samples shall be collected in accordance with the recommendation of relevant British standard codes (B S Codes)/ equivalent International Standards. Or an alternative recognize method as agreed by NEA. Undisturbed samples shall be taken in cohesive material or weak cemented granular material where ever possible at 1.0 m interval or at each change in stratum.

The depth of Water Table, if encountered, shall be recorded in each borehole. In case the soil investigation is carried out in winter/summer, the water table for rainy season shall be collected from reliable sources and recorded in the report.

All samples, both disturbed and undisturbed, shall be identified properly with the borehole number and depth from which they have been taken.

The sample shall be sealed at both ends of the sampling tubes with wax immediately after the sampling and shall be packed properly and transported to the Contractor's laboratory without any damage or loss. The logging of the boreholes shall be compiled immediately after the boring is completed and a copy of the bore log shall be handed over to the Engineer-in-change.

iv) Trial Pits

The Contractor shall excavate two number trial pits for Dhungesangu Substation as and where directed by RPGCL, of Plan area 10 sq. m and not exceeding 4 m depth. Undisturbed samples shall be taken from the trial pits as per the direction of the RPGCL. All Trial Pits shall be refilled with approved material after the tests are complete and shall be compacted in layers of not more than 500 mm. ***There is no extra payment for this work. This work shall be part of under Contract item "Exploration works for soil strength of foundation including laboratory test".***

v) Plate load test

Three number of Plate load tests shall be conducted each at the location as applicable only to determine the bearing capacity, modulus of sub grade reaction and load/settlement characteristics of soil at shallow depths by loading a plane and level steel plate kept at the desired depth and measuring the settlement under different loads, until a desired settlement takes place or failure occurs. The specification for the equipment and accessories required for conducting the test, the test procedure, field observations and reporting of results shall conform to relevant BS standard. Plate load test shall be performed at the proposed foundation depth below finished ground level for bearing capacity.

Undisturbed tube samples shall also be collected from the pit at 1.0 m depth and bottom of pit from natural ground level for carrying out laboratory tests.

The size of the pit in plate load test shall not be less than five times the plate size and shall be taken up to the specified depth. All provisions regarding excavation and visual examination of pit shall apply here. Unless otherwise specified the reaction method of loading shall be adopted. Settlement shall be recorded from dial gauges placed at four diametrically opposite ends of the test plate.

The load shall be increased in stages. Under each loading stage, record of Time vs. Settlement shall be kept as specified in relevant British standard codes (B S Codes)/ equivalent International Standards. Backfilling of the pit shall be carried out as per the directions of the RPGCL. Unless otherwise specified the excavated soil shall be used for this purpose. In cases of gravel-boulder or rocky strata, respective relevant codes shall be followed for tests. There is no extra payment for this work. This work shall be part of under Contract item " ***Exploration works for soil strength of foundation including laboratory test*** "

vi) Laboratory Test

The laboratory tests shall be carried out progressively during the field work after sufficient number of samples has reached the laboratory in order that the test results of the initial bore holes can be made use of in planning the later stages of the field investigation and quantum of laboratory tests.

All samples brought from field, whether disturbed or undisturbed shall be extracted/prepared and examined by competent technical personnel, and the test shall be carried out as per the procedures laid out in the relevant British standard codes (B S Codes)/ equivalent International Standards.

The following laboratory tests shall be carried out

a) Visual and Engineering Classification

b) Atterberg limits Tests.

c) Natural moisture content, bulk density and specific gravity.

d) Grain size distribution analysis.

e) Swell pressure and free swell index determination.

f) California bearing ratio.

g) Consolidated drained test with pore pressure measurement.

h) Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, PH value, and organic matter and any other chemical harmful to the concrete foundation.

i) In case rock is encountered, the soil test required for rock as per relevant British standard codes (B S Codes)/ equivalent International Standards including following tests shall also be conducted.

(i) UCC test.

(ii) Point load index test.

vii) **Test Results and Reports**

The Contractor shall submit the detailed report in three (3) copies wherein information regarding the geological detail of the site, summarized observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. The contractor shall also submit the bearing capacity calculation in editable soft copy to RPGCL. Initially the contractor shall submit draft report and after the draft report is approved, the final report in three (3) copies shall be submitted. The field and laboratory test data shall bear the signatures of the Investigation Agency, Contractor and also site representative of RPGCL.

The report shall include, but not limited to the following:-

a) A plan showing the locations of the exploration work i.e. bore holes, trial pits. Plate load test, electrical resistivity test, CBR sample location etc.

b) Bore Logs: Bore logs of each bore holes clearly identifying the stratification and the type of soil stratum with depth. The values of Standard Penetration Test (SPT) at the depths where the tests were conducted on the samples collected at various depths shall be clearly shown against that particular stratum.
Test results of field and laboratory tests shall be summarized strata wise as well in combined tabular form. All relevant graphs, charts tables, diagrams and photographs, if any, shall be submitted along with report. Sample illustrative reference calculations for settlement, bearing capacity, pile capacity shall be enclosed.

viii) **Recommendations:**

The report should contain specific recommendations for the type of foundation for the various structures envisaged at site. The Contractor shall acquaint himself about the type of structures and their functions from the RPGCL. The observations and recommendations shall include but not limited to the following:
a) Geological formation of the area, past observations or historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table etc.
b) Recommended type of foundations for various structures. If piles are recommended the type, size and capacity of pile and groups of piles shall be given after comparing different types and sizes of piles and pile groups.
c) Allowable bearing pressure on the soil at various depths for different sizes of the foundations based on shear strength and settlement characteristics of soil with supporting calculations. Minimum factor of safety for calculating net safe bearing capacity shall be taken as 3.0 (three). Recommendation of liquefaction characteristics of soil if applicable shall be provided.
d) Recommendations regarding slope of excavations and dewatering schemes, if required.
e) Comments on the Chemical nature of soil and ground water with due regard to deleterious effects of the same on concrete and steel and recommendations for protective measures.
f) If expansive soil is met with, recommendations on removal or retainment of the same under the structure, road, drains, etc. and thickness of treatment shall be given. In the latter case detailed specification of any special treatment required including specification or materials to be used, construction method, equipment's to be deployed etc. shall be furnished. Illustrative diagram of a symbolic foundation showing details shall be furnished.
g) Recommendations for additional investigations beyond the scope of the present work, if considered such investigation as necessary.
f) In case of foundation in rocky strata, type of foundation and recommendation regarding rock anchoring etc. should also be given.
Payment for the Contract item " ***Exploration works for soil strength of foundation including laboratory test*** " will be made at the unit location price bid. Therefore, in the Price Schedule, the lump sum price shall include full compensation for all costs incurred in furnishing all materials, labor and other operations related to soil testing.

ix) **Electrical Resistivity Test**

This test shall be conducted to determine the Electrical resistivity of soil required for designing safety-grounding system for the entire station area. The specifications for the equipment and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall confirm to relevant British standard codes (B S Codes)/ equivalent International Standards. The test shall be conducted using Wagner's four electrode method as specified in relevant British standard codes (B S Codes)/ equivalent International Standards.. Unless otherwise specified at each test location, the test shall

be conducted along two perpendicular lines parallel to the coordinate axis. On each line a minimum of 8 to 10 readings shall be taken by changing the spacing of the electrodes from an initial small value of 0.2 m up to a distance of 50.0 m.

17.5.2 Conducting Survey and Preparation of Design/Drawing

The Contractor shall conduct the detail survey of proposed site and prepare site contour plan. On the basis of the geotechnical survey report and soil study carried out by him-self, the Contractor shall perform detailed design for each structure and foundation described in Clause 17.3 on the basis of the design criteria and codes or regulations of international standards or equivalent Indian standards.

Prior to proceeding with the design work, design conditions or design values which shall include allowable stress, safety factor, load conditions and applicable standards, shall be approved by the Employer.
The Contractor shall submit to the Employer for approval the Contractor's drawing, structural and other calculation sheets, bill of materials, construction method and schedule for the construction of civil works.

In case modification of detailed design of civil work is required, the Contractor shall promptly inform the Employer and shall submit modified drawings to the Employer for approval.

Payment

Payment for contract item "Preparation of Design/Drawing of steel structure /equipment foundation, control building including as built drawing all complete" will be made in lump-sum unit bid price ("lot") to the Contractor for conducting detail survey, preparation of design/drawing works. Therefore, in the Price Schedule, the unit bid price shall include all costs incurred in connections therewith.

17.6 EARTH WORKS & EXCAVATIONS

Clearing and Stripping

Clearing shall include removal and disposal of all tress, bushes, down timber, tree roots, debris, posts, fences, houses and boulders exposed outside ground, etc. out of the construction sites. It shall also include the demolition of any indicated structures and other obstructions from the areas to be occupied by permanent Works of the Contract, and as indicated on the drawings, specified herein or as directed by the Employer.

Stripping shall include cutting of 150 mm topsoil, leveling and all other related works to strip off the substation sites. Topsoil approved by the Employer shall be stockpiled for use in the finish grading and seeding work. Stockpiled topsoil shall be free from trash, vegetation, or other debris. The Contractor's scope shall include stripping of the complete substation area.
The Contractor may use Facilities available at the site unless and until the object disturbs to complete the specified works. The Contractor shall remove all unused and unnecessary material from the site with prior consent of the Employer.

The Contractor shall be responsible for prevention of damage to structures and other objects, which are not included in the clearing work. No objects of any kind outside the indicated limits of the work shall be removed

or damaged. The Contractor shall protect existing utilities, which are not specifically included in the work. The Contractor shall be responsible for employment of safe methods of demolition and clearing.

Payment

Measurement for the Contract item "Clearing and Stripping" shall be made square meter for actual work done and Payment shall be made unit bid price per square meter for the stripping of substation area. Therefore, in the Price Schedule, the unit bid price shall include full compensation for all costs incurred in performing the clearing and stripping, including but not limited to, removal and disposal of houses, fences, bushes, splash, roots and debris and stripping, cutting, stockpiling and disposal of topsoil, exposed rocks or unsuitable earth material etc.

Excavation For Foundation

(1) Scope

Excavation shall consist of the removal of material for the construction of foundations for drainage structures, retaining walls, head walls, cut off walls, culvert, bridges and other similar structures to the lines and dimensions shown on the Drawing or as instructed by the Engineer in accordance with the requirements of these Specifications. The work shall include construction of the necessary cofferdams and cribs and subsequent removal of all necessary sheeting, shoring, bracing, diversion of water/flow, draining and pumping, the removal of all logs, stumps, grubs and other deleterious matters and obstructions necessary for placing the foundations; trimming bottoms of excavations; and clearing up the site and the disposal of all surplus material.

(2) Excavation

Excavation shall be taken to the length and width of the lowest step of the footing and the sides shall be left to plumb where the nature of soil allows it. Where the nature of soil or the depth of the trench does not permit vertical sides, the Contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer.

The depth to which the excavation is to be carried out shall be as shown on the Drawing or as directed by the Engineer.

(3) Dewatering, Diversion of Flow and Protection

Normally, open foundations shall be laid dry. Where water is encountered in excavation due to stream flow, seepage, springs, rain or other reasons, the Contractor shall take adequate measures such as bailing, pumping, constructing diversion channels, drainage channels, bunds, cofferdams and other necessary works to keep the foundation pit or trenches dry, when so required and to protect the green concrete/masonry against damage by erosion, failure of cut slopes or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the Contractor, but subject to approval of the Engineer. Approval of the Engineer shall, however, not relieve the Contractor of the responsibility for the adequacy of dewatering and protection arrangements and for the quality and safety of the works.

Where cofferdams are required, these shall be carried to adequate depths and heights, be safely designed and constructed and be made as watertight as is necessary for facilitating construction to be carried out inside them. The interior dimensions of the cofferdams shall be such as to give sufficient clearance for the construction and inspection and to permit installation of pumping equipment, etc., inside the enclosed area.

Sheet-piling shall be carried down well below the bottom of the pile caps or footings, but without interference with any bearing piles. Cofferdams shall be rigidly constructed and efficiently braced to withstand external pressures when water is pumped out. Sheeting shall be reasonably watertight and all appreciable leaks encountered during the operations shall be stopped so that construction of pile caps can be carried out in the dry. The Contractor shall rectify any cofferdam which, for any reason, has moved, tilted, or changed its shape and/or size.

Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete or for a period of at least 24 hours thereafter, unless it is done from a suitable sump and is separated from the concrete work by a watertight wall or other similar means.

At the discretion of the Contractor, cement grouting or other approved methods may be used to prevent or reduce seepage and to protect the area of excavation.

The Contractor shall take all precautions in diverting flow and in discharging the drained water as not to cause damage to the works, crops or any other property. If any such damage is caused due to any negligence of the Contractor, it shall be the sole responsibility of the Contractor to repair/restore to the original condition at his own cost or compensate for the damage.

(4) Preparation of Foundation Base

The bottom of the foundation pit shall be levelled both longitudinally and transversely or stepped as directed by the Engineer. Before footing is laid, the surface shall be slightly watered and rammed, if surface is not wet. In the event of excavation having been made deeper than that shown on the Drawing or as otherwise ordered by the Engineer, the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of the Contractor. Ordinary filling shall not be allowed for the purpose to bring the foundation to level.

When rock or other hard strata is encountered, it shall be freed of all soft and loose materials, cleaned and cut to firm surface either leveled or stepped as directed by the Engineer. All seams shall be cleaned out and filled with cement mortar or grout to the satisfaction of the Engineer. In the case of rock excavation, annular space around footing shall be filled with concrete of grade M10 up to top level of rock.

After the excavation is completed, the Contractor shall inform the Engineer to that effect and no footing, bedding materials or structures shall be placed until the Engineer has approved the depth and the suitability of foundation material.

If, at any point, in any foundation excavation, material unsuitable for foundations is encountered, the Contractor shall, if so instructed by the Engineer, shall remove all such materials and refill with suitable materials thoroughly compacted by tamping or rolling in layers of not more than 150 mm thick each.

(5) Slips and Blows

If there are any slips or blows in the excavation, these shall be removed by the Contractor at his own cost.

(6) Public Safety

Where required, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accident.

The Contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures.

(7) Removal of Cofferdams

All cofferdams with all temporary sheeting and bracing shall be removed by the Contractor after the completion of the substructure unit. The removal shall be carried out in such a manner as not to disturb or damage the finished concrete. However, sheet piling below the top of the pile caps may be left in place at the Contractor's option and expenses.

No bracing nor other material shall be left in cofferdam in such a way as to extend into the concrete of the structure.

Cofferdam located in embankments under the roadway shall be removed to an elevation at least 1.2m below the subgrade. Those located in a stream or lake and within the limits of low water shall be removed to the elevation of the stream or lake bed, except that in established navigation channels, they shall be removed to an elevation at least 600mm below the established bottom of the channel. Those located outside the above defined limits shall be removed to an elevation at least 600mm below subgrade.

Refilling of Foundation Pits and Trenches, Removal of Supports and Filling To Structures

Refilling of foundation pits and trenches shall consist of pervious backfill and/or common backfill as shown on the Drawing or as directed by the Engineer.

(1) Materials

(a) Pervious Backfill

Unless otherwise specified in the contract, it shall consist of gravel, crushed gravel, crushed rock, natural sands, manufactured sands or combinations thereof. It shall conform to the grading limits set out in Table below.

Grading Limits of Pervious Backfill

Sieve Size (mm)	Percentage Passing by Weight
40	100
10	45-100
2.36	25-80
0.60	8-48

0.075	0-6

(b) Common Backfill

Common backfill materials other than pervious backfill shall be suitable material.

(2) Method of Filling

Backfilling material shall not be permitted under water unless specifically described in the contract or approved by the Engineer. It shall be placed and compacted in layers in compliance with the requirements. Any support structures for the excavation shall be withdrawn as the filling proceeds unless described in the contract or ordered by the Engineer to be left in. The backfill shall be placed in by such methods which shall avoid loading the structure in any manner which may affect its stability or overload its underlying foundation material or substructure. The backfill in front of abutments and wing walls shall be placed first to avoid the possibility of forward movement. Precautions shall be taken to prevent any wedge action against upright surfaces, and the slopes bounding the excavation shall be stepped as directed by the Engineer before backfill is placed. The backfill material around box culverts, piers and curtain walls shall be placed simultaneously on both sides of the structure. When the structure is so designed that its strength is dependent on the restraining effect of the superstructure (such as in portal frames and propped abutments), the backfill shall not be placed until the superstructure has been completed to the extent and strength necessary to provide the required restraint. When the Contract requires wedges between steel superstructure and the parapet of wing type abutments, the wedges shall be placed in advance of placing any fill above the lower 1/3 of the abutment and shall be removed when directed by the Engineer.

(3) Site Grading

Since the site is in sloping ground, all required cutting and filling work has to be done by the contractor in order to achieve the required grades.

The Contractor shall provide and compact fill materials within the limits of the work to the lines, grades and elevations to be specified by the Employer. The Contractor shall provide details of filling materials to the Employer for approval. Site grading shall also include cutting of slopes. Site grading shall also cover areas as directed by the Employer including that for future bays. Each level shall be plain throughout. The Contractor shall submit detail calculations of cut and fill areas and total volume.

The Contractor may use fill materials available from cut areas, if suitable. This material shall be well-graded coarse gravel soil, relatively free from, loam or vegetable matter and with no stones over 10 cm in maximum dimensions, or material of equivalent strength and characteristics. Representative samples from proposed borrow sources shall be submitted to the Employer for approval. Approval of borrow source shall not mean automatic approval of all materials obtained from that source. All fill materials will be subject to approval of Employer. If any material is rejected by Employer, the Contractor shall remove it from site without any extra cost to the Employer.
The Contractor shall, at his option, use areas approved by the Employer for production of select borrow or, at his own expense, make arrangements for obtaining select borrow at other sources with prior approval of the Employer.

Unless otherwise specified by the Employer, compaction shall be to the following densities at optimum moisture content, as determined by ASTM D-1557, Method-D or equivalent Codes.

a) Fill locations and required density.

1) Under building and yard foundations - 95 percent
2) Sub-base for roadways - 90 percent
3) All other locations - 90 percent

b) It is the Contractor's responsibility to select his method for attaining the required compaction and obtain approval of the Employer for the proposed method. If the method of compaction proves unsatisfactory, it is the Contractor's responsibility to take remedial measures and obtain the approval of the Employer for the changes made. For the compaction of fill, 10 ton vibrating roller is preferable.

c) The Employer reserves the right to have compaction tests performed by an independent laboratory, with all testing costs borne by the Contractor. Any additional compaction or replacement of fill required to meet the specified density, as evidenced by the tests, shall be done by and at the expenses of the Contractor.

d) Failure of the compacted fill to reach the required density as evidenced by the tests shall be the cause of rejection by the Employer of the work in the affected area(s). Unless the Contractor can rework and compact the fill to the required density, he shall remove the fill in the areas affected. Subsequently the Contractor shall replace the fill material, which he can compact to the required density.

e) Compaction shall be carried out in layer wise, each layer not exceeding 300 mm loose thickness.

Payment

Measurements for classes of earthwork i.e. excavation in foundation and ground levelling, backfilling and site-grading shall be in cubic meter and payment shall be made at contract unit rate of respective item. The contract unit rate shall include materials and labors required to furnish and placed in accordance with the Specifications, as shown on drawings, or as directed by the Employer.

Payment for the Contract item "Site grading" will be made at the unit price for cubic meter bid. Therefore, in the Price Schedule, the unit price shall include full compensation for all costs incurred in furnishing all materials and all other operations related to fill including but not limited to:

(a) Obtaining materials from cutting zone of switchyard as well as from the Employer's approved source.
(b) Transporting materials to job site from source, to temporary stockpiles and/or points of final disposition.
(c) Placing and compacting material as per specification.
(d) Leveling the top surface of both cut and fill areas to the finished grade.

Soil excavation works includes the excavation in Foundations of Control Building, soil cutting of Switch Yard area and excavation for foundation of equipment, excavation for fencing, Septic tanks & storm water drains. Excavation shall conform to the dimensions and elevations as shown on the approved drawings. The general cut slope shall not be steeper than 1: 1; however, where the Contractor shall not excavate the slope to satisfy the condition above, temporary supports to the sides of excavations shall be required by means of timbering, sheet piling or shoring.

When foundations rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation. When subsoil for foundations become mucky on top due to construction operation or any other reason, such subsoil shall be removed and replaced by one or more layers of compacted sand or compacted crushed rock, as directed by the Employer.

Excavated materials, suitable for use as backfill, shall be deposited by the Contractor in storage piles at the area approved by the Employer. However, surplus excavated materials shall also be hauled and transported to the disposal area designated by the Employer.

Timber shoring

This specification covers the general requirements of timber shoring for open excavations for structure foundations.
Close timbering shall be done by completely covering the sides of the pits generally with short, upright members called polling boards. These shall be of minimum 250mm x 400mm sections or as directed by the Employer.
The boards shall generally be placed in position vertically side by side without any gap on each side of the excavation and shall be secured by horizontal walling of strong wood at maximum 1.2 meters spacing, strutted with bellies or as directed by the Employer. The length of the belly struts shall depend on the excavation and supported by vertical walling, which in turn shall be suitably strutted. The lowest boards supporting the sides of the trench or pit shall remain exposed, so as to render the earth liable to slip out.
Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit. The type of timbering shall be as approved by the Employer. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of excavations, pits, etc., from collapsing.
Timber shoring may be required to keep the sides of excavations vertical to ensure safety of adjoining structures, or to limit the slope of excavations, or due to space restrictions or for other reasons. Such shoring shall be carried out, except in an emergency, only under instructions from the Employer.
No separate payment will be made to the Contractor for timber shoring. All costs incurred in connection therewith shall be included in the unit bid prices for the construction of the various foundation types and other civil works.

Backfill

The Contractor shall place and compact the backfill materials to the lines, grades and dimensions to be shown on the approved drawings. The materials to be used for backfill, the amount thereof and the manner of depositing the materials shall be approved by the Employer.

Payment:

Measurements for classes of earthwork i.e. excavation in foundation and ground levelling, backfilling and site-grading shall be in cubic meter and payment shall be made at contract unit rate of respective item. The contract unit rate shall include materials and labors required to furnish and placed in accordance with the Specifications, as shown on drawings, or as directed by the Employer.

Payment for the Contract item "Site grading" will be made at the unit price for cubic meter bid. Therefore, in the Price Schedule, the unit price shall include full compensation for all costs incurred in furnishing all materials and all other operations related to fill including but not limited to:

(e) Obtaining materials from cutting zone of switchyard as well as from the Employer's approved source.
(f) Transporting materials to job site from source, to temporary stockpiles and/or points of final disposition.
(g) Placing and compacting material as per specification.
(h) Leveling the top surface of both cut and fill areas to the finished grade.

Soil excavation works includes the excavation in Foundations of Control Building, soil cutting of Switch Yard area and excavation for foundation of equipment, excavation for fencing, Septic tanks & storm water drains. Excavation shall conform to the dimensions and elevations as shown on the approved drawings. The general cut slope shall not be steeper than 1: 1; however, where the Contractor shall not excavate the slope to satisfy the condition above, temporary supports to the sides of excavations shall be required by means of timbering, sheet piling or shoring.

When foundations rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation. When subsoil for foundations become mucky on top due to construction operation or any other reason, such subsoil shall be removed and replaced by one or more layers of compacted sand or compacted crushed rock, as directed by the Employer.

Excavated materials, suitable for use as backfill, shall be deposited by the Contractor in storage piles at the area approved by the Employer. However, surplus excavated materials shall also be hauled and transported to the disposal area designated by the Employer.

Sand filling

Sand filling shall be recommended below the poor foundation areas, where some foundations will be laid. The sand procured for filling shall be clean, dry, coarse, hard, angular sand free from clay lumps, organic matter and confirm to IS 383. The quality of sand shall be approved by the Employer before procurement. The sand shall be filled in layers and adequately compacted, i.e. up to 85% of relative density as directed by the Employer

Payment:

Measurements for payment for the Contract item "Sand filling "shall be in cubic meter.
Payment for the Contract item "Sand filling" will be made at the unit price for cubic meter and the quoted unit price shall include full compensation for all costs incurred procurement, compaction and all other operations, tools & tackles, complete for finished item of work.

17.7 Slope Protection/Retaining wall

Random Rubble Stone Masonry Wall

Random rubble stone masonry wall shall be used in retaining wall/slope protection wall, drain wall and bottom of switchyard fence.
All rubble stone masonry work shall be made with random rubble stone from the best quarry and built in 1:4 cement mortar (1cement: 4 sand). The stones must be approved by the Employer before using in the construction work.

The stone shall be hard, tough, sound and durable. No stone shall be less than 150mm and more than 450mm. Face stone should be comparatively larger and uniform in size and color with a good appearance. Breadth of face stone should be greater than height. All the stones shall be wetted thoroughly before laying. Random masonry wall shall be laid in courses of 0.3m to 0.9m height. The thickness of all walls shall be as shown in drawing.

The joints should not be thicker than 20mm. In the corners, the stones should be chiseled at both sides and also on the top of the stone walls where the wall / course is ending and such surfaces being built up. Not more than 600mm height of masonry shall be constructed at one time.
For subsurface drainage weep hole above o.5 m above ground level shall be provided and spacing of weep hole shall be 2m horizontally and 1m vertically c/c of weep hole. To make weep hole PVC pipe of 75mm diameter in size shall be fixed in wall in proper gradient to drain out water.

Payment

Measurements for payment for the Contract item "Random Rubble Stone Masonry " shall be in cubic meter". Payment for the Contract item "Random Rubble Stone Masonry" will be made at the unit price for cubic meter and the quoted unit price shall include full compensation for all costs incurred procurement of all materials, scaffolding, curing, labor and all other operations, tools & tackles, complete for finished item of work including pipe for weep holes.

17.8 Antiweed treatment, plastic laying and stone spreading /Crushed rock surfacing

Scope of Work

The Contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification. Crushed Rock spreading along with sand and black plastic 200 gauze laying shall be done in the areas of the switchyard under present scope of work within fenced area.

General requirement

The material required for site surfacing/stone filling shall be free from all types of organic materials and shall be of standard quality, and as approved by the RPGCL. The material to be used for stone filling/site surfacing shall be uncrushed/crushed/broken stone of 40 mm nominal size (ungraded single size) conforming to relevant BS. Hardness, flakiness shall be as required for wearing courses shall be as are per relevant BS.

(a) Hardness

Abrasion value as per relevant BS.

Impact value as per relevant BS.

(b) Flakiness Index

One test shall be conducted as per relevant British standard codes (B S Codes)/ equivalent International Standards.

Anti-weed treatment

After all the structures/equipment are erected, 3-4 layers (as instructed by employer) antiweed treatment shall be applied in the switchyard where ever stone spreading along with fine sand filling followed by laying of plastic of suitable thickness is to be done and the area shall be thoroughly de-weeded including removal of roots. The recommendation of local agriculture or horticulture department may be sought where ever feasible while choosing the type of chemical to be used. The anti-weed chemical shall be procured from reputed manufacturers. The doses and application of chemical shall be 3 times more than manufacturer's recommendation. RPGCL shall decide final formation level so as to ensure that the site appears uniform devoid of undulations. The final formation level shall however be very close to the formation level indicated in the approved drawing. The surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by RPGCL. The sub grade shall be consolidated by using one ton roller with suitable water sprinkling arrangement to form a smooth and compact surface. The roller shall run over the sub grade till the soil is evenly and densely consolidated and behaves as an elastic mass. In areas that are considered by the RPGCL to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipments, the material shall be compacted by hand, if necessary. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling compaction. After completion of the compaction inside the switchyard area, contractors has to fill the 100 mm fine sand and over which black plastic of suitable thickness shall be laid before spreading the stones of first layer. A final layer of 150 mm thickness of uncrushed/crushed/broken stone of 40 mm nominal size (ungraded size) shall be spread uniformly over sand and plastic cover layer. Separate measurement and payment of BOQ item "Crushed rock surfacing including laying of sand and plastic as per technical specifications" shall be made in cubic meter as per BOQ.

Payment

Measurements for payment for Contract item " Crushed rock surfacing " shall be on cubic meters of crushed stone furnished and placed in accordance with Specifications, as shown on the drawings or as directed by the Employer and shall be measured net by deducting area covered by permanent structure and fixtures.

Payment for the Contract item "Crushed rock surfacing in switchyard" will be made at the unit price per cubic meter bid. Therefore, in the Price Schedule, unit price shall include full compensation for all costs incurred in furnishing all materials and all other operations related to the fill including but not limited to

a) Obtaining and application of chemicals
b) Obtaining and laying of black plastic
c) Obtaining materials (crushed rock) from the Employer's approved source
d) Transporting materials to job site from source, to temporary stockpiles and/or to point of final disposition
e) Placing and spreading material

There will be no separate payment for sand and plastic works.

17.9 Foundation and Concrete Works

Foundation Works

A. General Requirement

The design of the foundation for control building, and substation steel structures, electro-mechanical equipment l etc., shall be attended and constructed. All designs and details shall be subject to the approval of Employer. Approval of designs by Employer in no way relieves the Contractor of responsibility for an inadequate foundation design.
All foundations shall be taken down and founded on firm virgin soil and no foundations shall be put on filled soil.

Factor of safety

Foundations shall be designed for actual working loads applied to the foundations by the equipment and structures. The foundations shall be designed to resist all vertical and lateral forces, uplift forces, overturning moments and any other forces with a minimum factor of safety of 2.0.

Bearing loads

The Contractor may use an allowable soil bearing pressure of 1.5 kg/sq.cm for the design of the foundation for the purpose of bidding, but this is only reference value. After award of Contract, the Contractor shall provide soil test report for review and approval of Employer and the Contractor shall carryout detail design of foundations based on it. There may be variation in the volume of work in final design as compared to the bidding design, for which the Contractor will not get any extra payment.

Concrete Works

Concrete work shall mean and include all and every concrete works, for the civil works. The Contractor shall perform the concrete work in strict conformity to the Specification and as directed by the Employer and shall inform Employer, at least 24 hours in advance, of the times and places which he intends to place concrete.

A. Composition of Concrete

General Mix Composition

The concrete shall be composed of cement, fine aggregate, coarse aggregate, water and admixtures as specified. All materials shall be well mixed and brought to the proper consistency. The mix proportions shall be as follows:

Grade of concrete	M20 (Substructure/super structure)	M15 (in ground floor slab & road works)
Minimum cement content	360 kg/m^3	260 kg/m^3
Maximum water cement ratio	.50	.50
Maximum slump	10cm	10cm

Minimum 28days concrete cube strength	210kg/sq.cm	150kg/sq.cm

The detailed concrete mix design shall be submitted to the Employer for approval on the basis of producing concrete, having suitable workability, consistency, density, impermeability, durability, and required strength with concrete compressive strength test records. If the minimum 28 days strength of M20 & M15 concrete grades as specified above cannot be achieved with the above cement content, more cement shall be used for which the Contractor will not receive any extra payment.

Consistency

The detailed mix proportions shall be submitted to the Employer for approval to secure concrete of the proper consistency and to adjust for any variation in the moisture content or grading of the aggregate as they enter the mixer. Addition of water to compensate for stiffening of the concrete before placing will not be permitted. Uniformity in concrete consistency from batch to batch will be required.

Soling Layer

Soling layer of mixed gravel or pebble of 10 cm thickness shall be used under lean concrete layer of all foundations.

Lean Concrete (M10) PCC

Lean concrete of minimum 5 cm. thickness shall be used under all foundations with the ratio of cement: fine aggregate: coarse aggregate equal to 1:3:5 (by volume).

B. Cement
Quality

The Contractor shall furnish normal Portland cement in fifty (50) kg net-weight sacks. The cement for the civil work shall conform to the requirements of "Portland cement, Type I" designated in ASTM C150 or equivalent Indian Code (IS263). Where conditions require the use of high sulphate resistance cement, cement conforming to the requirements of ASTM C150 Type V shall be used without any cost to Employer.

C. Coarse Aggregate
Quality

Coarse aggregate shall conform to the requirements of ASTM C 33 or equivalent Indian code (IS383) and shall be either natural gravel or manufactured coarse aggregate. Coarse aggregate shall consist of well-shaped clean, hard, dense, durable rock fragments and shall not contain wood chips and any other impurities.

Grading

Coarse aggregate shall be graded for each maximum size within the standard limits specified as follows :

Percentage passing by weight

Designation of size in inch (sieves with square openings)	**2 inch**	**1-1/2 Inch**	**1 inch**	**3/4 inch**	**3/8 inch**	**No.4 inch**
40 mm (1-1/2 to 3/4 inch)	100	90 to 100	20 to 55	0 to 15	0 to 5	
20 mm (3/4 inch to No.4)	-	-	100	90 to 100	20 to 55	0 to 10

D. Fine Aggregate
Quality

Fine aggregate shall conform to the requirements of ASTM C33 or equivalent Indian code (IS 383) and shall be natural sand or manufactured sand. It shall consist of clean, hard, dense and durable rock particles, free from injurious amounts of dust, silt, stone powder, pieces of thin stone, alkali, organic matter and other impurities.

Grading

The fine aggregate as batched shall be well graded, and when tested shall conform to the following limits:

Sieve size	Percentage passing by weight
9.51mm (3/8 inch)	100
4.76 mm (No.4)	95 to 100
2.38 mm (No.8)	80 to 100
1.19 mm (No.16)	50 to 85
595 micron (No.30)	25 to 60
297 micron (No.50)	10 to 30
149 micron (No.100)	2 to 10

E. Admixture

The Contractor shall use admixture, if required, listed below in order to improve the quality of concrete or mortar such as workability and finish ability and water tightness.

Air-entraining agent - ASTM C260
Water-reducing and set retarding agent - ASTM C494
Plasticizer

The cost of the material and all costs incidental to their use shall be included in the unit price bid in the Price Schedule for concrete in which the materials are used.

F. Batching and Mixing

The Contractor shall provide equipment and shall maintain and operate the equipment to produce the required quality of concrete.

When any mixer produces unsatisfactory results, the Employer may direct the Contractor to increase the mixing time or repair the mixing blades, and the Contractor shall promptly carry out the directions of the Employer.

The order of feeding the materials into the mixer shall be subject to approval of the Employer. If concrete is to be mixed by hand, it shall be subject to approval of the Employer.

G. Placing of Concrete.
General Conditions

Prior to placing concrete, the Contractor shall submit to the Employer for approval the mixed proportion, the characteristics of each materials of concrete, the concrete placing schedule, placing equipment, and method of execution of work. No concrete shall be placed until all formwork, treatment of surface, placing of reinforcement and other parts to be embedded have been inspected and approved by the Employer.

For each lot of concreting works, an authorization letter of concrete placing (pour card/check list) shall be prepared and submitted, which will be authorized by the Employer after having inspection of prerequisite of general conditions of concrete placing.

Placing of concrete shall not be permitted under the following conditions, unless specifically approved by the Employer.

1. When it rains.
2. When illumination is imperfect for night work.
3. When vibrator is not working.
4. When the Employer orders to stop.

Preparation for Placing:

Treatment of foundation surfaces

All surfaces of foundation upon or against which the concrete is to be placed shall be cleaned and moistened thoroughly before the placing. When concrete is placed upon or against earth foundations, the Contractor shall, in accordance with the direction of the Employer, remove all objectionable substances such as standing water, flowing water, fragments of wood.

Treatment of surfaces of construction joints

Prior to placing the concrete upon or against the hardened concrete, the surface of the construction joints shall be cleaned, moistened and removed of all defect or loose concrete, and unsound foreign materials.

Transporting and Conveying

The concrete which has elapsed more than 60 minutes after being discharged from the mixer and/or in which slump loss exceeds 3.0 cm as it is delivered to the site for placing, shall be disposed off at the place designated by the Employer. All such waste concrete shall be borne to the Contractor's account. Concrete shall be placed with a vertical drop not greater than 1.0 m except where suitable equipment is provided to prevent segregation or where specifically authorized.

Concrete, which has segregated during transportation, shall be re-mixed. Re-tempering of concrete shall not be permitted.

Placing

After the surface of unformed construction joint has been cleaned and the placing of concrete has been approved by the Employer in accordance with the provisions of the preceding Sub- articles , surface of unformed construction joint shall be covered with a layer of mortar approximately 1.5 cm thick. The Contractor shall place concrete upon the fresh mortar before it begins to set. The mortar shall be of richer cement content than the concrete without coarse aggregate. The cost of the mortar shall be included in the unit bid price for the foundation lot.

Concrete shall be deposited in all cases, as nearly as practicable, directly in its final position and shall not be caused to flow such that it will permit lateral movement or cause segregation of the coarse aggregate, mortar or water from the concrete mass.

Consolidation

Immediately after placing, every layer of concrete shall be consolidated to the maximum practicable density so that it closes snugly against all surfaces of reinforcement bars and embedded fixtures and against all corners of the forms. Consolidation of concrete shall be done by electric or pneumatic power-driven, immersion-type vibrators or other approved means.

H. Concrete Construction Tolerance

Variations in alignment, grade and dimension of the structures from the established alignment, grade and dimensions shall be remedied or removed and replaced by the Contractor at his own expense as directed by the Employer.

I. Repair of Concrete

The Contractor shall repair at his own expense the imperfections of concrete surfaces and the irregularities which do not meet the specified dimensions. Repairing work shall be performed and completed within 24 hours after the removal of forms, in accordance with the direction of the Employer.

J. Curing.

Prior to placing concrete, the Contractor shall obtain Employer's approval in respect of the method to protect and cure concrete and the facilities he proposes to use. After concrete has been placed, it shall be protected and cured strictly in accordance with the method approved by the Employer.

All costs for the curing of concrete shall be included in the unit price bid for concrete works.

K. Forms.

General Conditions

Forms shall be used, wherever necessary, to confine and shape the concrete to the required lines, and as directed by the Employer. Forms shall have sufficient strength to withstand the pressure resulting from placing and

vibrating of the concrete, and shall be maintained rigidly in positions. Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Each form shall be so prepared that each section may be removed individually without injuring the concrete.

The costs of all labor and materials for forms and for any necessary treatment of coating of forms shall be included in the unit bid price for form work.

Removal of Forms

Forms shall not be removed without the approval of the Employer. As a rule, the forms shall be removed at the following minimum times after concrete has been placed:

Side forms of column and walls	2 days (48 Hours)
Supporting forms of floors and beams	28 days

Measurements for payment for the Contract item "form works " shall be in Square meter". Payment for the Contract item " form works " will be made at the unit price for Square meter and the quoted unit price shall include full compensation for all costs incurred procurement of all materials, labor and all other operations , tools & tackles, complete for finished item of work.

L. Grouting

Grouting for seating structural steel members and equipment on foundations shall be non-shrink Portland cement mortar grout, or a suitable commercially available grout, at the Contractor's option. Grouting shall be done under pressure by means of an expanding agent or by means of a static head. Proportioning and mixing of grout shall conform to the following:

(a) Mortar grout containing aluminum powder as an expansive agent, mixture of 1 part cement and 2 parts sand, by weight, with a water-cement ratio not exceeding 0.55. The quantity of aluminum powder used shall be approximately 0.005 percent of the weight of cement, the actual quantity to be determined from tests with materials to be used, and at the temperature and under the conditions of placement. Aluminum powder shall be blended with cement in proportions of one part powder to 50 parts cement, by weight, and the blend shall be sprinkled over the dry batch. After all ingredients are added, the batch shall be mixed for 3 minutes. Grout, which has not been placed within 45 minutes, shall be rejected.

(b) In lieu of use of an expansive agent, settlement shall be reduced by extending the mixing period or by delaying final mixture to minimize the interval between time of placement and initial set and placement the under static header pressure. The mortar grout shall be a mixture of one part cement and 2.5 parts sand, with a minimum necessary, to enable placement.

No separate or direct payment will be made to the Contractor for Grouting. All costs incurred in connection therewith shall be included in the unit bid price for the construction of various foundation types.

M. Tests

The Contractor shall make all necessary tests for determining the mixed proportions of each type of concrete, including tests of aggregates, so as to produce the concrete as specified.

In order to control the quality of concrete to be placed, the Contractor shall perform the following field tests:

Slump Test

A slump test will be made from each of the first three batches mixed each day. An additional slump test will be made for each additional 40 cubic meters of concrete placed in any one day. Slump will be determined in accordance with ASTM C 143 or equivalent Indian code.

Compression Test

Three sets of three concrete compression test cubes/ cylinders will be made each day when concrete is placed or as directed by the Employer. One set of each group will be tested at an age of 7 days and the other set will be tested at an age of 28 days. The third set will be an extra set to be tested only if needed. If the compressive strength indicates a compressive strength of less than 210 kg/sq.cm for M20 grade and 160kg/sq.cm for M15 grade., Employer will determine what remedial measures are necessary and the Contractor shall perform these remedial measures at his own expense.

Concrete test cubes/cylinders will be made, cured, and stored in accordance with ASTM C31 or equivalent Indian code (IS 516). Concrete cubes/cylinders will be tested in accordance with ASTM C39 or equivalent Indian code (IS 516).

No separate or direct payment will be made to the Contractor for tests. All costs for the tests shall be included in the unit bid price for the concrete works.

M10 Lean Cement Concrete (PCC)

The PCC of Control Building foundation, Switch yard civil work foundations, Septic tanks, , foundations of fencing & gates and drains etc., are included in this item.

Measurement for payment for the Contract item, "Lean Cement Concrete" shall be in cubic meter. Payment for the Contract item "Lean Cement Concrete" will be made at the unit bid price for all costs incurred in furnishing all materials, equipment and labor and all other operations etc., for finished item of work.

M20 Reinforced Cement Concrete (RCC) for sub/super structure

RCC , M20 for sub structure and super structure of Control Building (including grade slab & cable ducts, septic tank), Switch yard civil work foundations and other miscellanies works are included in this item.

Measurement for payment for the Contract item, " M20 Cement Concrete Work in structure" shall be unit price for cubic meter.
Payment for the Contract item "M20 Cement Concrete Work in structure" will be made at the unit price for all costs incurred in furnishing all materials, compaction, equipment and labor and all other operations etc., for finished item of work.

Form work for Sub and Super concrete structures

The Contractor shall place all the Plywood or equivalent with required strength and rigidity to get smooth sound concrete sections as per the design drawings for all RCC woks of control buildings and switch yard civil works. The forms shall be adequately braced to maintain proper lines & levels of the structural members.

Measurement for payment for the Contract item, "Form work" shall be unit price for Square meter
Payment for the Contract item "Form work" will be made at the unit price for all costs incurred in furnishing all materials, scaffolding & bracing arrangements, at all leads & lifts, equipment and labor and all other operations etc., complete for finished item of work.

Reinforcement steel

The Contractor shall place all the reinforcement bars in the concrete structures as shown on the approved drawings, bar bending schedules for the above works and as directed by the Employer. The reinforcement bars shall be furnished by the Contractor. The reinforcement bars used for the concrete structure shall be Tor-steel / HYSD reinforcing bars and dimensions, shapes, tensile strength, yield point, elongation and other properties, shall conform to BS 1144 or equivalent Indian code (IS 1786).
Reinforcement bars shall be accurately placed and special care shall be exercised to prevent the reinforcement bars from being displaced during the placement of concrete. Intersecting points and splices of the reinforcement bars shall be fixed by using suitable clips or annealed wires. The reinforcement bars in structures shall be placed and supported by use of concrete blocks, metal spacers, metal hangers or other satisfactory devices to ensure required coverage between the reinforcement bars and the surface of concrete. Drawings of bar lists/schedule shall be submitted to the Employer for approval. The cost of binding wires, cutting and placing of steel bars shall be included in the unit price bid for Reinforcement steel.

Measurement for payment for the Contract item, "Reinforcement steel" shall be kilogram (kg).
Payment for the Contract item "Reinforcement steel" will be made at the unit price shall include full compensation for all costs incurred in furnishing all materials, including reinforcement bars, rolling margins, wastages, binding wire , at all leads & lifts, equipment and labor and all other operations etc., complete for finished item of work.

17.10 Substation Steel Structures

General
The scope includes design, fabrication, proto- assembly, supply and erection of galvanized steel structures for equipment support structures. gratings & supporting beams. Towers, girders and lightning masts shall be lattice type structures fabricated from structural steel conforming to IS2062/ ASTM 36 (for MS) and IS 8500/ ASTM572 (for HT). All equipment support structures shall be fabricated from GI pipe conforming to YST 22 or of higher grade as per IS 806.

a. Wind Load.

Risk Co-efficient (k1)	1.00
Terrain Roughness Co-efficient (K2)	1.08

(but Gust factors corresponding to terrain category –II shall be considered for conductors/earth wire, Tower and Insulator for arriving the wind load)

Design Wind Speed (Vd) 47 m /sec

b. Human Load: 240 kg at the center of the beam.

c. Load due to conductor and weight of equipment and accessories:

The following loads shall be considered for design as per IS802 and CBIP manual on Transmission lines
Load due to the ACSR conductor shall be wind load, dead weight and short circuit forces.
Weight of equipment including insulator string shall be according to actual installation.

The switchyard gantry structures shall be designed for the two conditions i.e. normal and short circuit (IEC 865). In both conditions the design of all structures shall be based on the assumption that stringing is done only on one side, i.e. all the three (phase) conductors broken on the other side.
The gantry structures shall be subjected to a vertical uplift of 500 kg at each supporting point of overhead ground wire and conductor. The minimum tension for conductor and ground wire will be 1000kg and 500 kg respectively and angle of deviation will be 15^0 (for both vertical & horizontal deviations). However the actual tension loads to be used for design shall be furnished by the contractor based on sag tension and short circuit forces, which will be approved by the Employer.

Factor of safety of 2.0 under normal conditions and 1.5 under short circuit condition shall be considered on all external loads for the design of switch yard structures.
The Contractor shall calculate the maximum and minimum stresses at any combinations of loading conditions
The girders shall be connected with lattice towers by bolted joints.

The lightening masts shall be 35 m height (approximately) lattice structure and designed for diagonal wind condition. The lightening mast shall be provided with two plat forms at 12.5m and 25m heights for mounting of lighting fixtures. These two platforms shall be provided with hand railings and structural steel access ladder with suitable protection rings. The geometry of lightening mast, general arrangement s of platform, railing& access ladder shall be approved by the Employer prior to design.

All the pipe structures shall be designed for the worst combination of dead loads, erection load, wind load/ seismic load, short circuit forces / operating forces acting on the equipment and associated bus bars.
Base plates and foundation bolts shall be designed for the loads for which the structures are designed confirming to IS 5624 and IS 800.

The Contractor shall use an allowable soil bearing pressure of 1.0 kg/cm^2 for the design of foundation for bidding purpose. But this is only reference value. After award of Contract, the Contractor shall conduct soil test and prepared soil test report. There may be variation in the volume of work in final design compared to the bidding design, for which the Contractor will not get any extra payment.

Uplift and overturning loads for switchyard tower foundations

The uplift and overturning resistance of concrete spread footings shall be assumed as the weight of a volume of earth in the form of an inverted frustum of a cone or pyramid. The cone or pyramid height shall be 30 cm

less than the depth from finish grade to the top of the concrete mat, the base area shall be the top area of the mat and the top area shall be determined by the intersection of planes starting at the mat edges and sloping outward at a 20^0 cone angle from the vertical, and the horizontal plane 30 cm below finish grade.

The following unit weights for overturning resistance or as per Geotechnical investigation whichever is less

a) Soil .....1,200kg/m^3
b) Concrete .....1,600kg/m^3

Detail calculations for each type of foundation shall be submitted to the Employer for approval. Such details shall show the following requirements:

a. Calculation of loads acting on foundation under different conditions.
b. Calculated safety factor for each type of stability and condition.
c. Maximum stresses in concrete and in steel reinforcement at any critical section.

Line and Grade:

The Contractor shall provide all lines and grades or elevation of the ground at each footing and set the necessary stakes that are required for the work and will be held responsible for their accuracy. Employer may check lines and levels set by the Contractor from time to time, but the responsibility for their accuracy shall rest entirely on the Contractor.

It is the intent of this specification to establish acceptable standards of quality and performance. Minor deviations in details due to manufacturer's standard, shop process will be considered for acceptance, provided that in the-opinion of the Employer, the proposed substitutions are equal in quality and performance to the specified material. All deviations shall be called out in writing in the proposal and shall be specifically indicated on the shop drawings. The Contractor will not get any extra payment for increase/decrease of work volume due to such deviations.

Design of Steel Structures.

Design Methods

The stress analysis shall be conducted by the force diagram method for all type of steel structures. Any computer program to be employed shall be prepared or approved by a recognized institute and be submitted to the Employer.

Loading Conditions

In additions to dynamic loads imposed by equipment, steel work shall be design to withstand simultaneously wind and other loads as follows:

Design and Ultimate Stresses Allowed in Design:

For tensile members of steel structures, the design stresses shall not exceed the yield point of materials even under test loading conditions. For compressive members, the design stresses shall not exceed the value of the ultimate buckling stress.

Ultimate stress allowed in design shall be as follows:

Members: (ASCE10-52, IS802)
Buckling: As per ASCE Manuals and Reports on Engineering Practice-No. 52 or equivalent Indian Codes.
Tension : less than 1.00 Fy
Bearing : Less than 1.80 Fy

Bolts : (IS1367, IS6639)
Shear less than 0.60 Fu
Bearing less than 1.00 Fu

Where : Fy : Yield point of steel member materials
Fu : Ultimate tensile stress of bolt materials

Limit of Effective Slenderness Ratio

The effective slenderness ratio (L/r) of members shall meet the following limits:

Leg member, main compression member and ground wire peaks	= 120
Other members having computed compressive stresses	= 200
Secondary members without computed compressive stresses	= 250
Tension member	= 350

In determining the slenderness ratios for various members' suitable provisions shall be taken into consideration for various types of end connections, eccentricity of load transfer in the member's effective length of members as per the CBIP Manual guideline Annexure-12 and 13.

Minimum Thickness and Size of Steel Members

Minimum thickness and size of steel members of structures shall be as follows:

Calculated members	40mmx5 mm
All other stressed members	not less than 40mmx4 mm

and secondary members	
Gusset plates	not less than 5 mm
Bolts and nuts	M-12 mm

In computing the net section of tension members, the diameter of the bolt holes shall be taken as 3.0 mm greater than the nominal diameter of the bolts. Net section on both straight and zigzag sections across the members shall be as specified in ASCE or BS.

Connections

a. Bolts: All connections shall be bolted and all stressed members shall be connected by at least one (1) bolt. For structural connections, a maximum of two bolt sizes may be used for each tower type, provided the quantity of each size is not less than 20 per cent of the total requirement for the tower and the bolts in any one connection are uniform in size.

b. Splices: The number of splices shall be practically minimum. Splices shall develop the maximum stress in member or seventy (70%) per cent of compressive strength of gross section or tensile stress of net section. No credit shall be allowed for bearing on abutting areas.

Design Drawings and Calculation

The design drawings shall show the following data and information:

Scaled line diagram of the steel structures showing all redundant bracing members and their sizes completely dimensioned and proving compliance with all clearance requirements.

All loadings and their manners of application including the determination of wind load (wind load on structure shall be applied at each panel point along the height of the steel structure.)

Calculations should show the following as a minimum:

a. Total stresses in each member for each loading case and the critical case.
b. The effective slenderness ratio, calculated stress ratio of maximum total stress to calculated stress for each member and strength of connection.
c. The estimated weight of the complete galvanized steel structures.
d. Size and type of steel for each member and number of bolts required for its connection.
e. The compression and uplift reactions and corresponding horizontal shears at each leg of all steel structures (column and equipment supports) for all loading cases.

Detailing

Detailing shall be as follows:

General:

Steel structure dimensions, framing, member sizes and length, number, size and length of bolts, thickness of each filler and other necessary details to fabricate each piece shall be shown on the approved detail drawings. No change shall be made without the written approval of Employer.

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

Step Bolts:

Step bolts shall be of 16 mm diameter and shall have round or hexagonal head. Each step bolt shall be provided with two hexagonal nuts. The minimum bolt length and length of unthreaded portion shall be 180 and 125 mm respectively. Step bolts shall not be used as connection bolts.

The step bolts shall be spaced alternately on the inner gauge line on each face of the angle about 40 cm centers. They shall be furnished for one leg of each steel tower from the base elevation of the steel tower.

Step bolts for lattice single pole or H-frames are not required.

U-Bolts:

U-bolts shall be suitably furnished on steel structures to suspend or terminate insulator strings or ground wire assemblies. Size of U-bolts shall withstand all loads acting on it.

Detail Drawings:

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

Bill of Material:

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

Fabrications

Workmanship

Workmanship shall be first class throughout. All pieces must be straight, true to detail drawings and free from lamination flaws and other defects. All clipping, back cuts, grindings, bends, holes and etc. must be true to detail drawings and free of burrs.

All identical pieces bearing the same erection number must be exactly interchangeable with each other and interchangeable in their relative position in all towers or structures of which they form a part.

Threads of bolts and nuts shall be cleanly rolled or cut and the face and head of nut shall be truly at right angle to the axis of the bolt.

Cleaning and Galvanizing

a. Cleaning:

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

b. Galvanizing:

All materials shall be hot-dip galvanized after fabrication and cleaning. Re-tapping of nuts after galvanizing is not required.

Galvanizing for structural mild steel products shall meet the requirements of ASTM A123. All holes in materials shall be free of excess shelter after galvanizing.

Galvanizing for bolts, nuts, washers, lock nuts, step bolts and similar hardware shall meet requirements of ASTM A153or equivalent. Excess shelter on bolts, nuts, washers, locknuts, step bolts and similar hardware's shall be removed by appropriate means acceptable to the Employer.

Finished materials shall be dipped into the solution of dichromate after galvanizing for white rust protection during sea transportation.

c. Uniformity of Coating:

The uniformity of coating test shall be made in accordance with ASTM A239 or equivalent. The minimum repetition times for one minute dip in uniformity test shall be as follows:

Steel shapes and plates..... 6
Bolts, nuts and similar hardware.....4

Galvanizing Coating Weight

Item	Description	Coating Weight (g/sqm)		Uniformity Test Time (1min. / 1 time)
		Average Value	**Minimum Value**	
1	Shaped Steel Over 6mm	More than 700	More than 610	More than 6
2	Steel Plates Under 6mm	More than 610	More than 550	More than 6
3	Bolts, nuts & Washers etc	More than 470	More than 400	More than 4

d. Straightening after Galvanizing:

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

e. Repair of Galvanizing:

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

f. Shop Assembly:

One of each type of steel structures shall be assembled in the shop to such an extent as to insure proper field erection. Reaming of untrue holes will not be permitted. A reasonable amount of drifting will be allowed in assembling. Shop assembled parts shall be dismantled for shipment.

Shop Tests

The following shop tests shall be performed with relevant provisions of the ASTM.

a) General inspection
b) Material tests
c) Assembly test
d) Galvanizing test

The Contractor shall furnish four certified copies of report of all tests to the Employer. The costs of all tests and reports shall be borne by the Contractor.

Payment

Payment for the Contract item "Steel Structures" will be made at the unit price of metric tonne (MT) for steel structures type used. Therefore, in the Price Schedule, unit price shall include full compensation for all costs incurred in furnishing all materials, equipment and labor and all other operations related to steel structure design, fabrication, installation etc.

Concrete Work

The detail specification for the concrete works of switch yard, cable ducts, duct banks and drains shall be as specified in Foundation and Concrete works as per clause no 22.9 and all the Foundation works of this section (Excavation, Lean concrete, RCC M20 grade for Sub structure, form work & reinforcement steel) will be measured and payment will be made accordingly. The supply & fixing of RCC Hume pipes for road crossings, storm water drainage culverts shall be included in the balance drainage and cross drainage works.

17.11 Brick Masonry Work

Materials

(a) Brick units shall be first class, sound, well burned, and free from defects that would impair its strength or affect its service-ability.

The Contractor should submit locally manufactured brick samples of six pieces for Employer's approval.

(b) Cement shall be ordinary Portland as per ASTM C150 Type I or equivalent.

(c) Sand shall be clean, fine, sharp granules, free from foreign or deleterious matter.

(d) Water shall be clean and free from acid, alkalis, oil or organic matter.

The Contractor should submit samples of cement, sand and lime for Employer's approval

Mortar Mixtures

The type of mortar mixture for brick masonry shall be 1:4 in ratio

Brick Masonry Laying

(a) Lay brick masonry in accurately spaced courses, level, plumb and true to line.

(b) Soak brick units in clean water for one hour before laying. Units shall be damped when laid.

(c) Lay brick in running bond with joints approximately 10mm wide.

(d) When brick masonry walls cross the recessed floor cable trenches provide and install cast-in-situ concrete lintels of sufficient size and strength to support and carry masonry walls across the trench sprays.

(e) Reinforce all masonry walls with cast-in-situ reinforced concrete formed flush with the masonry surfaces for cement plaster-finish.

(f) Provide concrete pilasters and horizontal tie for every 9 square meters of masonry wall surface, plus at all corners and door jambs.

(g) Size of Wall

(1) The entire periphery wall shall be constructed in 360mmthickness.

(2) The entire partition wall shall be constructed in 240mm and 110mm thickness. But the latter one shall be constructed at less than 2.0 m span only.

Curing

Spray masonry surfaces with water twice daily for a period of 10 days, or until the surface receives a plaster finish.

Protection

Where exposed to weather, protect top of masonry with water tied material in such a way that it will protect the completed work. Masonry wall shall set for 48 hours before any load is applied on the completed work.

Payment

Measurements for payment for the Contract item "Brick Masonry " shall be in cubic meter. Payment for the Contract item " Brick Masonry " will be made at the unit price for cubic meter and the quoted unit price shall include full compensation for all costs incurred procurement of all materials, scaffolding, curing, labor and all other operations, tools & tackles, complete for finished item of work.

17.12 Plastering and pointing works

Plastering work shall be done for internal walls bottom wall of switchyard fence.

Plastering

Materials shall conform to the respective specifications and other requirements specified below:

(a) Sand shall be coarse, clean sharp sand, free from clay, loam or other impurities. Sand shall be uniformly graded from coarse to fine confirming to IS 383.
(b) Portland cement shall be as per ASTM C150 Type I or equivalent (IS 263). Only one brand of cement shall be used in the work.

Construction

(a) Thickness of Plaster
Thickness of plaster from the face of the plaster base to the finish plaster surface shall be 20 mm and 12. 5mm for internal and ceiling as well as external walls respectively.

(b) Preparation for Plastering
Concrete surfaces shall be thoroughly cleaned and free of paint, efflorescence, oil, grease, acids and other loose or foreign matter prior to application of base coats. No plasterwork shall be applied on masonry works less than 2 weeks old.

(c) Mortar
Mortar shall consist of one part Portland cement and four parts of sand.

(d) Sand

Sand shall be hard, clean, and free from mud and other material not desirable for setting mortar.

(e) Cement

Cement shall be as specified in Concrete and Foundation works.

(f) Water

Water shall be fresh, clean and free from acids, alkali, sewage and other organic matter.

(g) Installation

(l) Setting Beds

Setting beds shall be composed by volume of 1 part Portland cement to 2 parts damp sand, and mixed with the minimum amount of water necessary to produce a workable mass.

Areas of setting bed spread at one time shall be only as large as can be covered with tiles before the mortar has obtained its initial set. Surplus mortar shall be removed.

Setting beds shall be spread and tampered to force out air pockets screened to a true plane, and sloped to drain or leveled as required.

The average thickness of setting bed in any room or space shall be less than 30 mm, but in no case shall the setting beds be less than 20mm or more than 30 mm thick.

(2) Mixing of Plaster

Plaster shall be mixed in mechanical mixers where hand mixing is approved for small quantities. Caked, or lamped material shall not be used. Each batch shall be proportioned by volume, accurately measured by manual or mechanical devices, and thoroughly mixed with the minimum amount of water until uniformity in color and consistency is obtained. Re-tempering will not be permitted and plaster that has begun to stiffen shall be discarded. Mortar 90 minutes after mixing shall be rejected for the plastering work.

(3) Proportions: 1: 4 by ratio

This ratio is to be used on all external walls, internal walls, ceiling and floors as required.

(4) Plastering

Plaster shall be done in two coatings; both shall be proportioned as mentioned above but sand to be used in the finish coating shall be of the finest grade.

The first coating shall be applied with a spatter-dash, which is to be done by forcibly throwing the wet mix on the surface and making no attempt to level it.

The second coating will be applied after the first coating has hardened. After this, a wet soaked sponge shall be rubbed on the finish surface.

Measurements for payment for the Contract item "Plastering / Pointing " shall be in Square meter". Payment for the Contract item " Plastering / Pointing " will be made at the unit price for square meter and the quoted unit price shall include full compensation for all costs incurred procurement of all materials, scaffolding, curing, labor and all other operations, tools & tackles, complete for finished item of work.

17.13 Flooring (Ceramic tile, Acid Resistance tile, Marble flooring)

Scope of Work

The exact location of this area shall be decided based on the layout during detailed design stage subject to the approval of the Employer.

17.14 Drainage and Sewage System

The drainage system is to drain all the storm run-off water and all other water by using pipe culverting system, open gutter and cable trench system to the public drainage pit outside the substation in accordance with the instructions of Employer. The Contractor shall perform and be responsible for drainage system according to the following specified items. The Contractor shall study and divert the existing drainage system. Septic tank and soak pit shall be constructed for the sewage system of control building and staff quarter building. All the Contractor's designed drawings shall be submitted to Employer for approval.

Drains will include, but not limited to, following:

- Open channel drains at top side of retaining wall and slope protection,
- Open gutters at lower side of retaining wall and slope protection,
- Open drains along both side of the roads,
- All drains shall be directed to the natural slopes and towards existing natural drain or kulo along the boundary of substation property periphery.

Principal Areas of Drainage

1. Switchyard area and cable trench
2. Road surface
3. Control building
4. Compound periphery

Drainage Pipe.

The Contractor shall design, furnish and install all pipes for drainage system as shown in the drawing for approval.

Drainage Channel Materials

a) All drains must be built with proper gradient.
Excavation must give allowance to formwork, which shall be refilled with proper compaction.

b) Concrete Pipes
Concrete pipes shall be of Np-3 class or equivalent in required size. Closed pipes shall be used at road crossing.

The perforated type pipes of 150mm dia shall be used for switchyard area. Perforated pipes shall be made of R.C.C hume pipe Np-2 class or equivalent. These pipes shall be protected with screened gravel of 25mm-4-mm size.

c) Mortars for drainage channel shall be a mixture of cement and sand mortar with a ratio of 1:4.

Open Channel Type Drainage

The surface shall be made as smooth as possible with plasterwork. Side and base shall be constructed in Stone masonry wall or concrete. The function of the gutter is to drain the surface run-off from the road surface and nearby area and near the slope protections. The size and slope of the gutter shall have adequate capacity for drainage of the area

Payment

The earth work excavation, PCC, RCC M20 grade works of drainage system, RCC Hume pipes for storm water drainage, power/ control cable crossing culverts and manholes shall be measured under appropriate items of works.

Payment for the above Contract item will be made at the unit price for against respective items of woks and the quoted unit price shall include full compensation for all costs incurred procurement of all materials, fabrication & erection, fixtures & fittings, hard ware, labor and all other operations , tools & tackles, complete for finished item of work.

17.15 Miscellaneous Outdoor Facilities.

General

The proposal shall include all miscellaneous outdoor facilities. The miscellaneous outdoor facilities shall comprise of switchyard fence with entrance gate, etc.

Prior to execution of the works, the Contractor shall prepare and submit design and detailed drawings of such works to Employer for approval. All works shall be executed in accordance with the stipulations of the relevant articles of the Specifications.

Switchyard Fencing and Gates

The work included under this item entails the complete furnishing and installation of all galvanized wire mesh fence, posts, gates, and appurtenances, complete and in finished condition, including the furnishing of all labor, materials, plant, tools and equipment including excavation required for the work.

Materials: The materials shall be as described in the drawing.

Erection: The Contractor shall erect the switchyard fence strictly conforming to provided drawing & this specification. Concrete works shall be in accordance with the details in the item of these Specifications concerning concrete work.

Payment

Measurements for payment for the Contract item " Switchyard Fencing & gates" shall be in Square meter". Payment for the Contract item " Switch yard Fencing & gates " will be made at the unit price for square meter and the quoted unit price shall include full compensation for all costs incurred procurement of all materials, structural steel supports, Gates (double & single leaf), labor and all other operations , tools & tackles, but excluding concrete item of works , etc., complete for finished item of work.

17.16 Outdoor Cable Trench, Duct Bank Conduits and HAND Hole

General Requirement

The detail design of the cable trench shall be the responsibility of the Contractor. All designs and details shall be subject to approval of the Employer. The inside depth of the trench shall be minimum 1 m if not specified.

Type of Cable Trench

Concrete cable trenches of adequate size shall be designed and constructed in accordance with the approved drawings and as directed by Employer. Main cable trench leading to control building shall be minimum 1.2 m breadth and 1.1 m depth (inside) and shall able to carry 3 no of cable trays fitted at workable interval or as approved. Cable trench shall be reinforced concrete trench with three layer of hot dip galvanized light gauge shape steel tray. The cover of trench shall be 80 mm thick pre cast RCC slabs (with form work mandatory) with the provision of handles (painted) in 4 alternate slab of approved design. The cover shall be fitted inside the outer wall of cable trench as shown in reference drawing. The top surface shall be smooth finished. The trench and cover where it crosses the road shall be calculated safe for the load of AASHO H20-S16. Trenches shall be designed with floor drains. Reinforced concrete, cast iron or heavy-duty PVC pipe of minimum 15-centimeter diameter shall be installed in the cable trench sump pit to nearest drainage sump to drain the water in the cable trench.

Conduit and Hand Hole

The Contractor shall provide the conduit and hand hole for the cable from the main trench to the steel structure or equipment foundation. The hand hole shall be reinforced concrete with galvanized steel chequered plate cover. The size of the hand hole shall be large enough to pull the cable from the conduit to the foundation.

Payment

Payment for the Contract item, "supplying, fabrication and installation of cable tray in cable Trenches for cable laying", will be made at the lump sum bid but payment of construction of civil work of cable trenches such as excavating and backfilling for the cable trenches, Constructing the cable trenches with floor drains, reinforced concrete wall, base and removable cover, providing road crossing conduit and conduit pipe at foundation blocks hall be made as per unit quoted price of respective items. Therefore, in the Price Schedule, "supplying, fabrication and installation of cable tray in cable Trenches for cable laying" lump sum price shall include full compensation for all costs incurred in furnishing all materials, equipment and labor and all other operations related to cable tray for trench design and construction, including but not limited to: a) Performing detail designs and preparation of construction drawings. b) Supplying transporting all materials to job site.

17.17 Electrical Accessories and installation

General Requirement

The following specifications will apply under all circumstance to the equipments and fittings to be supplied and installed against this contract and it is to be insured that the Contractor shall obtain for himself at his own expenses and his own responsibility all the purpose of making the tender and for entering into a contract keeping in view the specifications detailed hereunder, drawings and design of the electrical installation and inspection of site etc. All electrical works to be executed under this contract shall be carried out of a highest degree of technical quality and workmanship. Installation shall be safe, simple, systematic order so that a general electrician can easily solve the problem arises during the maintenance of the system.

The tender rates shall include for the cost of material, erection, connection, testing and commissioning, supervision, transport, tools, all taxes, breakage, wastage, sundries, scaffolding, and maintenance of installation works for guarantee period of one year etc.

SCOPE OF WORK

The scope of work under this contract shall under due consideration of the requirements as stipulated in the specification include;

a) Supply and installation of the main panel board, distribution boards, sub distribution boards and energy meter after getting approval from the Employer.
b) Supply and Installation of minimum 25 sq. mm three phase copper cable with cable shoes from control room to staff quarter having total length of 100m, if supply cannot be provided from control building, it is the responsibility of contractor to take the supply from service mains.
c) Supply and laying of 1100 V grade multi core PVC insulated copper cable.
d) Supply and wiring of Light/Fan and Power points with PVC insulated copper conductor cables in concealed HDP pipe in wall, ceiling and floors as per drawings.
e) Supply and erection of Telephone Distribution Board and Telephone junction boxes as per drawings.
f) Supply and fixing of lighting fixtures, power & telephone sockets, switches etc. as per drawings.
g) Supply and embedding of Earthing Materials and connections to Main & Sub Distribution Boards with bare copper conductor in concealed HDP pipe wherever applicable.
h) Excavation, backfill, cutting and patching, brick-work and concrete work, sleeves, inserts, anchors, etc. as required for proper installation in accordance with the requirements drawings and specifications.
i) Testing and commissioning of the electrical equipments including Main and Sub distribution Boards, lighting fixtures, power and telephone sockets etc.
j) Where the electrical work is associated with the work of the others, the contractors shall confer with the persons affected and shall furnish them with all necessary information, drawings, dimensions etc. and shall coordinate the electrical work with the work of other trades to insure a satisfactory installation, in accordance with the drawings and specifications and with the high standards of trade practices base on I.S. code of practice.

k) Whenever recessed fittings are required to be provided the electrical contractor shall be responsible for informing the building contractor to keep the necessary recesses in the slab, columns, beams and in the false ceiling.

DESCRIPTION OF WORK

The description of work includes the following:

- L.V. electrical installation for Dhungesangu 132 kV Substation Project.
- Supply and laying of PVC insulated copper cable armoured and unarmoured of different sizes laid in ground, PVC duct, HDP conduit as mention in the BOQ.
- Supply and laying of PVC insulated telephone indoor pair type cables of different sizes laid in PVC duct and HDP conduit as mentioned in the BOQ.
- Laying PVC type conduits for computer networking and smoke detector.
- Supply and installation of Main Panel Board, Distribution Board and Sub Distribution Board, lighting fixtures, power and telephone sockets, switches, earthing and Telephone Distribution Boards, Telephone junction boxes as per drawings and specifications.
- Laying of HDP pipe in wall, ceiling and floors and drawing of conductor through HDP pipe as per drawing and specifications.
- Testing and commissioning.

GENERAL SPECIFICATIONS FOR ELECTRICAL WORKS

1. GENERAL REQUIREMENT

1.1. All fittings, accessories and appliances shall conform to relevant British or Indian standards whichever applicable.

1.2. All wiring shall be installed in accordance with British or Indian standards and shall be conduit wiring or as instructed by the Employer/ Engineer.

1.3. The system shall have 230V, 50Hz, single phase two wire AC supply or 400 V, 50Hz three phase system four wire AC supply whichever applicable as per drawing or as instructed by the Employer/ Engineer.

1.4. The notation R, Y and B in the three phase system indicate three different phases to be connected in the circuits and while connecting the circuits the color codes of different phases should be strictly followed.

1.5. The incoming section of three-phase main distribution board shall be provided with suitable barriers to maintain phase segregation.

1.6. All electrical fittings and wiring accessories shall be installed in accordance with IS – 1963.

1.7. The system should provide ease to fittings for maintenance and repair and for any possible modification to the system.

1.8. There shall be two distinct circuits, one for lights and fans and the other for power appliances.

1.9. Prior to the installation of the lighting, fans and plug points and distribution boards, switches etc. final positions shall be ascertained by the Contractor with the Employer/ Engineer.

2 ISOLATION AND PROTECTION

2.1 Means for isolating the supply to the building shall be provided to the point of commencement of supply through LT, TP MCCB in the Main Panel Board (MPB) as shown in the drawings. The Main Distribution Boards controlling the supply to the building should be readily accessible.

2.2 Means for projecting the different circuits there shall be Sub Distribution Boards having DP, MCB Isolator and outgoing MCB's for light and power circuits as shown in the drawing. The Sub Distribution Boards controlling the supply to the different circuits in the building should be readily accessible.

2.3 Protective devices such as MCCB/MCB used in the installation should be capable of interrupting any short circuit current that may occur, without danger.

2.4 The switches shall be connected to the lives only and never on neutral.

2.5 An earthing conductor with insulator covering shall be installed along with power circuit conductors and earthing with bare copper conductor in duct or through HDP pipe shall be installed to the Main Panel Board, Distribution Boards and Sub Distribution Boards.

3 LIGHTS AND FAN SUB CIRCUITS

3.1 Light and fans may be wired on the common circuit. Each sub circuit shall have not more than a total of ten points of lights including fans, 5A sockets outlets whichever applicable as per drawing. The load on each sub circuit shall be restricted to 800 Watts.

4 POWER SUB CIRCUIT

4.1 The load on each power sub circuit should normally be restricted to 2000 Watts. In no case there shall be more than three outlets on each sub circuit. A single outlet of capacity 3000 Watts per circuit shall be provided for dedicated power supply for air conditioning. In no case, load more than 3000 watt shall be exceeded per circuit.

5 SWITCHES

5.1 A switch shall be provided adjacent to the normal entrance to any area for controlling the general lighting in that area; the switches should be fixed in a usable wall space and should not be obstructed by a door or window in its fully open position. One light shall be connected to both switch and separate electronic solid fan regulator. Only in some cases two lights with one switch and three lights with one switch shall be connected as shown in the drawings.

6 FLEXIBLE CORDS

6.1 Flexible cords shall be used only for pendants and for connection of fixtures only. Flexible cords shall not be used in the following cases.

(a) As a substitute for the fixed wiring.
(b) For concealed wiring.
(c) If attached permanently to the walls, ceiling. etc.

7 MATERIALS

7.1 The contractor has to get approval of the drawing if applicable and the samples of all the materials and equipments to be supplied and installed under this contract. Non approval given by the Employer/ Engineer to any drawings or samples submitted by the contractor shall in any way exonerate the Contractor from his liability to carry out the work in accordance with the terms of the contract.

7.2 All materials and equipments shall be new and shall be in accordance with the standard as established by the Indian standard. Where material or equipment are specified or shown on the drawings by name of the other manufactures may be considered for use if of equal quality appearance and electrical and mechanical characteristics and approved by the Employer/ Engineer. If the Contractor wishes to use any other materials or equipment, he must obtain permission of the Employer/ Engineer in writing.

7.3 Any material supplied by the Employer, if damaged in any way during the execution of work or otherwise, shall be replaced by the Contractor at his own cost.

8 INSTALLATION

8.1 Installation of all lighting shall be done experienced electricians and supervised by the Employer/ Engineer. Lighting fixtures shall not be done installed until wall and ceiling finishing work is completed.

8.2 All pendent type fixtures in the same room shall be installed at a uniform height from the floor level. Mounted fixtures shall be properly aligned and mounted as indicated on the drawings or as directed by the Employer/ Engineer. Where the fixtures does not itself provide a suitable cover for the fixture outlet box, suitable cover plate on canopy shall be provided.

9 STORAGE AND PROTECTION

9.1 Particular care shall be taken to protect materials, equipment and fixtures against dampness and mechanical damages during period of storage and progress of construction and cleaning operations.

10 QUALITY OF WORK

10.1 The work shall be carried out in the best workman like manner and any defect or minor changes in the design etc. If pointed out shall be carried out by the contractor without any extra charge.

10.2 Workmanship and good appearance of the installation shall be of equal, and all portions of the work shall be so laid and installed that the work as whole is of uniform quality and shall present a neat appearance in a manner meeting the approval of the Employer/ Engineer.

10.3 The Contractor shall verify in the field all measurements necessary for the electrical work and shall assume responsibility.

11 PROGRESS AND COMPLETION OF WORKS

11.1 The work shall be commenced immediately after the Contractor receives instructions to proceed.

11.2 The Contractor in consultation with the Employer/ Engineer draws up a time schedule on commencement of the work. This time schedule must be adhered to.

11.3 The Contractor/Engineer shall employ adequate labours to complete the work within the schedule time and shall make his own arrangement for housing labor and materials etc. A whole time electrical supervisor shall be employed by the Contractor who will remain at site to receive orders or any other instructions from the Employer/ Engineer.

11.4 Materials which are defective or damaged during the progress of work shall be replaced or repaired in as approved manner at the expense of the Contractor. The installation shall comply with all applicable laws and ordinances and with the requirements of Indian codes and as specified herein or shown on the drawings. The progress of the electrical works shall be carried out so as to conform to the progress of the work and entire installation shall be completed as soon as the condition of the building will permit.

11.5 Upon completion of the installation of the lighting fixtures and lighting equipments, they must be in first class operation condition and in perfect conditions. At the time of final inspection, all fixtures and equipment must be complete, with lamps and required glassware or reflector, which must be clean and free from defects. Any fixtures, reflectors or glassware brown prior to the time of final inspection and acceptance, shall be replaced at the Contractor's expense.

12. PERFORMANCE OF WORK

12.1 All cutting, drilling channelling, patching etc. required for installation of electrical work shall be carried out in a manner approved by the Employer/ Engineer. Any defect of finish, plaster, woodwork, metalwork masonry, concrete or other material resulting from the performance of the work shall be replaced or repaired at no expense to the Employer and to the satisfaction of the Employer/ Engineer.

13. INSPECTION, TESTING AND COMMISSIONING

13.1 The Contractor shall notify in writing to the Employer/ Engineer about the completion of the work. Within thirty days from the date of this notification, the Employer/ Engineer shall send his representative to remain present at the times of carrying out the tests by the Contractors. The Contractor shall fix up this date in consultation with the Employer/ Engineer for such test.

13.2 The Contractor shall be responsible for providing the necessary instruments and the subsidiary earths for carrying out the tests without any extra charge.

13.3 Prior to test, feeders and branches shall be continuous from service contract point to each outlet, all panel feeders and devices connected and fuses in place. The Contractor shall test the electrical system for short circuits and earth. Installation resistances measured in mega ohm shall not less than 30 divided that whole installation need not be required to have an insulation resistance greater than one mega ohm. Test shall be carried out in accordance with the requirements of the B.S. and Indian codes and shall be conducted in the presence of the Employer/ Engineer. Any defect or

damages in way during testing and commissioning shall be corrected or replaced by the Contractor at his own cost.

14. MAINTENANCE AND GUARANTEE

The Contractor guarantee by his acceptance of the contract that all work installed will be free from any and all defects and if during a period of one year from date of completion and acceptance of work any such defects on workmanship material or performance replace, repair or otherwise correct the defects of deficiency, without cost to the Employer, within a reasonable time. In the event of default on this guarantee by the Contractor, the Employer may have works done as required and charge the cost to the Contractor.

15. MAIN PANEL BOARD (MPB)

Panel board is intended for indoor use and shall be fabricated from high quality of mild steel sheet of minimum 2mm thickness. It shall be weather proof, dust and vermin proof with hinged cover and built in lockable device. Interiors of the board shall have ample space for incoming/outgoing cables, MCCB's and for fitting other accessories.

Three phase and neutral bus bar made of from high conductivity electrolytic copper bar shall be fitted on suitable insulator support.

The board shall be painted with two coat of primer red oxide before a final coat of enamel. Following accessories shall be provided in the board.

Three phase and neutral bus bar of high conductivity electrolytic copper of sufficient cross sectional area so that a current density of 750 Amp/sq inch shall not exceeded at normal current rating. The neutral bus bar shall be rated at not less than 50 % of the phase bus bar. Earthing bus of suitable sizes

- 600 volt supporting insulators placed sufficiently closed together to prevent bus bars sags and to withstand wet test of 3 kV and impulse withstand test of 28 kV.
- Indicating lamps for each phase
- Volt meter (0-600V) range and ammeter (0-1000amp) range with selector switches to indicate respective switch reading of voltage and current on all phase. The voltmeter and ammeter shall be from reputed manufacture having ISO-9001 or ISI certificate.
- 415 volt MCCB of the following ratings shall be used.

1000 Amp, TP 85 kA	1 No
225 Amp, TP 36 kA	4 No
200 Amp, TP 36 kA	2 No
175 Amp, TP 36 kA	1 No
60 Amp, TP 36 kA	2 No

15.1 Provisions for connecting the incoming outgoing cables mentioned in the Bill Of Quantities, all accessories including connections, fixing cable lugs, insulating materials etc all complete.

15.2 The panel board shall be Himalaya Bijuli Udhyog or Hyonjan Electrical Fabricator or equivalent and tested according to the BS or IS specifications.

16 MAIN DISTRIBUTION BOARD (DB):

Distribution Boards (DB) are intended for indoor use flush mounted on wall and shall be fabricated from high quality of mild steel sheet of minimum 2mm thickness. It shall be weather proof, dust and vermin proof with hinged cover and built in lockable device. Interiors of the board shall have ample space for incoming/outgoing cables, MCCB's and for fitting other accessories.

Three phase and neutral bus bar made of from high conductivity electrolytic copper bar shall be fitted on suitable insulator support.

The board shall be painted with two coat of primer red oxide before a final coat of enamel.

Following accessories shall be provided in the board.

Three phase and neutral bus bar of high conductivity electrolytic copper of sufficient cross sectional area so that a current density of 750 Amp/sq inch shall not exceeded at normal current rating. The neutral bus bar shall be rated at not less than 50 % of the phase bus bar.

Earthing bus of suitable sizes

- 600 volt supporting insulators placed sufficiently closed together to prevent bus bars sags and to withstand wet test of 3 kV and impulse withstand test of 28 kV.
- Indicating lamps for each phase
- Volt meter (0-600 V) range and ammeter (0-250 Amp) range with selector switches to indicate respective switch reading of voltage and current on all phase. The voltmeter and ammeter shall be from reputed manufacture having ISO-9001 or ISI certificate.
- 415 volt MCCB of the following ratings shall be used.

Incomer MCCB TP 36 kA

Outgoing MCCB TP 30 kA

Provisions for connecting the incoming outgoing cables mentioned in the bill of quantities. All accessories including connections, fixing cable lugs, insulating materials etc all complete.

The panel board shall be Himalaya Bijuli Udhyog or Hyonjan Electrical Fabricator or equivalent and tested according to the BS or IS specifications

17 SUB DISTRIBUTION BOARD

Sub-distribution board is intended to indoor use and shall be wall mounted. It shall be fabricated from high quality of 16 gauze mild steel sheet. It shall be dust and vermin proof, provision of hinge front cover and lockable device. Interiors of the board shall have ample space for incoming/outgoing PVC insulated cables PVC insulated copper wires as mention in the bill of quantities, incoming TP MCCB's and outgoing SP MCB.

Three phase and neutral bus bar made of from high conductivity copper bar shall be fitted on suitable insulator support. Earthing bus of suitable sizes

The board shall be painted with two coat of primer red oxide before a final coat of enamel.

Following accessories shall be provided in the board.

600 volt supporting insulators placed sufficiently closed together to prevent bus bars sags and to withstand wet test of 3 kV and impulse withstand test of 28 kV.

18 INDICATING LAMPS FOR EACH PHASE

415 volt MCCB of Mitsubishi/Terasaki (Japan) or Legrand (France or equivalent)

40 to 100 Amps, 25 kA for incoming

6 Amp or 16 Amp SP MCB 9 kA for outgoing circuits.

Provisions for connecting the incoming cables and outgoing PVC insulated copper wires as mentioned in the drawing and BOQ and all accessories including connections, fixing, cable lugs, insulating materials etc all complete.

The panel board shall be Himalaya Bijuli Udhyog or Hyonjan Electrical Engineering Fabricator or equivalent and tested according to the BS or IS specifications.

19 SPECIFICATION OF MOLDED CASE CIRCUIT BREAKERS

This specification covers the supply of molded case circuit breakers. The circuit breaker shall be fabricated and tested in accordance with IEC947-2 latest revision or equivalent national standard and shall be suitable for connection to 400/230 volt,3-phase-4wire, solidly grounded system. Circuit breakers shall be rated as mentioned in the Bill of Quantities. Circuit breakers shall be completely enclosed in a molded case and shall be factory sealed. Circuit breaker shall have a quick make, quick break, over current switching mechanism that is mechanically trip-free for simultaneous tripping of all poles. Tripping due to overload or short circuit shall be clearly marked on the breaker case.

The circuit breaker shall be of inverse time and instantaneous trip type

20 SPECIFICATION OF MINIATURE CIRCUIT BREAKERS

This specification is for the supply of miniature circuit breakers(MCB) use in SDB for the protection of final circuit. Circuit-breakers shall be suitable for use on 400/230V A.C systems and shall be a minimum short circuit rating of 9kA.

21 CIRCUIT BREAKER - SINGLE POLE

Circuit breakers shall be manually operated with trip free operating mechanism, quick make, quick break dual tripping (thermal and magnetic) type with deionizing type arc chutes.

The circuit breakers shall conform to IEC 898-1987 or equivalent national standards. All poles of such circuit breakers shall be given on each circuit breaker to show whether it is in the closed, opened or tripped condition.

22 PVC INSULATED 1100 VOLT GRADE CABLE

This Specification covers the supply of 1100 Volt, PVC -insulated stranded copper power cable of different sizes. The electric cable shall be manufactured and tested in full compliance with British Standard BS 6346: latest revision, or equivalent Indian standard IS 694

The cable shall be stranded, multi-core, with sizes as specified in the Bill Of Quantities. Conductor insulation shall be extruded PVC compound and shall be rated 1100 Volt. All reel shall be legibly marked in paint with the following information:

a) Size of conductor

b) Color of insulation

c) Length in meters

d) Net weight of cable.

23 LAYING OF CABLES

The cable shall be so laid that they will not interfere with other structures. All water pipes , sewerage line or other facilities if exposed during the excavation in laying the cable shall be properly supported and protected until the back filling and compaction around the these facilities is completed. Sufficient clearances of electrical cable from other facilities line should be maintained as per BS or IS specification.

Where cables are laid directly in the ground cable trenches of sufficient width, it shall be excavated at least below 3 ft from the ground level. Cable shall be covered by fine sand at least 3" both above and below of the cable and protected on top by bricks across the trench cross section. Road crossing should be avoided where possible, if a cable has to be laid across the road / drain a suitable size of RCC hume pipe shall be used to protect the cable.

If two or more cables are laid in the same trench care should be taken in maintaining proper spacing between them as mentioned in BS/IEE regulations or IS specification so that current carrying capacities of the cables will not be affected

Care should be taken not to damage or unnecessary strain in cable .In case of installing the cable in PVC duct and HDP excessive bends should be avoided.

24 CONDUIT

Electrical conduit used in the final sub-circuits of the electrical services shall be rigid, non-metallic HDP conduit of an approved manufacturer conforming to IS: 2509 and shall be used only with corresponding approved accessories.

The size of the conduit shall be in accordance with the number and size of electrical cables to be drawn into the conduit. The number of cables that may be drawn in a conduit shall be as specified in the table below or as stipulated in the appropriate section of the IS code or equivalent. Conduit sizes shall not be less than 19 mm diameter.

Conduit shall be embedded in building structural works and conduit runs shall be straight and shall follow the shortest route between points or as shown in electrical drawings. Wherever necessary

bends or diversion may be achieved by bending the conduit or by employing approved bends, inspection boxes, elbows or similar fitting. Conduit accessories such as ceiling outlets, junction boxes shall be of approved quality. The physical integrity or the conduit and accessories as an integral electrical component shall be ensured by approved means such as the use of water-resistant cement bonding on all unscrewed conduit joints and termination and use of rubber gasket in entry points to junction boxes or outlets or other approved means.

Conduit embedded in civil works shall include an 18 SWG galvanized 'fish' wire inserted during the time of conduit laying to facilitate drawing in cables a later stage.

25 LIGHTS AND FAN POINTS

Concealed wiring to light and fan points shall be run inside the walls, ceiling and floors in a concealed $\frac{3}{4}$" diameter HDP pipe with 3/22 SWG PVC insulated, 600 V grade, single core, standard copper conductor cables conforming to the relevant British or Indian standards. The conduit pipe shall terminate in approved GI sheet metal junction boxes of appropriate size as shown on the drawings. 5A control switches shall be incorporated in the general lighting circuits as indicated in the drawings.

The lights and fan points includes the materials required for the connection of fixtures, ceiling fan and exhaust fan to the metal junction boxes and switches as shown on the drawings.

26 POWER POINTS

26.1 Concealed wiring to power socket outlets shall be by means of 2x7/22 SWG PVC +1x3/22 SWG or 2x7/20 SWG PVC +1x3/20 SWG PVC insulated 600 V grade, single core, standard copper conductor cables in a concealed rigid $\frac{3}{4}$" diameter HDP pipe in the floor, slab or brickwork and terminated in 18 SWG thick GI sheet metal boxes conforming to the relevant Indian or British standards to meet the approval of the Employer/ Engineer.

26.2 The power points include the materials required for the connection of socket outlets to the MCB's installed on the sub-distribution boards as shown on the drawings.

27 SUPPLY CONNECTION TO LIGHTS AND FAN POINTS

27.1 The supply connection means the conduit run from MCB's installed on the Sub Distribution Boards to the GI sheet metal junction boxes connecting lights and fan sub-circuits as shown on the drawings. Wiring of supply connection shall be done means of 2*3/20 SWG, PVC insulated 600 V grade single core standard copper conductor cables in a concealed $\frac{3}{4}$" diameter HDP pipe in floors, slab or brickwork as shown on the drawings and shall confirm to the relevant Indian or British standards.

27.2 The supply connection include the materials required for the connection of MCB's installed on the Sub Distribution Boards to the GI sheet metal junction boxes as shown on the drawings. It shall be measured and paid to the Contractor in run meters approved by the Employer/ Engineer.

28 METAL JUNCTION BOXES

28.1 The metal junction boxes shall be hot dipped 18 SWG thick galvanized iron sheet metal boxes. It shall be fixed in wall or beams as shown on the drawings or as instructed by the Employer/ Engineer.

28.2 The conductors shall be joined mechanically tight in the junction boxes and insulated with proper layers and thickness of approved electrical tape providing insulation not less than that of the conductor. The junction boxes shall be covered with GI sheet of appropriate size and fixed tightly.

29 SINGLE POLE SWITCHES

29.1 All switches shall be single pole one way or two way as required and of wall mounted 230 V, 5A suitable for recessed mounted and flush finish on wall with 18 SWG thick GI sheet metal box and shall be installed at any height up to 1.5 m above the finished floor level.

29.2 The type of switches shall be CPL/Anchor dyna type or equivalent as approved by the Employer/ Engineer.

30 POWER SOCKETS

30.1 All the power outlet shall be 230 V, 50 Hz 5/15A, 3 pin Switch socket SP Dyna type switch suitable for recessed mounting and flush finish on wall including 18 SWG thick GI sheet metal box and screws and shall be installed 20 cm above the finished floor level.

30.2 The type of power outlets shall be CPL/Anchor Dyna type or equivalent as approved by the Employer/ Engineer.

30.3 The power outlets shall be switched and earthed with 1*3/20 SWG or 1x3/22 SWG PVC insulated stranded copper wire.

31 WIRING OF TELEPHONE POINTS

Wiring to the telephone socket outlets shall be by means of 2 pairs (2 x 2 x 0.45 mm) telecommunication cable in a concealed rigid $\frac{3}{4}$" dia. HDP pipe in floor, slab or brickwork and terminated in appropriate size of GI sheet metal boxes conforming to the relevant Indian or British standards to meet the approval of the Employer/ Engineer.

32 TELEPHONE SOCKETS

The entire telephone sockets outlet shall be 230 V, 50Hz, 2 pin, suitable for recessed mounting and flush finish on wall with 18 SWG thick GI sheet metal box and screws and shall be installed 20 cm. above the finished floor level.

The type of telephone socket outlets shall be CPL/Anchor or equivalent as approved by the Employer/ Engineer.

Telephone sockets shall be 2 gang and one gang as mentioned in the bill of quantities.

33 TELEPHONE DISTRIBUTION BOARDS

The telephone distribution boards shall be two incomer's $\frac{3}{4}$" diameter HDP pipe and at least four outgoing $\frac{3}{4}$" diameter HDP pipe and metal connecting links having at least 10 pairs fixed in a base frame.

The fabrication of telephone distribution board shall be sheet steel enclosed, flush mounted dust vermin proof with hinged cover and built in locking device. It shall be adequate size to house all the fittings and shall be approved by Employer/ Engineer.

The telephone distribution board shall be installed on the readily accessible position 1.5m above the finished floor level as shown on the drawing or as instructed by the Employer/ Engineer.

The telephone distribution board shall include the connection of all telephone sockets to the main supply as instructed by the Employer/ Engineer.

100 Pair box shall be with three incoming 20 pair cable and five outgoing cable (4x20 pair cable +1x10 pair cable) total pair in DB shall be 60 pair. In case of 50 pair boxes there will be three incoming 2x 20 pair cable +1x10 pair cable and four outgoing cable (3x 20 pair+1x10 pair cable).total pair in DB shall be 40 pairs.

34 WALL MOUNTED FIXTURES

34.1 General type wall mounted fixtures shall be 250V, 50 Hz fixture shall be wall bracket type including brass holder and 100 W GLS bulb and shall be installed 2.3 m above the finished floor level. Before installation the Contractor has to approve the samples by the Employer/ Engineer.

34.2 Decorative type compact fluorescent lamp (CFL) fitted wall bracket shall be with 2 no of SL type 18 watt CFL lamps. It shall be SL Duo fancy FL 734 Phillips type or equivalent.

Decorative type CFL luminaries shall be made of CRCA sheet steel (powder coated) housing, finished in white inside and outside fitted with high purity anodized aluminum mirror reflector. G23 base and complete with control gear. Two 11 Watt S type CFL shall be fitted. It shall be BJMS211 Bajaj type or equivalent.

Ceiling mounted dome fixture shall be 250 V, 50 Hz, milky and frosted 200 mm diameter round dome fixture including metallic holder with ceramic insulator, base frame, and 60 W GLS bulb as specified in the price schedule and bill of the samples by the Employer/ Engineer.

35 FLUORESCENT TUBE LAMP FIXTURES

The type of fluorescent tube lamp fixtures shall be as specified in the price schedule and Bill of Quantity but if the Contractor has to supply equivalent quality in such a case it has to be approved by the Employer/ Engineer. Before installation the Contractor has to approve the samples by the Employer/ Engineer. The mentioned brand should be ISO 9001 or 9002 certified or equivalent.

Mirror optic recessed mounting type luminaries shall be fitted with two 36 W trulite type tube light. It shall comprise of white powder coated CRCA sheet steel housing complete with accessories and

high purity anodized finished in white inside and outside fitted with high purity anodized aluminum mirror reflector assembly with cross louvers, It shall be BJLM 236 Bajaj type or equivalent.

Decorative 4x18 W luminaires shall be comprising of white powder coated CRCA sheet steel housing complete with accessories such as copper wound polyster filled ballast, starters,4x18 W trulite tube light and other accessories. it shall be covered with spring loaded prismatic polystyrene louvre assembly. It shall be BJSL418 Bajaj or TBS 74/418 Phillips or equivalent.

Industrial type luminaires shall be comprising of 2x36 W tube light, copper wound polyster filled ballast, starters etc. it shall have a mounting channel and covers made from CRCA sheet steel, stove enameled. Vitreous enameled reflector which can be installed and removed without aid of any tools. It shall be TKC 24/236 Phillips type or equivalent.

Decorative 1x18 W wall mounted tube light luminaires shall consist of CRCA sheet steel stove enameled white inside & outside, copper wound polyester filled ballast, starters ,1x18 W tube light and other accessories. A guiding stud and two number of end caps shall be provided.

36 CEILING AND EXHAUST FANS

The type of ceiling fan shall be as specified in the price schedule and Bill of Quantity or equivalent quality to be approved by the Employer/ Engineer. Before installation the Contractor has to approve the samples by the Employer/ Engineer.

It includes installation, connection of ceiling fan and fixing of electronic solid fan regulator suitable for recessed mounting and flush finish on the wall with 18 SWG thick GI sheet metal box near the single way control switch and the exhaust fan with appropriate frame shall be installed as shown on the drawings or as instructed by the Employer/ Engineer.

Ceiling fans shall have the power balanced motor with double ball bearings. The blades shall be accurately balanced to ensure smooth service and their contours shall be designed for maximum air delivery air cutting noise. The blades shall be made from non-corrosive aluminum alloy and coils shall be from electrolytic copper with best insulating coating.

The exhaust fan shall be totally enclosed highly efficient heavy or light duty motor as mentioned in the Bill of Quantities with pressure die cast aluminum rotor mounted on two ball bearings. The blades shall be accurately balanced to ensure smooth service and their contours shall be designed for maximum air delivery at minimum power consumption. It shall be stove enameled glossy paint finish/epoxy paint with specially pretreated components to enhance corrosion resistance. It shall confirm to IS 2312 with latest amendment.

Low voltage (LV) 50 W halogen lamp luminaires shall be closed dichroic germiline type. It shall consists of front glass cover, dichroic coating reflector, specially designed GU bases, Axial coil. It shall be fitted with 12V 50 W halogen lamp, transformers and other accessories. It is DN 651 Philips type or equivalent.

Flood light luminaires shall be cast aluminum housing for corrosion resistance and is provided with a glass cover to ensure insect free performance without the ingress of water provision.

Lamp replacement should be from the front of the luminiares and shall consist of 1x300 W halogen lamp and all other accessories complete.

Garden light shall be of decorative post top lanterns consisting of aluminum canopy, opal acrylic bottom cover and cast spigot, suitable for use with 150W GLS lamps/HPMV 125 W/70 W HPSV lamp. It shall be fitted with 150 W GLS lamp and also inclusive of 75 mm dia galvanized pipe of 2.0 meter long and other accessories.

37 INTERCOM CABLES

The type of intercom cables shall be as specified in price schedule and bill of quantity but if the contractor has to supply equivalent quality in such a case it has to be approved by the Employer/ Engineer. Before installation the contractor has to approve the samples by the Employer/ Engineer.

Intercom cable shall connect PABX to telephone distribution boards(TDB) and TDB to telephone junction boxes. Main telephone cable shall be laid in PVC duct and HDP pipe as mention in the BOQ. PVC duct shall be of 4"x3"& 4"x4" size depending upon the number of the cable as shown in the drawing.

The intercom cables shall be connected to all telephone distribution boards from PABX system through a concealed rigid 1" dia. HDP pipe in wall, floors and ceiling as shown on the drawing or as instructed by the Employer/ Engineer.

Split type wall mounted room air conditioners shall be operated on 230 V, 50 Hz. The heating and cooling capacity shall be minimum 22000 BTU/hr and 27000 BTU/hr respectively. It shall be highly efficient and shall have at least following features:

– low vibration twin rotary compressor

– power select function

– power level monitor

- auto change over (cooling/heating)

- auto restart function

- 24 hr on off programmable timer

- 1 hr off timer

- Auto swing louver & auto air swing

- LCD wireless remote control

- Detachable & washable front panel & air filter.

38 EARTHING

38.1 EARTHING SET

The earthing shall be done as per IS 3043-1966.

The earthing set shall consist of the following:

a) 600x600x3.15 mm electrolytic copper plate as earth electrode;

b) The hard drawn copper earth strip of size 25x3.15 mm shall connect the earth electrode, main panel, and distribution boards as per drawing and instruction;

c) 1/4"dia,1"long electroplated copper nuts & bolts;

d) 1.5 meter long,19mm dia, GI pipe and other required accessories for watering;

e) Cement concrete work of ratio 1:4:8 for watering arrangement as per drawing;

f) Charcoal and salt;

g) 600x600x50 mm concrete slab cover

38.2 INSTALLTION METHOD

The earthing shall be done as follows:

a) Joints between wires and copper strip shall be done by solder less "pressure" connectors.

b) Underground joints shall not be permitted in any case.

c) In making earth connection advantage must be taken of the permanently moist soil available in the vicinity of the building.

d) Earth wire connections to any apparatus, or any termination shall be done by solder less crimping type cable lugs.

38.3 EARTH RESISTANCE

The earth resistance in no case shall exceed 5 Ohms. The earthing shall be improved by addition of extra earthing set to bring down the value of earth resistance in case measured value comes more than 5 Ohms by the Contractor in no extra cost.

The Contractor shall follow the standards listed below wherever applicable to this contract.

IS Specifications:

(b) Switch gear bus bars	IS 375-4963
enclosures for low Voltage switchgear	IS 2147-1962
(f)PVC cables	IS 1554-1964

(g) Tungsten filament lamps.	IS 418-1963
(h) Ceiling fans	IS 374-1966
(i) Steel boxes for enclosure of electrical	IS 5113-1969
(j) Switch socket outlets.	IS 4615-1968
(k) Three pin plug and sockets	IS 1293-1967
(l) Switches for domestic and similar purpose.	IS 3854-1966
(m) Copper conductors.	BS 6360
Codes of Practice:	
(a) Wiring	BS 3346
(b) Cables	BS 2004
(c) Earthing	IS 3043-1966
(d) Electrical wiring installation	IS 732-1963
(e) Switchgear installation	IS 3072-1965 Part I
(f) Light protection	IS 2309-1969
(g) Fixtures	IEC Lighting hand book (5th edition.)
(h) Emergency lights	BS 5266
(i) Luminaries	IEC 598

22.24 Payments

Payment for Civil Works

Payment for the civil works shall be made on the basis of actual quantity approved by Employer as shown on approved drawings. The method of measurement shall be of required accuracy and shall be approved by Employer.

Payments will be made in the following manner:

a) Payment for the items that can be measured shall be made on monthly progress basis according to the unit cost quoted in the Price Schedule.

b) Payment against unit price for foundation work shall be made upon completion of each foundation including setting, excavation, reinforced concrete works and backfilling complete.

Payment against unit price for foundation work for slope protection works (gabion, stone masonry etc.) shall be made upon completion of each foundation including setting, excavation, reinforcement concrete, plain cement concrete works and backfilling all complete.

c) Payment for the lump sum items, except the Buildings, shall be paid for the monthly progress of work in percentage after the work has been approved by Employer.

d) Payment for the Control Building, will be made on item wise unit basis.

f) Payment for additional works shall be made in accordance with the additional statement for monthly progress payment at the amount as agreed.

Chapter 18: Inspection, Testing and Commissioning

18.1 Scope of Work

The whole of the Works supplied under the Contract shall be subject to inspections and tests by the Employer and/or their Representatives during manufacture, erection and after completion. The inspections and tests shall include, but not be limited to, the requirements of this section of the Specifications.

The Contractor shall provide all appliances, apparatus, supervision, labor and services necessary to carry out all tests at his own cost, unless specifically stated otherwise.

The Contractor shall furnish the detailed schedule of his schedule for routine test before dispatch from factory and commissioning plan at least one month prior to the scheduled date. The schedule shall include the testing/commissioning procedures, testing sequences and details of special testing equipment, tests and commissioning record formats, information about relevant standards etc.

The scope of the commissioning program includes the site testing and putting into successful operation of all the equipment supplied under the Contract, for 132kV, AC & DC plants and all secondary voltages systems. Testing of energy meters and certification of their accuracy shall also be included.

18.2 Objectives of Commissioning Test

The objectives of commissioning work, prior to the successful energisation of equipment/system at full voltage and connection to the system, are the following:

- Confirm the integrity (correctness) of installation.
- Confirm the integrity of insulation, connections and phasing.
- Ensure proof of equipment characteristics.
- Review workmanship.
- Confirm the correct implementation of the design.
- Check equipment ratings.
- Check settings and operation of protective relays.
- Check and measure resistivity of grounding grid and grounding system.
- Confirm the proper functioning of SCADA system.

18.3 Quality Assurance, Inspection and Testing

To assure that the supply and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his subcontractor's premises or at the Site or at any other place of work, are in accordance with the Specifications, the Contractor shall adopt suitable quality assurance program to

control such activities at all points necessary. Such program shall be outlined by the Contractor and shall be finally accepted by the Employer after discussions before the award of the Contract. A quality assurance program of the Contractor shall generally cover, but not be limited to the following:

(a) His organization structure for the management and implementation of the proposed quality assurance program.

(b) Documentation control system.

(c) Qualification data for Contractor's key personnel.

(d) The procedure for purchases of materials, parts, components, and selection of sub-contractors services including vendor analysis, source inspection, incoming raw materials inspection, and verification of materials purchases.

(e) System for shop manufacturing including process controls and fabrication and assembly controls.

(f) Control of non-conforming items and system for corrective actions.

(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 products to the Employer.

(l) System for maintenance of records.

(m) System for handling storage and delivery.

(n) A quality plan detailing out the specific quality control procedure adopting for controlling the quality characteristics relevant to each item 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.

18.3.1 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 material/equipment.

The Employer, through his duly authorized representatives, reserves the right to carry out Quality Audit and Quality Surveillance of the systems and the procedures of the Contractor's and the subcontractor's Quality Management and Control Activities.

18.3.2 Inspection, Testing and Inspection Certificates

The provisions of the clauses on Test and Inspection of the General Conditions of Contract and Special Conditions of Contract shall be applicable to the supply and erection portions of the Works. The Employer shall have the right to re-inspect at his expenses, any material though it would have been previously inspected and approved by him at the Contractor's works before, and if, after the same are inspected at Site following the latter, material is found defective, then the Contractor shall bear the cost of this inspection and reinstatement according to specification.

18.4 Tests at Manufacturers Works

18.4.1 General

Where no specific test is specified, then the various items of materials and equipment shall be tested in accordance with the relevant Indian, British, IEC, or American Standards. Where no appropriate standard is available, tests shall be carried out in accordance with the maker's standard practice, which shall be subject to the Employer's approval.

At least fourteen days' prior notice, in writing or by telefax, shall be given to the Employer of the readiness of the plant for test or inspection and every facility shall be provided by the Contractor and sub-Contractor (s) to enable the Employer or their Representative to carry out the inspections and witness the tests. This includes progress, test rig and packing inspections also.

Inspection of equipment will not be carried out unless the Employer has approved copies of the relevant sub-orders, drawings and test procedures.

No equipment shall be packed, prepared for shipment, or dismantled for the purpose of packing for shipment, unless it has been satisfactorily inspected, or inspection has been waived by the Employer.

Functional electrical and mechanical tests shall be carried out on the completed plant after assembly in the Works. The extent and method of recording the results shall be agreed by the Employer in sufficient time to enable the tests to be satisfactorily witnessed or to make any changes to the proposed program of tests.

All instruments and apparatus used in the performance of the tests shall be subject to the approval of the Employer and, if required by the Employer, shall be calibrated to an agreed standard at a laboratory of national standing to be nominated by the Contractor and approved by the Employer.

The costs of carrying out such calibration shall be borne by the Contractor in all cases.

The costs of making any test shall be borne by the Contractor. This shall apply to tests performed at the site or elsewhere.

After receiving the prior information about the completion of manufacturing at the factory, the Employer will depute his personnel to the Contractor's factory to witness the fabrication, assembly and testing of any or all parts of major equipment. The number of the Employer's personnel and equipment to be witnessed will be as listed below. The duration of such visits shall be as per inspection/testing requirements.

S. No:	Equipments	Inspection Plan

1	132 kV SF6 circuit breakers	2 persons, 1 visit
2	132 kV and 33 kV Disconnecting Switch	2 persons, 1 visit
3	132 kV Instrument Transformers (CT and CVT)	2 persons, 1 visit
4	Control and Relay Panels	2 persons, 1 visit
5	Substation Automation System and SCADA	2 persons, 1 visit
6	Communication systems	2 persons, 1 visit
7	132 kV XLPE Cable	2 persons, 1 visit

Note:

1) ***The duration of final factory testing and inspection of power transformer shall be 10 (ten) days whereas duration of final factory testing & inspection of all other equipments shall be 7 (seven) days.***
2) ***Under unavoidable circumstances, if employer could not depute its representatives to witness factory inspection & testing, then contractor shall arrange independent third party with no added cost to Employer. For such test, contractor shall arrange for employer to witness the test virtually via online medium.***

18.4.2 Test Certificates

All principal test records, test certificates and performance curves shall be supplied to the Employer with three number of copies within 30 days of the completion of any test.

These test records, certificates and performance curves shall be supplied for all tests, whether or not they have been witnessed by the Employer or his representative. The information given on such test certificates and curves shall be sufficient to identify the material or equipment to which the certificate refers and should also bear the Contract reference title. Specified requirements shall be shown on each certificate for comparison with actual test results.

When all equipment has been tested, test certificates of all factory and site tests shall be compiled by the Contractor into volumes and bound in an approved form complete with index. Two copies of each volume shall be supplied to the Employer's representative and five copies to the Employer.

18.4.3 Type Tests

Type tests are required to prove the general design of the equipment and the Contractor may submit certificates of such design tests, which have been carried out on identical equipment. Notwithstanding any provision in BS, IEC or ANSI Standards, the Employer shall have the right to accept such certificates in lieu of the specified type tests or to reject them.

The type tests prescribed shall be carried out at the Contractor's cost in all cases, where either such certificates are not available or are rejected by the Employer.

18.5 Responsibilities

To ensure that the test jurisdiction and transfer of responsibilities is regulated by strict safety and handover procedures, the Contractor agrees the interface with the Employer to establish and implement handover procedures consistent with the terms of these Specifications.

The Employer shall retain full jurisdiction over all commissioning activities, which may affect the operation of the existing system. In these circumstances and when so requested, shall provide technical advices and assistances.

The Contractor shall be responsible for technical guidance and assistance in establishing the scope and method of tests, witnessing of the testing, assessment of results, and re-negotiation of the changes in test schedules which may be necessary as a result of other circumstances, such as delays in the delivery, possible equipment failures.

18.6 Safety Procedures

The Contractor shall share the responsibility for safety procedures with the Employer.

The Contractor shall establish and implement a work permit and tagging system and associated safety procedures (subject to the review of Employer) for all equipment, systems and areas not covered by the Employer's safety procedures.

The Employer will assume responsibility for the establishment and implementation of tagging, safety and work permit procedures for the protection of personnel and equipment, as soon as equipment and systems are connected to or are energizable from the existing system.

18.7 Training to Employer's Staff

The Contractor shall plan for the Employer's staffs' participation, either continuously or on a regularly recurring basis, in the commissioning work and:

Allow the Employer's staffs to become familiar with the operating and maintenance aspects of the new equipment supplied by him,

Maintain a continuing assessment with the Employer of the precautions required in or possible consequences of, initial energization of equipment,

Allow for the above two necessary objectives in the preparation of schedules.

The Contractor shall station at site, at least, one technical expert for a minimum of six months continuously after commissioning to rectify any problems, as well as train the Employer's attending staffs. If required, the length of his stay shall be extended as per requirement, which shall be at the Employer's discretion.

18.8 Commissioning Staffs

The Contractor shall provide commissioning personnel including skilled and unskilled labor as required. Submit a list with names, experience and proposed duration of the stay of key personnel on site, consistent with the construction schedule, along with the commissioning program.

Ensure that only staffs assigned to commissioning fulfills that duty for the duration of the assignment.

Ensure that commissioning staffs have authorization, and the competence, to undertake minor repairs or to make temporary redesigns and to reconnect systems to meet the specified system performance to preclude delays in energization and putting into commercial service of any part of the works.

18.9 Test Equipment

The Contractor shall ensure that all instruments, tools and other equipment required for testing and commissioning are available on site, ensure that the test equipment is of satisfactory quality and condition and, where necessary, is calibrated by an approved authority or standard.

Make arrangements for the provision of power supplies for testing with necessary vector configuration, voltage and current rating.

18.10 Commissioning Program

Prepare a commissioning program for approval by the Employer and for incorporation into the Project master construction program. Allocate adequate time in this program to permit full commissioning of all components.

Carry out all testing during normal working hours as far as practicable. Tests, which involve existing apparatus and system outages, may be carried out outside normal working hours. Give the Employer sufficient notice to allow for the necessary outage arrangements to be made in conformity with the testing program.

Note that no tests listed in the agreed program will be waived except upon the instructions or consent of the Employer in writing.

18.11 Test Procedures

The following basic tests, in addition to others, shall be carried out:

- Measurement of insulation resistance.
- AC withstand voltage test

18.12 Requirements for Field Tests

The field tests shall be carried out in presence of Employer under the following conditions:

AC withstand test voltages for conductors and outdoor equipment shall be normal operation voltage of the transmission line and, withstand voltage test shall be carried out for ten (10) minutes by the normal voltage mentioned above.

The fields tests shall be carried out by the Contractor after adjustment of all the equipment have been completed.

Expandable and lead wires and other materials required for the field tests shall be arranged by the Contractor. The Contractor shall be responsible for providing all measuring instruments, test equipment and tools required for the tests.

Preparation of the test record sheets and test reports shall be the responsibility of the Contractor and the results of the field tests shall be submitted by the Contractor for Employer's approval.

Measurement of insulation resistance of the equipment of voltage less than 11 kV shall be performed at 1,000 V. Measurement of insulation resistance of the equipment of voltage ≥11 kV, 5,000 V, motor driven insulation tester shall be used.

After completion of the measurement of insulation resistance mentioned above, ac withstand voltage test shall be performed by the normal operation voltage of the existing power system in accordance with the following procedure:

- 132 kV Main Circuit: The 132 kV circuit breakers and disconnecting switches, except for circuit breakers receiving power for the test from the existing power system through a transmission line, shall be closed, succeeding, normal operation voltage shall be charged on the equipment and bus conductors for ten (10) minutes for ac withstand voltage test. The indication value of meters mounted on the board during the ac withstand voltage test shall be recorded on the test record sheets prepared by the Contractor.

The Contractor shall submit test procedures, consisting of detailed test methods and samples of the related test record forms, for all equipment to be tested, to the Employer for approval along with the commissioning program. The Contractor shall also strictly adhere to these procedures for the commissioning tests.

18.13 Records

Maintain an up-to-date record of all commissioning activities on site.

Record the results of the tests clearly on forms and formats approved by the Employer and with clear references to the equipment and items tested, so that the record can be used as the basis for maintenance tests, in future. Submit the required number of site test records to the Employer as soon as possible after completion of the tests.

Record the details of the test equipment and instruments used in the test sheets, in those cases where the instrument or equipment characteristics can have a bearing on the test results.

18.14 As Built Drawings

Keep an ongoing record of all changes on a master set of drawings. Produce and supply a minimum of five complete sets of marked-up "As Constructed/As-Built" drawings before leaving the Site. Correct and re-issue the original drawings as soon as possible as per this specification.

18.15 Test Methods

Carry out all necessary tests for commissioning the substations. The following clauses detail the tests which are considered to represent the minimum required in addition to those specified under the appropriate IEC Publications, other approved standards and the manufacturer's instructions for each item of equipment.

Strictly adhere to the methods of testing approved by the Employer.

18.16 Site and Commissioning Tests for Main and Auxiliary Equipment

General Checks

- Make a general check of all main and auxiliary equipment. Include a check of the completeness, correctness and condition of ground connections, labeling, arcing ring, paint surfaces, cables, wiring, pipe-work, valves, blanking plates and all other auxiliary and ancillary items.
- Check for oil and gas leaks and that insulators are clean and free from external damage. Check that loose items, which are to be handed over to the Employer, e.g., blanking plates, tools, spares, etc. are in order and are correctly stored or handed over.

18.16.1 Power Transformers

Make all tests as per commissioning tests called for in the Manufacturers' instructions manual.

Record and submit to Employer in a hardcover binder, all test data obtained.

18.16.2 Circuit Breaker Tests

- For the SF6 circuit breakers, test the gas system to prove the gas density, its dryness and its di-electric strength. Measure the gas leakage rate.
- Check and set pressure switches settings when required. Also test mechanical operating systems.
- Carry out contact resistance tests. In the case of multi-interrupter circuit breakers, perform resistance tests at each interrupter or pair of interrupters as well as through the series of interrupters on each pole.
- Test local and remote trip/close operation and perform circuit breaker and auxiliary contact timing tests on all circuit breakers.

18.16.3 Control/ Relay Panels, energy meters and Switchboards

- Carry out general testing and inspection, as referred to above. The Contractor shall also carry following tests: a) Carrier signal testing b) protective relay testing c) Instrument transformers testing c) Phase correcting testing. Functionally test and perform the timing tests on circuit breakers and AC and DC circuits, associated with stand-by auxiliary supplies and stand-by generating sets, particularly where automatic operation is defined.
- Carry out insulation measurement tests of secondary circuits with a 1000 V DC megger before and after high voltage testing.
- Check shutters, interlocking, earth procedures and the inter-changeability of components.

- Carry out a high voltage 50 Hz dielectric test on each bus at 75% of the specified value for the equivalent factory test.

18.16.4 Disconnecting Switches and Earth Switches

- Test all disconnecting switch and earth switches operationally to confirm contact pressures, contact resistance, simultaneous-operation of all phases and the ease of operation.
- Check the local and remote indications and the operation of auxiliary contacts. Check the earthing mat at the operating positions and check the availability of connecting points for maintenance earthing arrangements.
- Test the earth switches and maintenance earthing devices to confirm the opening and closing sequences and check the ground mat connections, indications and manual locking devices.

18.16.5 Lightning Arresters

- Inspect and verify the condition and satisfactory mounting of the arresters and their earth connections, electrodes and operation counters. Note the counter readings.

18.16.6 Busbar and Connections

- Test flexible busbars and connections to ensure that the correct tensions, sags and clearances will be maintained over the range of environmental conditions and loads without stress to other equipment. If dynamometers are used to check the sags and tensions, check them before and after use.
- Check rigid busbars and connections to ensure that the busbars will not cause overloading of the supporting insulators under load conditions and under the range of climatic variations applicable to the Site. Ensure that expansion and contraction of the equipment is fully accommodated by flexible connections.

Test conductivity on selected connections and joints.

- Perform high voltage DC tests on all HV cables and isolated phase bus bars at 75% of the specified value for the equivalent factory test. Carry out with at least 1000 V DC megger the insulation measurement test, before and after high voltage tests.

18.16.7 Batteries and Battery Charging Equipment

- Test the insulation to earth of the complete DC system.
- Test the batteries and chargers to confirm the charger ratings, adjustment, alarm systems and battery capacity for the specified length of time at maximum expected loading.
- Record the specific gravity and cell voltages of the batteries during the initial charge and when fully charged and maintain proper regular records until the battery is taken over by the Employer.
- Interlocking
- Check all interlocking arrangements, both electrical and mechanical.

18.16.8 Grounding System

- Carry out the tests and measurements in accordance with IEEE Standard 80.
- Test the effectiveness of the bonding and grounding and make conductivity tests on selected joints on the main grounding system and at the connections to equipment and structures. Check the precautions taken to avoid corrosion attack on the grounding system.
- Measure the resistance of the grounding system to the remote earth indicating method and equipment used. Separate test probes of minimum 300 to 600 meters length to effectively test the grounding system.
- Perform grounding resistance measurements with the transmission line earth wires disconnected from the grounding grid.

18.16.9 Area Lightning

- Check all lighting circuits including the operation of relevant photoelectric cells and remote/local commands.
- Measure the lighting levels throughout the substation on horizontal surface 800 mm above ground level and on all vertical surfaces of transformers, marshaling kiosks, etc.
- Measure the lighting levels in the area surrounding the substation up to 20 m from the fence.

18.16.10 Particular Constraints and Special Tests

- The Contractor shall be prepared to cooperate with any special tests requested by the Employer.

Chapter 19: Testing and Maintenance Equipment

Scope

The scope of work comprises of supply, testing, training and commissioning of testing equipments including all the necessary accessories for complete commissioning of Dhungesaghu 132 kV Line Bay Expansion wir at the Substation.

19.1 Technical Requirement

The technical requirement of insulation tester shall have following features:

1. Voltage selection – 40V to 1KV in 10V steps, 1KV to 5KV ,5kV to 15kV in 25 V steps, With Enable Voltage Lock Option
2. Kit should have Mains (without battery) operation & rechargeable battery operation For Mains 250V, 50Hz AC supply and 6 hrs of battery operation in case of operated through battery.
3. The instrument should perform automatic tests and measure Insulation Resistance, current, capacitance, Polarization Index, Step voltage tests, DAR & Dielectric Discharge, Ramp Test, Burn test
4. Rated analogue display resistance 100 KΩ to 10 TΩ.
5. Rated Digital Display Resistance 10 KΩ to 35 TΩ.
6. Instrument should display direct reading of voltage across the test piece when the test is in progress.
7. Instrument should display leakage measurement.
8. Short Circuit - 6 mA @ 10KV
9. Instrument should have Breakdown or 'Burn' mode
10. Instrument should have 8mA Interference Rejection, plus instrument should have additional filter of 10, 30 and 100, 200 seconds time constant selectable.
11. Kit should be capable of guard out parallel leakage resistance with a max error of 2%. Same should be demonstrated in filed with the help of demo box of resistance.
12. Kit should have facility to do complete testing from remote using USB through Laptop.
13. Kit should have facility for live data streaming through Bluetooth.
14. Kit should be supplied through 15meter screened cables for better repeatability.
15. Insulation Resistance Measurement should be in Digital and Analogue with backlit display.
16. The kit should have capability for sharp voltage rise even in case of low resistance value say 1Mohm kit should able to inject 5kV@1Mohm if desire voltage range is 5kV.
17. Instrument should have capability for 11 hours logging @5 sec interval as a internal memory with date/time stamp

18. The equipment should have 1000V protection between all test terminal up to 3000m altitude, should have dedicated voltage measurement range to 600V.
19. The Equipment should be portable & weight of equipment should be in the range of 4.5kg
20. Manufacturer should have registered office and service centre in India and documentary evidence should be submitted for same.

19.1.1 Measurement Range

Digital
Digital display 10 KΩ to 35 TΩ.

Analogue display 100KΩ to 10TΩ.

Current Measurement
0.01 nA to 6 mA

Capacitance Measurement
10nF to 50 µF

Test time should be selectable from
1 second to 99 minutes 59 Seconds

Voltage Measurement range:
30 to 660VDc or AC

0 to 10000V DC when testing

Mains Input voltage : 90-264 V, 50Hz.

Operating Temperature: -20ºC to 55ºC

Storage Temperature: -25ºC to 65ºC

Safety Should Conform to IEC 1010-1 (1995)

Environmental Protection Instrument should be rated to IP65 Instrument should have compliance to following Safety standards IEC1010-1 (1995), EN61010 (1995) to installation category IV, 600 V,

19.2 Digital Multimeter

19.2.1 Technical Requirement

a) The Multimeter shall have TRMS voltage and current measurement

b) The display shall have digital and analogue arc

c) The Multimeter shall have 10000 Counts and 41/2 digits resolution

d) The Multimeter shall have Minimum, maximum, average, hold and auto hold functions

e) The meter shall have Voltage range up to 1000 V AC, DC and AC+DC

f) The meter shall have AC/DC Current range from 0.1mA to 10A

g) The meter shall have the resistance range from 0.01 ohm up to 50 Mega ohms

h) The meter shall have the conductance range up to 60nS

i) The meter shall have the capacitance range up to 20mF

j) The meter shall have the frequency range up to 100KHz

k) The multimeter shall have Phase sequence measurement for 3 phase circuit and motor testing

l) The multimeter shall have 10 MΩ and 10 kΩ input impedance switching

m) The multimeter shall have Non-contact live circuit detection with Hi/Low sensitivity

n) The multimeter shall have 800 Hz Low pass filter

o) The multimeter shall operate in temperature from -10 °C / 50 °C

p) The multimeter shall store in temperature from -30 °C / 70 °C

q) The multimeter shall operate up to a altitude of 2000m

r) The multimeter shall operate on two AA Alkaline batteries

s) The multimeter shall weigh less than 500gms

t) The multimeter shall have a standard warranty of 1year and extendable up to 3years

u) The meter shall have combined CAT III 1000 V and CAT IV 600V protection as per IEC61010-1 for use on high energy, low voltage electrical applications

v) The multimeter shall have protection of IP54

w) Thermocouple Type K shall be supplied

x) The multimeter shall be supplied with Red/Black silicone test leads with probes, 2 AA alkaline batteries

19.2.2 Measurement

The digital multimeter supplied shall have the following measurement range with specified accuracy given below:

a) Voltage DC

Maximum range: 1000 V
Maximum resolution: 0.1 mV
Accuracy: ± 0.1% + 2 dig

b) Voltage AC

Maximum range: 1000 V
Maximum resolution: 0.1 mV
Accuracy: ± 1.0% + 3 dig

c) Current DC

Maximum range: 10 A
Maximum resolution: 0.01 mA
Accuracy: ± 1.0% + 3 dig

d) Current AC

Maximum range:10 A
Maximum resolution: 0.01 mA
Accuracy: ± 1.5% +10 dig

e) Resistance

Maximum range: 50 MΩ
Maximum resolution: 0.01 Ω
Accuracy± 1.0% + 2 dig

f) Conductance

Maximum range: 60 nS
Maximum resolution: 0.01 nS
Accuracy: ± 1.5% + 10 dig

g) Capacitance

Maximum range: 20 mF
Maximum resolution: 1 nF
Accuracy: ± 2% + 2 dig

h) Diode

Maximum range: 2.8 V
Maximum resolution: 0.001 V
Accuracy: ± 1.0% + 2 dig

i) **Temperature Range**: -20 °C / 300 °C (-4 ºF / 572 ºF)
Maximum resolution: 0.1 °C/ºF
Accuracy: ± 1.0°C + 20 dig

j) Phase rotation
Operating voltage: 90 Vac to 440 Vac, Operating frequency: 50 Hz / 60 Hz nominal

k) Frequency measurement:

Range/resolution
100.00 Hz / 0.01 Hz
1.0000 kHz / 0.0001 kHz

10.000 kHz / 0.001 kHz
100.00 kHz / 0.01 kHz
Accuracy: ±0.1% +2

19.3 Portable Digital Micro-Ohm Meter/ Contact Resistance Meter

19.3.1 Technical Requirement

The microprocessor-based kit shall be suitable for measuring low resistance of circuit breaker, switch, dis-connectors, isolators, welding joints etc. The equipment should be microprocessor based with LCD Display.

The Kit shall be suitable for use in high voltage sub-stations. The equipment should have compatible to PC and features for measurement, storage and reporting. The equipment should have in built software to enable individual test or an entire series of test and store the results.
All function must be carried even if both side of circuit breaker; isolator etc is grounded for safe working condition of human being.

The resistance reading should be digital and displayed directly without any need for any balancing or calculations. The test set should indicate output Current of the present value and this should be achieved without any need for manual control.

The current output of the test set should be true ripple free DC.

19.3.2 Measurement

Test Current: 10- 600A DC with Resolution of 1A or better. 600 Amps should be injected for minimum 2 minute and 100 Amp for more than 15 minutes/continuously.

Resistance:

a) Range : 0.1µ Ω to 1.0 Ω;

b) Accuracy: 1% of reading ± 1digit of FS

c) Resolution: 0.1µ Ω to 0.1 m Ω (Lower range to Higher Range)

The supplier should mention clearly about the battery if any which is inside the equipment and necessary for the operation or for testing. The battery should be maintenance free type. Supplier should mention the type & make, size, rating of battery.

General Requirement:
Environment:
Application field or use in high-voltage substations and industrial environments.

Temperature
Operation -20 to +50°C (-4°F to +122°F)
Storage -40oC to +70oC (-40°F to +158°F)
Relative humidity %RH 5%-95%, non-condensing
Applicable Standards.
LVD EN 61010-1:2001

EMC EN 61326:1997

General

Mains voltage 100 - 240 V AC, 50 / 60 Hz
Power consumption (max) 13 A at 100 V, 6 A at 230 V
Protection Thermal fuses, Software

Chapter 20

Technical Data Sheets (Guaranteed Technical Particular)

(Bidder's Name)

S. No:	Description of Equipments under present scope
2.	Isolator/ Earth Switches
3.	Circuit Breakers
4.	Lightning Arresters (Surge Arresters)
5.	Current Transformers
6.	Voltage Transformer
7.	Battery and Battery Chargers
8.	Grounding System
9.	1.1 kV grade power and control cable
10.	LT Switchgear
11.	Air Conditioning System
12.	Station Auxiliary Supply (Station Transformer)
14.	Control and Relay Panel
15.	Substation Automation System
16.	Communication Equipments
17.	Insulator, Hardware and Accessories
18.	Bay Control Unit
20.	Civil Works

TECHNICAL SCHEDULE FOR DHUNGESANGU 132 kV SUBSTATION

1.0 Guaranteed Technical Particular of Disconnecting Switch (Isolator)

1.1 Guaranteed Technical Particular of 132 kV Disconnecting Switch (Isolator) with & without Grounding (Earth Switch)

DESCRIPTION	UNIT	REQUIREMENT	OFFERED DATA
1. Manufacturer and Country of origin			
2. Years of manufacturing experience	Years	*Minimum 10*	
3. Manufacturer's designation as per submitted catalogue / Model no.		To be furnished	
4. Applicable standard		IEC	
5. Type		3-Pole; Center break	
6. Local and remote both operations		Required	
7. Frequency	Hz	50	
8. Rated maximum voltage	kV	*145*	
9. Rated current			
a) Normal current	A	*1250/2000*	
b) Short time for 1 sec	kA	*40*	
10. Insulation level			
a) Impulse withstand voltage	kV crest	650	
b) Power frequency withstand voltage (1 min, rms)	kV	275	
11. Maximum current the switch can safely interrupt			
a. Bus/line charging current	A	0.5 min	
b. Potential transformer magnetizing current	A	0.5 min	
12. Clearance			
a. Between live parts and ground	Mm		
b. Between fixed contact and blade in open position	Mm		
13. Main contacts			
- Material of contacts		copper alloy	
- Coating of contacts		Silver plated	
- Material of the contacts of the earthing switch		copper alloy	
- Coating of the contacts of the earthing switch		Silver plated	
14. Material of terminals			
15. Coating of terminals			
16. Operating mechanism		*Electrical & Manual*	

17. Local operating device provided	Yes/No	Yes	
18. Auxiliary contacts			
a) Type (convertible or fixed)		Convertible	
b) Continuous current rating at 110V DC	A		
c) Material		Copper	
d) Contacts silver-plated?	Yes/No	Yes	
19. No of operations switch can withstand without deterioration of contacts	Nos.		
20. Type of interlocks furnished:		Electrical & Mechanical	
21. Are the disconnectors and the earthing switches mechanically interlocked to each other	Yes/No	Yes	
22. Weight of disconnecting switch	Kg		
23. Auxiliary power supply			
a) DS operating motor supply voltage	V/ Phase	230/400V / 3Ph	
b) DS operating motor power	WT		
c) Space heater and cubicle	V/ Phase	230V / 1Ph	
d) Control circuit	V	110V, DC	
24. Insulator			
a) Manufacturer			
b) Creepage distance in air	Mm		
25. Number of NC. Contacts (minimum)	No.	8	
26. Number of NO. contacts (minimum)	No.	8	
27. Enclosure protection		IP-55W	
28. Thickness of sheet (minimum)	Mm	2	
29. Earthing switch			
a) Operating mechanism		Manual	
b) Type of interlocks furnished		Electrical & Mechanical	
30. Number of NC. Contacts (minimum)	No.	4	
31. Number of NO. contacts (minimum)	No.	4	
32. Weight of earthing switch	Kg		
32. Delivery of equipment in months following award of contract. (Allowing time for approval of drawing.)	Month		

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

2.0 Guaranteed Technical Particular of Outdoor Circuit Breaker

2.1 Guaranteed Technical Particular of 132 kV SF6 Circuit Breaker

DESCRIPTION	UNIT	REQUIREMENT	OFFERED DATA
1. Manufacturer and Country of Origin			
2. Years of manufacturing experience	Years	*Minimum 10*	
3. Manufacturer's designation as per submitted catalogue/ Model No.		To be furnished	
4. Applicable standard		IEC	
5. Type / Class		SF6 / outdoor	
6. Poles	No.	3	
7. Local and remote operations		Both Required	
8. Rated maximum voltage	kV	145	
9. Rated current	A		
a) Normal current	A	1250/2000	
b) Short time for 1 sec	kA	*40*	
10. Frequency	Hz	50	
11. Insulation level			
a) Impulse withstand voltage	kV	650 (crest)	
a) Power frequency withstand voltage (1 min, rms)	kV	275	
12. Rated short circuit breaking current	kA	40	
13.Rated short circuit making current	kAp	102	
14.Interrupting time at 100% capacity			
a) Max. opening time	Ms		
b) Total interrupting time	Ms	60	
15. Closing time	Ms		
16. Make Time	Ms	120	
17. Rated a. Line-charging breaking current	A		
18. First pole to clear factor		1.3	
19. Operating mechanism			
a) Type		Spring operated	
b) Number of mechanisms per breaker set		1 for Line CB 3 for BC & Transformer CB	
c) single/three phase auto reclosure		*Single for 132 kV line*	
d) enclosure protection		IP55W	
e) Nominal Operating voltage of Closing/ Tripping coil	V, DC	110	
f) Operating voltage range - Closing	% of rated	85-110%	

- Tripping	Voltage	70-110%	
g) Spring charging Motor rating			
- Capacity	kW		
- Rated voltage	V	110 V, DC	
h) Time required by motor to charge the spring completely	Sec	30	
21. Push button for local operation	Yes/No	Yes	
22. Selection switch for local/ remote control	Yes/No	Yes	
23. Anti-pumping device provided	Yes/No	Yes	
24. Trip-free feature provided	Yes/No	Yes	
25. Gas density detector provided	Yes/No	Yes	
26. Operation counter provided	Yes/No	Yes	
27. Space heater provided for cubicle	Yes/No	Yes	
28. Operating duty cycle		O-0.3 sec-CO-3 min-CO	
29.Thickness of sheet steel of cubicle	Mm	min 2	
30. Number of Auxiliary Contacts	No.	8NO, 8 NC	
31. Number of possible operations without maintenance: for contacts - Rated short circuit breaking current - Rated normal current - for mechanism	 No. No. No.	 Not less than 10 Not less than 2,000 Not less than 2,000	
32. Rated SF6 gas pressure	kgf/cm^2		
33. Guaranteed SF6 gas loss per annum	% / annum	<0.1	
34. Porcelain insulator			
a) Manufacturer			
b) Creepage distance	Mm		
35. Padlocking provision for local cubicle	Yes/No	Yes	
36. Gas pressure gauge provided	Yes/No	Yes	
37. Total weight of circuit breaker	Kg		

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

3.0 Guaranteed Technical Particular of Lightning Arrester (Surge Arrester)

3.1 Technical Particular of 120 kV Lightning Arrester (Surge Arrester)

DESCRIPTION	UNIT	REQUIREMENT	OFFERED DATA
1. Manufacturer and Country of origin			
2. Years of manufacturing service	Years	*Minimum 10*	
3. Manufacturer's designation as per submitted catalogue / Model No.		To be furnished	
4. Applicable standard		IEC	
5. Type		Gap less metal – oxide / Outdoor	
6. Rated voltage rating of L.A.	kV	120	
7. Impulse withstand voltage, (crest)	kV	650	
8. Power frequency withstand voltage	kV	275	
9. Rated frequency	Hz	50	
10. Nominal discharge current	kA	10	
11. Surge counter with insulating base furnished?	Yes/No	Yes	
12. Leakage current measuring instrument furnished?	Yes/No	Yes	
13. Porcelain creepage distance	mm		
14. Line terminal with accessories provided	Yes/No	Yes	
15. Earth terminal with accessories provided	Yes/No	Yes	
16. Has manufacturer exported such units?	Yes/No	Yes	

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

4.0 Guaranteed Technical Particular of Current Transformer

4.1 Technical Particular of 132 kV Current Transformer

DESCRIPTION	UNIT	REQUIREMENT	OFFERED DATA
1. Manufacturer and Country of Origin			
2. Years of manufacturing experience	Years	*Minimum 10*	
3. Manufacturer's designation as per submitted catalogue / Model No.		To be furnished	
4. Applicable standard		IEC	
5. Type		*outdoor* *oil immersed*	
6. Number of phases	No.	single	
7. Number of cores in each CT	No.	*5*	
8. Frequency	Hz	50	
9. Rated Primary Voltage	kV	132	
10. Insulation level			
a) Impulse withstand voltage	kV (crest)	650	
b) Power frequency withstand voltage (1 min. rms)	kV	275	
11. Rated peak withstand current	kA		
12. Creepage distance	Mm		
13. Short time thermal rating (1 Sec)	kA	40	
14. Ratings			
15. Current ratio	A	*1200-600-300*/1 A for line	
16. Rated VA burden for each core	VA	30	
17. Accuracy class		*PS* for protection & 0.2 for metering	
18. Dimension (L x W x H)	Mm		
19. Weight	Kg		
20. Delivery of equipment in months following award of contract (Allowing time for approval of drawings.)	month		

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

5.0 Guaranteed Technical Particular of Voltage Transformer

5.1 Technical Particular of 132 kV Capacitive Voltage Transformer

DESCRIPTION	UNIT	REQUIREMET	OFFERED DATA
1. Manufacturer and Country of origin			
2. Years of manufacturing experience	Years	*Minimum 10*	
3. Manufacturer's designation as per submitted catalogue /Model No.			
4. Applicable standard		IEC	
5. Type		Outdoor oil immersed	
6. Frequency	Hz	50	
7. Rated primary voltage			
a) Nominal	kV	132/√3	
b) Maximum voltage	kV	145/√3	
8. Insulation level			
a) Impulse withstand voltage (primary)	kV	650	
b) Power frequency withstand (1 min. rms) (primary)	kV	275	
9. Creepage distance	mm		
10. High voltage capacitor			
a) Number of capacitor			
b) Capacitance of each stack	pF		
c) Manufacturing tolerance	(+/-%)		
d) Total value of the high voltage capacitor	pF		
11. Intermediate voltage capacitor			
a. Number of stacks			
b. Capacitance of each stack	pF		
c. Manufacturing tolerance	+/-%)		
d. Total value of intermediate voltage capacitor	pF		
e. Equivalent capacitance for carrier coupling	pF		
f. Capacitance of CCVT	pF		
12. Value of the equivalent capacitance	pF		
13. Open circuit intermediate voltage	V		
14. Rating			
a) Voltage ratio	kV	132/√3: 0.11/√3	
b) Rated burden	VA	50	
c) Accuracy class		3P & 0.2 for metering	

d) Overvoltage factor			
- Continuous		1.1	
- 30 seconds		1.5	
e) Connection			
f) Secondary fuse			
- Type			
- Manufacturer			
- Amp rating	A		
g) Power factor		0.85	
h) Number of secondary windings		*3*	
15. Knife switch and fuse on secondary provided	Yes/No		
16. Dimension (LxWxH)	mm		
17. Weight	kg		
18. Delivery of equipment in months following award of contract (allowing time for approval of drawing)	month		

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

6.0 Guaranteed Technical Particular of Battery and Battery Charger

6.1 Technical Particular of 110V and 48V Battery

DESCRIPTION	UNIT	REQD.110 V	OFFERED DATA 110 V
1. Manufacturer and Country of Origin			
2. Manufacturing experience	years	*Minimum 10*	
3. Type of battery		Maintenance free valve regulated lead Acid	
4. Applicable standards		IEC	
5. Number of cells	No.		
6. Number of units	No.		
7. Number of cells in a unit	No.		
8. Nominal voltage rating	V	110	
9. Nominal capacity at 27^0C at 10 h discharge time to cell end voltage 1.85	AH	600 Ah	
10. Ampere capacity at 27^0C at 15 min discharge time to cell end voltage 1.75	A		
11. Battery construction (type)			
12. Type of plates			
a) Positive (flat or tubular)			
b) Negative			
13. Type of rack - Rack dimensions			
14. Float charging voltage	V		
15. Equalizing charging voltage	V		
16. Internal resistance of one cell	ohm		
17. Short circuit current withstand capacity	A		
18. Float charging current	A		
19. Charging current of a fully discharged battery at 8-hour charging rate	A		
20. End voltage of each cell	V		
21. Charging efficiency of the battery	%		
22. Max. duration in month, the battery can be kept without charging	month		
23. Battery life (guaranteed value)	years		
24. Delivery of equipment in months following award of contract (allowing time for approval of drawings)	month		

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

6.2 Technical Particular of 110V and 48V Battery Charger

DESCRIPTION	UNIT	REQD.110 V	OFFERED DATA 110 V
1. Manufacturer and Country of Origin			
2. Manufacturing experience	years	*Minimum 10*	
3. Type of charger		constant voltage	
4. Applicable standard		IEC	
5. Manufacturer's designation as per submitted catalogue		To be Furnished	
6. Output rating	A	80	
7. Range of DC voltage variation	±V		
8. Maximum AC input	kVA		
9. Input Voltage / phase	V	400 V, 3 ph	
10. Ripple	%	< 2%	
11. Efficiency of charger at 100 % output	%		
12. Temperature rise above ambient of 40 degree C			
a) Solid state elements	^{0}C		
b) Wound elements	^{0}C		
13.Voltage regulation	%	+3% -2% max	
14. Float voltage adjustment			
15. Equalizing voltage adjustment			
16. Auto equalizing charge provided?	Yes/No	Yes	
17. Timer for equalizing charge provided?	Yes /No	Yes	
18. End switching to limit equipment	type		
19. Manual over-ride switch for selection of float/equalizing charge provided?	Yes /No	Yes	
20. Delivery of equipment in months following award of contract (allowing time for approval of drawings)	month		

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

7.0 Guaranteed Technical Particular of Station Grounding System

DESCRIPTION	Size	Material	OFFERED DATA
Main ground grid conductor material		Copper	
Main Earthing Conductor to be buried in ground	25×4 mm Or 120 sq.mm	Copper flat Stranded copper	
Conductor above ground& earthing leads (for equipment)	120 sq.mm	Stranded copper	
Conductor above ground& earthing leads(for columns & aux. structures)	≥ 120 sq.mm	Copper conductor	
Earthing of indoor LT panels, Control panels and outdoor marshalling boxes, MOM boxes, Junction boxes& Lighting Panels etc.	≥ 120 sq.mm	Copper conductor	
Rod Earth Electrode	16 mm dia, 3000mm long	Copper Clad Steel	
. Pipe Earth Electrode (in treated earth pit) as per IS.	16 mm dia, 3000mm long	Copper Clad Steel	
Earthing for motors	16 mm dia, 3000mm long	Copper Clad Steel	
Earthing conductor along outdoor cable trenches	16 mm dia, 3000mm long	Copper Clad Steel	
Earthing of Lighting Poles	16 mm dia, 3000 mm long	Copper Clad Steel	
Earthing system designed for	≤ 1 ohm		

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

8.0 Guaranteed Technical Particular of 1.1 kV grade power and control cable

8.1 Technical Particular for Fiber Optic Cable

S.N.	DESCRIPTION	UNIT	OPGW
1	Galvanized steel wires/Aluminium Clad Steel wire		
1.1	No. of and Diameter	Nos/mm	
1.2	Lay Outer layer	Mm	
1.3	Steel Quality (Grade)		
1.4	Normal Cross-Sectional area	mm2	
1.5	Weight	Kg/m	
2	Overall diameter	mm	
3	Ultimate tensile strength	Kg	
4	Tension in steel air at every day temperature	kg	
5	Equivalent modulus of elasticity	kg/m2	
6	Maximum Working tension	kg	
7	Coefficient of linear expansion	/°C	
8	Standard length on each drum	km	
9	Maximum weight of Cable drum	kg	
10	Optical Ground Wire		
10.1	Optical fiber type	mode	
10.2	No. of optical fiber	nos	
10.3	Lay of outmost layer		
10.4	Cross sectional area	mm2	
10.5	Fiber Diameter a. Mode field diameter	µm	
	b. Cladding diameter		
10.6	Standard		

	a. Single mode fiber		
	b. Optical fiber cable		
	c. Stranding part		
11	Optical attenuation at wave length		
11.1	a. 1310mm	dB/km	
11.2	b. 1550mm	dB/km	
12	Short circuit carrying capacity	kA*sec	
13	Fiber optic fitting and accessories		
13.1	a. Suspension assembly		
13.2	b. Tension assembly		
14	Vibration dampers		
14.1	a. Type		
14.2	b. Weight	kg	
14.3	Distance from clamp mouth to attachment point a. 1st damper	mm	
	b. 2nd damper (if required)	mm	

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

8.2 Technical Particular for Low Voltage Power Cable

DESCRIPTION	UNIT	REQ.	OFFERED DATA
1Manufacturer and Country of Origin			
Type		Armoured	
Applicable standard		IEC	
Voltage rating			
a) Suitable for max. system voltage	V	600	
b) Voltage grade of the cable (Uo/U)	V	600/1100	
Conductor material		Copper	
Insulation			
- Material			
Overall jacket			
- Fire retardative		Yes	
- Moisture resistant		Yes	

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

8.3 Technical Particular for Low Voltage Power Cable

DESCRIPTION	UNIT	REQ.	DATA
Manufacturer and Country of Origin			
Type		Armoured	
Applicable standard		IEC	
Voltage rating			
a) Suitable for max. system voltage	V	600	
b) Voltage grade of the cable (Uo/U)	V	600/1100	
Conductor material		Copper	
Insulation			
- Material		Polyethylene	
Overall jacket			
- Fire retardative		Yes	
- Moisture resistant		Yes	

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

9.0 Guaranteed Technical Particular of LT Switchgear

9.1 Technical Particular of 400 volts A.C. Power Distribution Panel

S. No:	DESCRIPTION	UNIT	REQ.	DATA
1	**ACDB General**			
1.1	Manufacturer and Country of Origin			
1.2	Applicable standard		IEC	
1.3	Type and model of ACDB as per manufacturer			
1.4	Dimension of Panel (L x B x H)	mm		
1.5	Type test report	Yes/No	Yes	
2	**Bus Bar**			
2.1	Dimension (Width x Thickness)	Mm		
2.2	Continuous current ratings	A	630	
2.3	Short circuit current (1 sec)	kA	10	
2.4	Current Density	A/sq.cm		
3	**Air Circuit Breaker**			
3.1	Manufacturer			
3.2	Type and model as per manufacturer			
3.3	Conforming standard		IEC	
3.4	No. of poles			
3.5	Opening/closing time	ms		
3.6	**Current**			
3.6.1	Rated continuous current carrying capacity	A		
3.6.2	Rated SC current at 400 V	kA	10	
3.6.3	Making Capacity	kA		
3.6.4	Rated SC Breaking current at 400V	kA		
3.6.5	Short time ratings for 1 sec			
3.7	**Voltage**			
3.7.1	Rated Voltage	V		
3.8	Basic Insulation Level	kV		
3.9	CT provided with ACB	Yes/No	Yes	
3.9.1	Manufacturer			
3.9.2	Type as per manufacturer			
3.9.3	Number of cores			
3.9.4	Ratio			
3.9.5	VA Burden	VA	10	
3.9.6	Accuracy class		1, 5P10	
3.9.7	Type of insulation		E or better	
4	**Fuse Switch Unit/ Switch Disconnectors**			
4.1	Manufacturer			

4.2	Type as per manufacturer with no. of poles			
4.3	Conforming Standard			
4.4	Voltage			
4.4.1	Rated operational voltage without derating			
4.4.2	Insulation voltage			
4.4.3	Impulse withstand voltage			
4.5	Current			
4.5.1	Operational current			
4.5.2	Conventional enclosed thermal current rating at 45°C			
4.5.3	Rated Continuous Fused SC current	kA		
4.5.4	Back up fuse rating			
5	**AC Meters/ Energy Meters (Details for Ammeters. Voltmeter, Energy Meters shall be furnished separately)**			
5.1	Manufacturer			
5.2	Type			
5.3	Range			
5.4	Accuracy			
5.5	Conforming Standard			
5.6	Is energy meter provided with facility to download data via optical connection	Yes/No	Yes	
5.7	Is optical probe and software for connection with energy meter provided	Yes/No	Yes	

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

9.2 Technical Particular of D.C. Power Distribution Panel

S. No:	DESCRIPTION	UNIT	REQ.	DATA
1	**DCDB General**			
1.1	Manufacturer and Country of Origin			
1.2	Applicable standard		IEC 61439	
1.3	Type and model of ACDB as per manufacturer			
1.4	Dimension of Panel (L x B x H)	mm		
1.5	Test report	Yes/No	Yes	
2	Grade of insulation level for equipments and wiring	kV	1.1	
3	DC Meters (Details for Ammeters. Voltmeter shall be furnished separately)			
.1	Manufacturer			
3.2	Type			
3.3	Range			
3.4	Accuracy			
3.5	Conforming Standard			
4	Ingress Protection		IP 42	
5	Annunciation for blowing of fuse	Yes/No	Yes	

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

10.0 Guaranteed Technical Particular of 132 kV Control and Relay Panel

10.1 Technical Particular of 132 kV Line and relay panel

DESCRIPTION	UNIT	REQD. Line Panel	Offered Line Panel
1. Manufacturer and country of origin			
2. Manufacturing experience	years	*Minimum 10*	
3. Type (simplex/duplex)			
4. Applicable standard		IEC	
5. Control panels furnished as per specification?	Yes/No	Yes	
6. Enclosure protection class	IP	IP 43	
7. Thickness of sheet metal used			
a)Front and rear portion	mm	>=3	
b) Side, top & bottom covers	mm	>=2	
c) Doors	mm	>=3	
8. All instruments, meters, relays and control switches flush or semi-flush type?		flush type	
9. Ground bus			
a)Material		copper	
b) Size	mm x mm	25 x 6	
10. Overall dimension of control boards (LxWxH)	mm		
11. Shipping data			
a)Size of the large package (LxWxH)	mm		
b) Weight of the heaviest package	Kg		
12. Delivery of equipment in months following award of contract. (Allowing time for approval of drawing)	month		
13.Indicating Instruments			
a) Ammeter			
Manufacturer's designation / Model No.			
Type			
Accuracy class		0.5	
Scale			
- Type of scale	linear / non-linear		
- Range of indication (...../1 A CT operated)	A	*0-1200*	
b) Voltmeter			
Manufacturer's designation / Model No.			
Type			
Accuracy class		0.5	

Scale			
- Range of indication	kV	*0-150*	
- Linear / non-linear			
c) Active power meter			
Manufacturer's designation / Model No.			
Type			
Manufacturer's type designation			
Applicable standard		IEC	
Rated voltage	kV	*132/√3: 0.11/√3*	
Rated current	A	*1200-600-300/1 A*	
Current range (Transducer operation)	mA		
Accuracy class			
Scale			
- Type		*Digital*	
- Range of indication	MW	*100-0-100 200-0-200*	
- Linear / non-linear			
d) Frequency meter			
Manufacturer's designation / Model No.			
Range of indication	Hz	47-53	
e) Energy Meter			
Manufacturer / Model No.			
Type		electronic 3- ph, 4 wire	
Applicable standard		IEC	
Class of accuracy		*0.2*	
Import and export meter provided	Yes/No	*Yes*	
Rated voltage	kV	*132/√3: 0.11/√3*	
Rated current	A	*1200-600-300/1 A*	
VA burden	VA		
f) ANNUNCIATORS			
Manufacturer's designation / Model No.			
Type		numeric	
Number of inputs (annunciator /event)			
Number of active points	No.	18	
Number of rows	No.	3	
Number of columns	No.	6	
Type of mounting		flush	

Replacement of individual inscription plates and lamps from front panel possible?	Yes/No	Yes	
Sequence of operation as per specifications	Yes/No	Yes	
g) **PHASE OVERCURRENT RELAYS: (Directional & Non-directional)**			
Manufacturer's designation / Model No.			
Type		*numeric*	
Applicable standards		*IEC*	
Triple pole or single pole		*Triple pole*	
Continuous overload capacity	x In		
Current setting range	% of rated current	*20 - 200%*	
Operating time at 10 times current setting	sec	3	
Reset time	ms		
Characteristics - IDMT (standard inverse) - IDMT (very inverse) - IDMT (extremely inverse) - Definite time		IDMT (standard inverse)	
Instantaneous unit provided	Yes/No	Yes	
- Current setting range	% of rated current		
Operating time	ms		
h) **GROUND OVER CURRENT RELAYS (Directional & Non-directional)**			
Manufacturer's designation / Model No.			
Type		numeric	
Applicable standards		IEC	
Single pole/Triple pole		three poles	
Continuous overload capacity	x In		
Current setting range	% of rated current	10 - 80%	
Operating time at 10 times current setting	sec	3	
Reset time	ms		
Characteristics - IDMT (standard inverse) - IDMT (very inverse) - IDMT (extremely inverse) Definite time		IDMT (standard inverse)	
Instantaneous unit provided	Yes/No	Yes	
- Current setting range	% of rated current	500-2000%	

Operating time	ms		
i) **BUS / TRANSFORMER DIFFERENTIAL RELAY**			
Manufacturer's designation / Model No.			
Applied standards		IEC	
Type		numeric	
Current magnitude difference setting range	% of rated secondary current		
j) SYNCHRO-CHECK RELAY			
Manufacturer's designation / Model No.			
Applied standards		IEC	
Type		numeric	
Rated input measuring voltage	V		
Voltage magnitude difference setting range	% of Vn	5%-30% of Vn	
Phase angle difference setting range	Degrees	5^0 - 30^0	
Frequency difference setting range	Hz	0.05 - 0.5	
Operating time	ms		
Reset time	ms		
Specify whether each relay incorporate with the following options of reclosing on:			
- Dead bus-live line	Yes/No	Yes	
- Dead line - live bus	Yes/No	Yes	
If the options of reclosing on dead bus- live line and dead line- live bus are separately furnished and mounted, specify:			
- type.			
-Voltage rating	V		
k**) AUXILIARY TRIPPING & LOCKOUT RELAYS**			
Manufacturer's designation / Model No.			
Applicable standards		IEC	
Type		numeric	
Operating time	ms		
l) BREAKER FAILURE RELAY			
Manufacturer's designation / Model No.			
Applicable standards		IEC	
Type		numeric	
Setting range	A		

m) OVERVOLTAGE PROTECTION RELAY			
Manufacturer's designation / Model No.			
Applied standards	IEC		
Type	numeric		
Operating Range			
Operating time			
n) **PHASE OVERCURRENT RELAYS: (Directional)**			
Manufacturer's designation / Model No.			
Type		*numeric*	
Applicable standards		*IEC*	
Triple pole or single pole		*Triple pole*	
Continuous overload capacity	x In		
Current setting range	% of rated Current	*20 - 200%*	
Operating time at 10 times current setting	sec	3	
Reset time	ms		
Characteristics - IDMT (standard inverse) - IDMT (very inverse) - IDMT (extremely inverse) - Definite time		IDMT (standard inverse)	
Characteristics Angle		45º	
Instantaneous unit provided	Yes/No	Yes	
- Current setting range	% of rated current	500-2000%	
Operating time	ms		
Indication - Hand resets flags provided LED provided	Yes/No	Yes	
Auxiliary DC Supply	Vdc	110	
0) **EARTHFAULT RELAYS: (Directional)**			
Manufacturer's designation / Model No.			
Type		*numeric*	
Applicable standards		*IEC*	
Triple pole or single pole		*Triple pole*	
Continuous overload capacity	x In		
Current setting range	% of rated current	*10-80%*	
Operating time at 10 times current setting	sec	3	

10.2 Trip steps

DESCRIPTION	UNIT	REQD. Line/ Bus Coupler Panel	Offered Line / Bus Coupler Panel
- number of trip steps - adjustable time of 1st step - adjustable time of 2nd step - both in steps	No. ms ms ms		
Operating times - maximum operating time - reset time	 ms ms		
p) DISTANCE RELAY			
Manufacturer's designation / Model No.			
Applicable standards		IEC	
Type		numeric	
No of zones - forward direction - reverse direction		 3 1	
- Zone reach setting ranges including steps			
- Zone 1	Ω/phase		
- Zone 2	Ω/phase		
- Zone3	Ω/phase		
- Reverse Zone	Ω/phase		
Zone timer setting ranges including steps			
- Zone 2	sec		
- Zone 3	sec		
- Reverse Zone	sec		
Directional sensitivity			
- Single phase and phase to phase faults			
- Three phase faults			
Are the following features incorporated in each distance relay?			
Instantaneous tripping when closing on three phases zero-volt bolted fault	Yes/No	Yes	
Carrier auxiliary relays for additional following carrier transfer trip schemes			
- Zone acceleration	Yes/No	Yes	
- Permissive under reaching	Yes/No	Yes	
- Permissive overreaching	Yes/No	Yes	
Auxiliary tripping relays	Yes/No	Yes	
Single pole tripping and reclosing scheme	Yes/No	Yes	
Operation indicators for each function	Yes/No		
Alarm for auxiliary DC voltage failure	Yes/No		

Built-in test facilities	Yes/No		
Power swing blocking facility	Yes/No	Yes	
VT supply supervision facility	Yes/No	Yes	
Specify whether the distance relay is insensitive to:			
-Frequency changes	Yes/No		
-Power swing (Hunting)	Yes/No		
-Capacitive loading	Yes/No		
FAULT LOCATOR (inbuilt / separate)		Inbuilt in distance relay	
Accuracy	%	< 3 %	
Calculating time	ms	< 20	
Does the fault locator incorporate following features?			
- Independent of the fault type	Yes/No	Yes	
- phase selection indication	Yes/No	Yes	
Mis-operation protection for loss-of-potential due to short circuit in the secondary of CVT	Yes/No	Yes	

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

11.0 Guaranteed Technical Particular of Substation Automation System

This schedule contains GTP for all the possible parameters of SACDA Equipments BCU generally have. Instead of simply confirming, the Bidder shall fill in the particulars against appropriate items in respect of each rating and type of equipment offered in the broad categories listed below along with supporting authentic technical documents.

(In the absence of GTP in the below mentioned format, the employer has every right to evaluate the product accordingly and bidder cannot raise any objection against any point of the technical scrutiny.)

S. No:	DESCRIPTION	OFFERED DATA
A	**BCU**	
1	Make and Type	
2	Numerical Technology	
3	Modular Design	
4	Nos of Analogue Input	
5	Nos of digital input	
6	Nos of input	
7	Data Storage	
8	Power Supply	
9	Self-Monitoring	
10	IEC 61850 protocol compatibility	
11	Binary input processing & Nos	
12	Analogue input processing & Nos	
13	Measured value acquisition	
14	Derived values	
15	Digital Outputs	
16	Sub-station/ Bay-interlocking	
17	Trip circuit supervision	
18	Event Logging Nos	
19	Disturbance files & record of waveforms, storage capacity	
20	Gateway support	
21	Local control, operation and display	
22	Contact bouncing in digital inputs shall not be assumed as change of state	
23	I/O processing capacities	
24	Internal Ethernet switches	
25	Nos of port	
26	Environmental conditions	
27	Mounting & design	
28	Warranty	
a)	Bay Control functions	
b)	Control mode selection	

c)	Command supervision	
d)	Commands for	
29	Local communication facility through HMI	
30	Local communication facility provided on front side	
31	Compatibility with employer SCADA for remote control	
32	Extension possibilities with additional I/Os inside the unit or via fiber-optic communication and process bus	
B	**Gateway**	
1	Power Supply	
2	Processor type	
3	Chipset	
4	Memory Type	
5	Standard memory	
6	Memory slots	
7	Internal hard disk drive	
8	Hard disk drive speed	
9	Optical drives	
10	Video adapter, bus	
11	Expansion slots	
12	Network Interface	
13	External I/O ports	
14	Operating system installed	
15	Make	
16	Antivirus software	
C	**HMI Server**	
1	Power Supply	
2	Processor type	
3	Chipset	
4	Memory type	
5	Standard memory	
6	Memory slots	
7	Memory upgrade	
8	Internal hard disk drive	
9	Hard disk drive speed	
10	Optical drives	
11	Flexible disk drives	
12	Classic type	
13	Video adapter, bus	
14	Expansion slots	
15	Audio	
16	Modem	
17	Network interface	

18	External I/O ports	
19	Monitor	
20	Keyboard	
21	Pointing Device	
22	Operating system installed	
23	Other	
24	Warranty	
25	UPS	
26	Make	
27	Antivirus software	
D	**DR Work Station**	
1	Power Supply	
2	Processor type	
3	Chipset	
4	Memory type	
5	Standard memory	
6	Memory Slots	
7	Memory upgrade	
8	Internal hard disk drive	
9	Hard disk drive speed	
10	Optical drives	
11	Flexible disk drives	
12	Classic type	
13	Video adapter, bus	
14	Expansion slots	
15	Audio	
16	Modem	
17	Network interface	
18	External I/O ports	
19	Monitor	
20	Keyboard	
21	Pointing Device	
22	Operating system installed	
23	Other	
24	Warranty	
25	UPS	
26	Make	
27	Antivirus software	
F	**Line Interface Unit**	
1	Area Network Type	
2	Power Supply	
3	Protocol/ Network	

4	Module	
5	No. of ports	
6	Ports/ Interfaces	
7	Features	
8	Make	
9	Manufacturer Warranty	
10	Suitability for nos. of F.O. Inlet/ Outlet	
11	IEC 61850 compatibility	
G	**Colour Laser Jet Printer**	
1	Model	
2	Power Supply	
3	Black print speed	
4	Black print resolution	
5	Print Memory	
6	Processor	
7	Print technology	
8	Pages quantity	
9	Paper handling	
10	Connectivity	
11	Manufacturer Warranty	
12	Networking	
13	Supporting OS	
14	Make	
15	Suitability to print all types of drafts and graphics	
H	**Laser Jet Printer**	
1	Model	
2	Power Supply	
3	Black print speed	
4	Black print resolution	
5	Print Memory	
6	Processor	
7	Print technology	
8	Pages quantity	
9	Paper handling	
10	Connectivity	
11	Manufacturer Warranty	
12	Networking	
13	Supporting OS	
14	Make	
15	Suitability to print all types of drafts and graphics	
16	Supported paper sizes	

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

12.0 Guaranteed Technical Particular of Communication System

S. No:	DESCRIPTION	OFFERED DATA
A	**Fiber Optic Based Communication Equipments**	
1	SDH Hierarchy Level	
a)	Capacity Aggregate bit-rate	
b)	CEPT E-1 ports	
2	Minimum no. of protected (MSP) ports	
3	No. of E1 ports in E1 tributary cards	
4	No. of ports in Ethernet tributary cards	
5	Service Channel Provision	
a)	Voice Channel	
b)	Data Channel	
6	Power Supply cards of SDH equipment	
7	Common control cards of SDH equipment	

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

13.0 Guaranteed Technical Particular of Insulator, Hardware and Accessories

DESCRIPTION	UNIT	REQ.	OFFERED DATA 132 KV
1. ACSR CONDUCTOR			
Manufacturer and Country of Origin			
Type		*Bear for 132 kV*	
Applicable standard	*IEC*		
No. of wires in Cardinal conductor			
a) Aluminum	No.		
b) Steel	No.		
Cross section			
a) Aluminum	Sq.mm		
b) Steel	Sq.mm		
c) Complete conductor	Sq.mm		
Overall diameter			
a) Steel core	mm		
b) Complete conductor	mm		
Ultimate tensile strength	kN		
Weight	kg/km		
2. SHIELD WIRE (If Applicable)			
Manufacturer and Country of Origin			
Type			
Applicable standard		*IEC*	
No. of wires	No.	*7*	
Nominal cross-sectional area	sq mm	*61.7*	
Overall diameter	mm	*10.05*	
Ultimate tensile strength	kg	*7,400*	
Zinc coating	g/sq.m		
Equivalent modulus of elasticity	kg/mm^2	*19,000*	
Weight	kg/km		
3. ALUMINUM TUBULAR BUS			
Manufacturer and Country of Origin			
Applicable standard			
Cross-section	mm^2		
Diameter inner / outer	mm		
Material			
4. FITTINGS			
Manufacturer and Country of Origin			
Applicable standards			
Material			
5. SUSPENSION/ TENSION INSULATOR STRING			

Manufacturer and Country of Origin			
Applicable standards			
Size of disc			
- Diameter	mm		
- Height	mm		
Number of units per string	No		
Combined mechanical and electrical failing load	kN		
Creepage distance per unit	mm		
Impulse withstand voltage	kV, crest		
Dry power frequency withstand voltage	kV		
Wet power frequency withstand voltage	kV		
Puncture voltage	kV		
6. POST INSULATOR			
Manufacturer			
Applicable standards		IEC	
Rated system voltage	kV		
Max. rated voltage	kV		
Unit size (Diameter)	mm		
Unit size (length)	mm		
Creepage distance	mm		
Insulation level			
a) Impulse withstand voltage	kV, crest		
b) Power frequency withstand voltage (1 min rms)	kV		
Failing load (bending)	kg		
Failing load (torsion)	kg-m		

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

14.0 Guaranteed Technical Particular of Bay Control Unit (BCU)

S. No:	DESCRIPTION	OFFERED DATA
1	Name of Manufacturer	
2	Type of unit monitoring	
3	Manufacturer's type designation	
4	Standards Applicable	
5	Rated Auxiliary Voltage	
6	No. of analogue variable (specify voltage and current separately)	
7	Rated frequency (Hz)	
8	No. of binary inputs	
9	No. of output	
10	Language	
11	Type of communication protocol supported by unit	
12	No. and type of communication ports	
13	Operating temperature range	
14	System response time	
14.1	Exchange of display	
14.2	Presentation of binary change	
14.3	Presentation of analogue change	
14.4	Order to process output	
14.5	Order to update display	
14.6	Report Generation	

Deviations from technical requirements and reasons for such deviations:

Signed: .....
As Representative for: .....
Address: .....
Date: .....

15.0 Guaranteed Technical Particular of 132 kV XLPE Cable

S.N	ITEMS	Requirement	Data Offered
1	Description of Cable	Single Core, XLPE	
2	Highest system voltage	145KV	
3	Voltage Grade	132KV	
4	Voltage variation		
5	Frequency	50 Hz	
6	Frequency variation	±3%	
7	Power frequency withstand voltage	190 KV rms	
8	Lightning impulse withstand voltage	±650 KV peak	
10	No of phase per Ckt	3	
11	Earthing system	Effectively earthed	
12	Size of Cable	800 mm2	
13	Max. in Conductor Temp.		
14	Fault level	40 KA for 1 second	
15	Maximum permissible short ckt temperature.		
16	CABLE DETAILS : CONDUCTORS		
16.1	Conductor material		
16.2	Conductor Shape		
16.3	Conductor Screen		
16.4	Resistivity of the semiconducting screen	Maximum 1000 ohm-meter	
16.5	Insulation		
	a) material	XLPE	
	b) specified insulation resistance at 900C		
16.6	Insulation Screen : Type & Material		
16.7	Resistivity of the semiconducting compound		
16.8	Longitudinal water barrier Material		
16.9	Radial moisture barrier Material		
16.10	Overall sheath		
16.11	Coating of outer sheath		
17.	Approximate Length of cable in a drum		
18	Bending Radius		
19	TESTS Applicable standards		
19.1	Type Test a) whether previous test reports will be sufficient b) whether sample to be Type tested against this order.	As per IEC	
19.2	Routine Test	As per IEC	

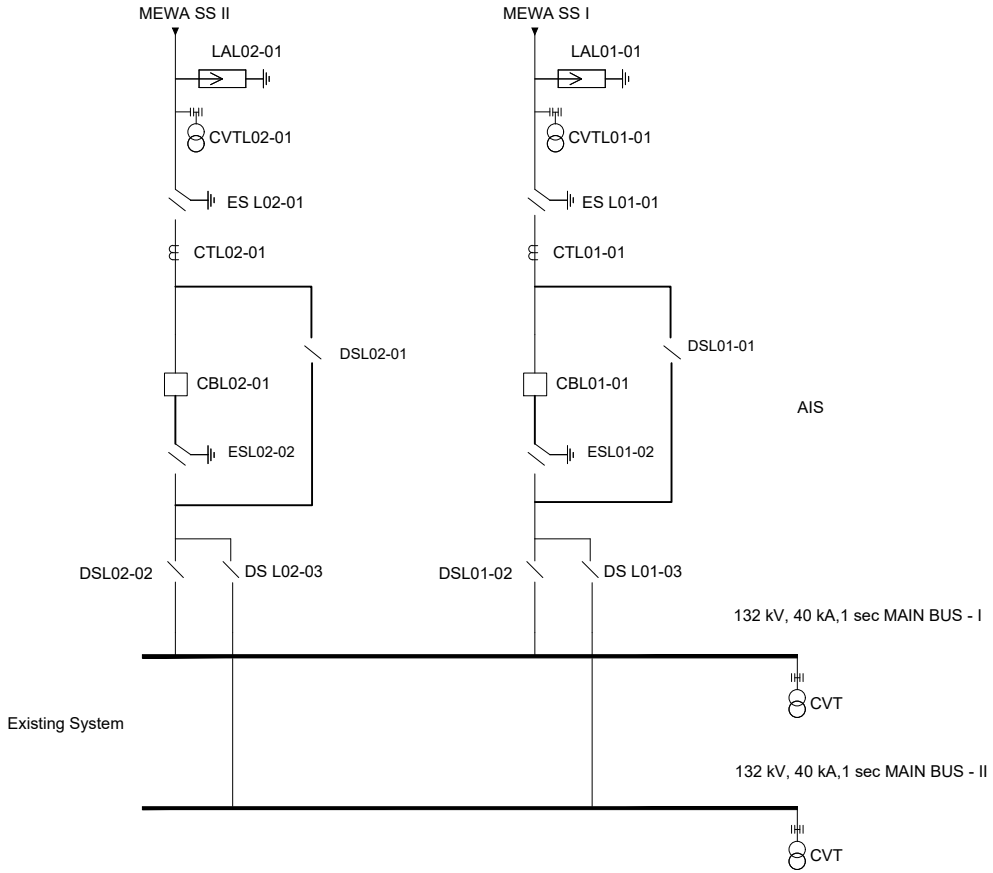
S.N	ITEMS	Requirement	Data Offered
19.3	Acceptance Test	As per IEC	
19.4	Whether test will be witnessed by purchaser or his representative	Yes. Acceptance test will be witnessed.	
20	INSTALLATION, TERMINATION AND JOINTS		
21	Ambient temperature Ground temperature Thermal resistivity of soil	450C 300C 1500C cm/Km	
22	Laying Configuration	Trefoil formation.	
23	Depth		
24	Termination		
25	Type		
26	Joints Required		
27	Earth Link Boxes Required		
28	Surge Suppressor Required		
29	Bonding Type		

Deviations from technical requirements and reasons for such deviations:

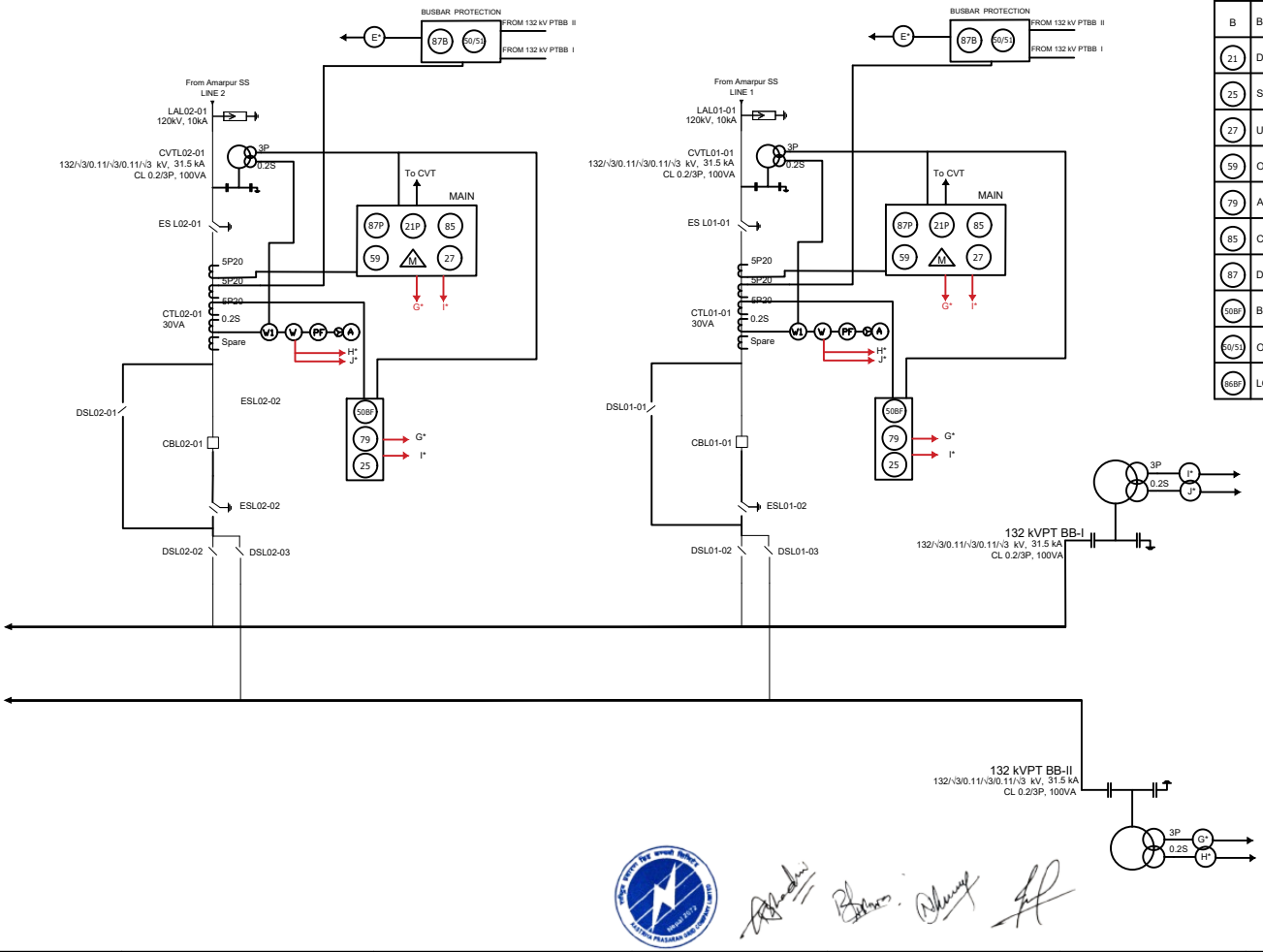
Signed: .....
As Representative for: .....
Address: .....
Date: .....

CHAPTER 21:

Tender Drawings



Nepal Government Ministry of Energy, Water Resources and Irrigation Kathmandu, Nepal	Client: Rastriya Prasaran Grid Company Limited Babarmahal, Kathmandu	**132 KV Line Bay Extension at Dhungesangu Substation**	DATE	REVISION	SIGNATURE	DESIGNED BY : DRAWN BY : CHECKED BY : APPROVED BY :	SCALE	**Single Line Diagram (For Tender Purpose only)**	DATE: DRG NO : SHEET NO :



LEGENDS

M	METERING
P	PRIMARY
S	SECONDARY
B	BUSBAR
21	DISTANCE RELAY
25	SYNCHRO CHECK RELAY
27	UNDERVOLTAGE RELAY
59	OVERVOLTAGE RELAY
79	AUTORECLOSING RELAY
85	CARRIER RECEIVER RELAY
87	DIFFERENTIAL RELAY
50BF	BREAKER FAILURE RELAY
50/51	OVERCURRENT RELAY
86BF	LOCKOUT RELAY

Nepal Government
Ministry of Energy, Water Resources and Irrigation
Kathmandu, Nepal

Client:
Rastriya Prasaran Grid Company Limited
Babarmahal, Kathmandu

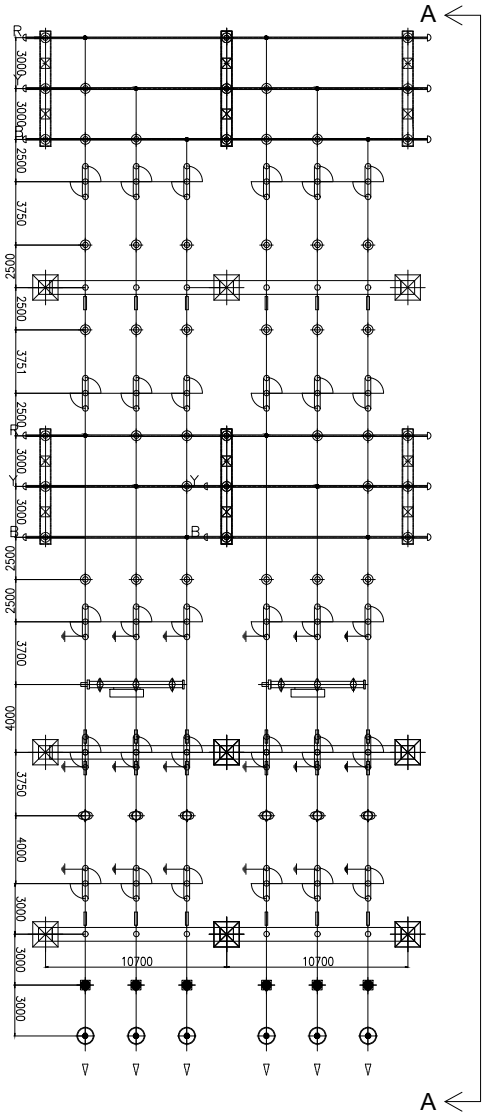
132 KV Line Bay Extension at Dhungesangu Substation

DATE	REVISION	SIGNATURE	
			DESIGNED BY :
			DRAWN BY :
			CHECKED BY :
			APPROVED BY :

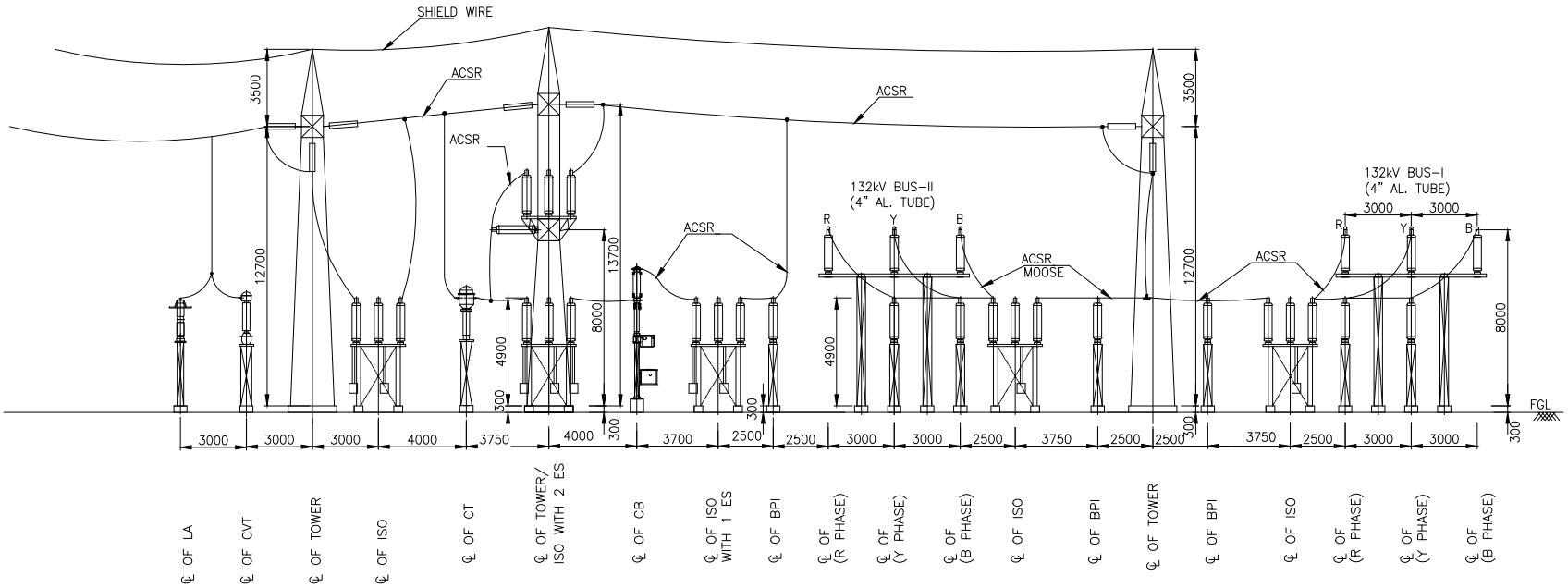
SCALE

Protection Diagram (For Tender Purpose only)

DATE:
DRG NO :
SHEET NO :



Nepal Government Ministry of Energy, Water Resources and Irrigation Kathmandu, Nepal	Client: Rastriya Prasaran Grid Company Limited Babarmahal, Kathmandu	**132 KV Line Bay Extension at Dhungesangu Substation**	DATE	REVISION	SIGNATURE	DESIGNED BY : DRAWN BY : CHECKED BY : APPROVED BY :	SCALE : **NTS**	**General Arrangement (For Tender Purpose only)**	DATE: DRG NO : SHEET NO :



Section A–A

Nepal Government Ministry of Energy, Water Resources and Irrigation Kathmandu, Nepal	Client: Rastriya Prasaran Grid Company Limited Babarmahal, Kathmandu	**132 KV Line Bay Extension at Dhungesangu Substation**	DATE	REVISION	SIGNATURE	DESIGNED BY : DRAWN BY : CHECKED BY : APPROVED BY :	SCALE : **NTS**	**Section Diagram (Section A-A) (For Tender Purpose only)**	DATE: DRG NO : SHEET NO :

RASTRIYA PRASARAN GRID COMPANY LIMITED

(An Undertaking of Government of Nepal)

Mewa-Changhe (Dhungesanghu) 132kV Transmission Line Project

BIDDING DOCUMENT
For
THE PROCUREMENT OF

Design, Supply, Installation, Testing and Commissioning of 132kV Line Bays & Associated Underground Cabling Work at Dhungesanghu Substation

National Competitive Bidding (NCB)

Single-Stage: Two-Envelope Bidding Procedure

Invitation for Bids (IFB) No. : RPGCL/NCB/W/MC/SS/083/84-01
Employer : Rastriya Prasaran Grid Company Limited

VOLUME III OF III

August 2026

Rastriya Prasaran Grid Company Limited
Mewa-Changhe (Dhungesanghu) 132kV Transmission Line Project
Buddhanagar, Kathmandu, Nepal
Tel. :+977-01-4610103
Email: info@rpgcl.com

Preamble of Bill of Quantities

A. General

1. The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, General and Special Conditions of Contract, Technical Specifications, and Drawings.
2. The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Project Manager and valued at the rates and prices bid in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Project Manager may fix within the terms of the Contract.
3. For any item for which measurement is based on records made before or during construction the records shall be prepared and agreed between the Engineer and the Contractor. Should the Contractor carry out such work without the prior agreement of the Engineer, the Engineer may request the Contractor to carry out investigations to confirm the extent of the work and the quantity of work certified for payment shall be solely at the Engineer's discretion. The cost of any such investigation shall be borne by the Contractor.
4. The rates and prices bid in the priced Bill of Quantities shall, except as otherwise provided under the Contract, include all construction equipment, labor, supervision, materials, erection, maintenance, insurance, profit, taxes, and duties, together with all general risks, liabilities, and obligations set out or implied in the Contract.
5. A rate or price shall be entered against each item in the priced Bill of Quantities, whether quantities are stated or not. The cost of items against which the Contractor has failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities.
6. The whole cost of complying with the provisions of the Contract shall be included in the Items provided in the priced Bill of Quantities, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related Items of Work.
7. General directions and descriptions of work and materials are not necessarily repeated nor summarized in the Bill of Quantities. References to the relevant sections of the Contract documentation shall be made before entering prices against each item in the priced Bill of Quantities. The Specification Clause references were given in the item description of the Bills of Quantities are for the convenience of bidders and generally refer to the principal relevant-specification clause but do not necessarily represent the whole of the specification requirements for the work required within the item. The presence of a Specification clause reference shall not in any way reduce the Bidders obligation to complete work in accordance with all the requirements of the Specification.
8. Provisional Sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Project Manager in accordance with the Conditions of Contract. The method of measurement of completed work for payment shall be in accordance with the Specifications.

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay Extension Work at Dhungesangu 220/132kV Substation
Price Schedule

Price Schedule No. 1: Provisional Sum

S. No.	Item Description	Unit	Qty.	Total Price		Local Transportation, Insurance and other incidental services		Total amount
				Unit Price NPR	Amount NPR	Unit Price NPR	Amount NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*	*(7)*	*(8)=(4)*(7)*	*(9)=(6)+(8)*
	Not Applicable							
	Total of Schedule 1							

Bidder's Name:….....
Signature of Bidder:….....
Designation: ….....
Date:….....
Company Stamp:….....

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 2: General Items

S. No.	Item Description	Estimated		Construction, Installation, Testing & Commissioning Services (Excluding Taxes & Duties)	
		Unit	Quantity	Unit Rate (NRs.)	Amount (NRs.)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6) = (4) x (5)*
	Not Applicable				
Total of Schedule 2					**-**

Bidder's Name:….....
Signature of Bidder:….....
Designation: ….....
Date:….....
Company Stamp:….....

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 3: Design Services

Sl. No.	Item Description	Unit	Quantity	Local Currency Price	
				Unit Price NRs	Amount NRs
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*
	DesignService				
	Not Applicable				
Total of Design Services					

*Note: The design cost is deemed to be included in Schedule 4

Bidder's Name:….....
Signature of Bidder:….....
Designation: ….....
Date:….....
Company Stamp:….....

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 a:Items to be supplied from abroad

S. No.	Item Description	Unit	Qty.	Total CIP Border Price (NRs.)		Local Transportation, Insurance and other incidental services (including port clearance etc.) applicable for supply of Plant & Equipment.		Total Amount
				Unit Price	Amount	Unit Price NPR	Amount NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*	*(7)*	*(8)=(4)*(7)*	*(9)=(6)+(8)*
	PART - A: OWNER ASSESSED QUANTITIES FOR CHANGE (DUNGESANGU) SUBSTATION							
	ELECTRICAL WORKS:							
A.1	**145 kV AIS Equipments:**							
a)	**CIRCUIT BREAKERS & SWITCHGEARS**							
1	145 kV, 1250 A, 40 kA, 3 Phase, SF6 circuit breakers complete with all accessories	Sets	2					
b)	**DISCONNECTING SWITCHES**							
1	145 kV, 3 Phase, center break disconnecting switch with grounding switch	Sets	4					
2	145 kV, 3 Phase, center break disconnecting switch with out grounding switch	Sets	6					
c)	**INSTRUMENT TRANSFORMERS:**							
1	145 kV, 8800pF, 50 VA, 132/√3 /110/√3 kV, Class 0.2/3P Capacitor Voltage Transformer complete with all accessories as per specification	Nos	6					
2	145 kV, 30 VA, 1200 A with 120 % extended rating current transformer	Nos	6					
d)	**LIGHTNING ARRESTORS:**							
1	120 kV, 10 kA Surge arrester (1 phase) including discharge counter	Nos	6					
e	**132 kV XLPE CABLE**							
1	132 kV XLPE insulated, 1Cx800 mm2 size copper cable as per technical specification including all other accessories	km	4.2					
2	Cable termination as per technical specification for interconnection with overhead transmission line for 132KV cables (including support insulators)	lot	1					
3	Straight through joints inscluding all accessories as per TS	Nos	4					
A.2	**CONTROL AND RELAY PANEL (WITH SUBSTATION AUTOMATION SYSTEM)**							

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 a:Items to be supplied from abroad

S. No.	Item Description	Unit	Qty.	Total CIP Border Price (NRs.)		Local Transportation, Insurance and other incidental services (including port clearance etc.) applicable for supply of Plant & Equipment.		Total Amount
				Unit Price	Amount	Unit Price NPR	Amount NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*	*(7)*	*(8)=(4)*(7)*	*(9)=(6)+(8)*
1	132 kV line control and relay panel complete with all accessories as per technical specifications	sets	2					
A.3	**1.1 kV GRADE LOW VOLTAGE CABLES**							
1	Power Cables (PVC)	LS	1					
2	Control Cables (PVC)	LS	1					
3	Cable glands, lugs for Power & Control cables	LS	1					
A.4	**BATTERIES AND BATTERY CHARGER**							
1	Float cum boost battery charger for 110 V battery complete with all accessories as per technical specification	set	1					
2	110 V, 600 AH batteries complete with all accessories	set	1					
A.5	**GROUNDING**							
1	Galvanized E.H.S. steel wires of size 7/3.35 for lightning shield wire in take-off and internal structures complete with all accessories	LS	1					
2	Earthing of substation with conductors (of same size used in underconstruction substation), electrode, grounding materials complete with all accessories	LS	1					
A.6	**Bus post Insulator:**							
1	132 kV Bus post insulators	Nos	12					
A.7	**ERECTION & MISCELLANEOUS MATERIALS**							
1	132 kV insulator strings, Disc insulator & accessories to complete the specified scope of works including for line tower	LS	1					
2	132 kV hardware, clamp, connectors & accessories to complete the specified scope of works including for line tower	LS	1					
3	ACSR conductors and accessories to complete the specified scope of works (The conductor should be same as used in TL)	LS	1					

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 a:Items to be supplied from abroad

S. No.	Item Description	Unit	Qty.	Total CIP Border Price (NRs.)		Local Transportation, Insurance and other incidental services (including port clearance etc.) applicable for supply of Plant & Equipment.		Total Amount
				Unit Price	Amount	Unit Price NPR	Amount NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*	*(7)*	*(8)=(4)*(7)*	*(9)=(6)+(8)*
4	Main Tubular bus, branch buses, connectors, expansion joint including all other accessories required to complete 132 kV double bus-bar configuration (Minimum Outer diameter and thickness of main bus 100.0 and 7.0 mm respectively and that of branches 75.0 & 5.0 mm)	LS	1					
5	Marshaling Box/Kiosk made of stanless steel with suitable size in switchyard works	LS	1					
A.8	**Illumination System**							
1	Outdoor Switchyard, Substation area, Street lighting etc as per technical specification	LS	1					
	SUB TOTAL OF ELECTRIC EQUIPMENTS FOR CHANGE (DUNGESANGU) SUBSTATION							
A.9	**SUBSTATION AUTOMATION/ COMMUNICATION / SCADA (Based on IEC 61850)**							
a)	**SUBSTATION AUTOMATION SYSTEM:**							
1	Inclusion of complete Substation automation system for new bays including hardware and software for the substation & remote control stations alongwith associated equipments.							
1.1	132 kV System	Bays	2					
2	Integration of all 132/33/11kV Bays under present scope with the SCADA of SIEMENS (SINAUT Spectrum) at Load Dispatch Centre, Kathmandu including supply of Hardware, Software, accessories etc. as per TS Section Project.							
A.10	**COMMUNICATION AND SCADA**							
1	Digital Protection Coupler	Nos	2					
2	Extension and interfacing of existing Communication Panel/equipment including Ethernet tributaries card Termination Equipment (Drop/Insert Multiplexer, Subscriber Line Interface Cards, Equipment Cabinets complete in all respects including establishment of Fibre Optic (FO) links for far end substation/s (Papung, Mewa hub SS) as per technical specifications	LS	1					
3	Optical Distribution Frame complete in all respects as per technical specifications	LS	1					

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 a:Items to be supplied from abroad

S. No.	Item Description	Unit	Qty.	Total CIP Border Price (NRs.)		Local Transportation, Insurance and other incidental services (including port clearance etc.) applicable for supply of Plant & Equipment.		Total Amount
				Unit Price	Amount	Unit Price NPR	Amount NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*	*(7)*	*(8)=(4)*(7)*	*(9)=(6)+(8)*
4	Optical Approach Cable -24 pair Fibre (DWSM -G.652D) along with Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable complete in all respects as per technical specifications	LS	1					
A.11	**CIVIL WORKS**							
a)	**Steel structure for post, beam and equipment supporting frame complete with bolts, fastner, pack washer, nuts, guest paltes and all accessories: (Extension works for 132 side)**							
1	132 kV take off gantry structures	Bays	2					
2	132 kV internal gantry structures gantry structure	Bays	2					
3	132 kV SF6 gas circuit breaker	Sets	2					
4	132 kV disconnecting switch with earth switch	Sets	4					
5	132 kV disconnecting switch with out earth switch	Sets	6					
6	132 kV capacitor voltage transformer	Nos	6					
7	132 kV current transformer	Nos	6					
8	120 kV surge arrestor	Nos	6					
9	132 kV Bus post insulator	Nos	12					
	Total of steel structure for gantry breaker etc							
A.12	**Auxilliary Parts**							
1	**145 kV AIS Equipments:**							
1.1	145 kV, 8800 pF CVT (excluding support structure/Commom JB)	Nos	2					
1.2	145 kV, 50 VA, 1200 A with 120 % extended rating current transforme	Nos	2					
1.3	120 kV Surge Arrestor with insulating base, terminal connector, Surge counter & accessories (excluding support structures)	Nos	2					
1.4	**Circuit Breakers**							
a	Tripping Coils	Nos.	5					
b	Closing Coils	Nos.	3					
c	Spring charging motor	Nos.	1					
d	Complete set of Rubber gaskets, 'O' rings and seals for SF6 gas (two quantity of each type)	Set	1					
e	Auxiliary relay, pressure switch, power contactors, push buttons, timers and MCBs etc. (one of each type & rating)	Set	1					
1.5	Disconnecting switches							
a	Main contact assemblies (fist anf finger)-3 Phase	Set	1					
b	Auxiliary contact assemblies	Set	1					
c	Interlocking coil set	Set	1					

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 a:Items to be supplied from abroad

S. No.	Item Description	Unit	Qty.	Total CIP Border Price (NRs.)		Local Transportation, Insurance and other incidental services (including port clearance etc.) applicable for supply of Plant & Equipment.		Total Amount
				Unit Price	Amount	Unit Price NPR	Amount NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*	*(7)*	*(8)=(4)*(7)*	*(9)=(6)+(8)*
2	**110 kV Battery Chargers**							
a	Fuse of each type	Set	1					
b	Ammeter	Sets	1					
c	Voltmeter	Nos	1					
d	Spare Battery Cells	Sets	1					
3	**Relay and Protection (132 kV)**							
3.1	**Line Protection**							
a	Numerical distance relay (1 no. of each type)	Set	1					
3.2	**Common Spares**							
a	Trip circuit supervision relay	nos	1					
b	Auxiliary relays (relay of each type)	nos	2					
c	Indicating lamps of each type (50 % of used)	set	1					
d	Fuse of each type(50 % of used)	set	1					
e	Ammeter	set	1					
f	Voltmeter	set	1					
4	**COMMUNICATION AND SCADA**							
a	Digital protection coupler	Set	1					
5	**SAS**							
a	Bay Control Unit (IED) of each type	set	1					
b	Ethernet Switch of each type	set	1					
6	**COMMON SPARES**							
6.1	Bay unit Module	Nos	1					
6.2	2 wire local subscriber interface card for PABX	Nos	1					
6.3	E1 Interface card for PABX	Nos	1					
7	**Mandatory Spares of Communication Equipments**							
7.1	SDH Equipment (STM-4 MADM upto 5 MSP protected directions)							
a	Common cards, Cross-connect/control cards, Optical base card, Power supply cards, power cabling, other hardware & accessories (each).	Set	1					
b	**Optical Interface Cards/SFP**							
(i)	L4.1 SFP	Nos.	1					
(ii)	L4.2 SFP	Nos.	1					
c	**Tributary cards**							
(i)	E1 Interface card (Min.16 interfaces per card)	Nos.	1					

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 a:Items to be supplied from abroad

S. No.	Item Description	Unit	Qty.	Total CIP Border Price (NRs.)		Local Transportation, Insurance and other incidental services (including port clearance etc.) applicable for supply of Plant & Equipment.		Total Amount
				Unit Price	Amount	Unit Price NPR	Amount NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*	*(7)*	*(8)=(4)*(7)*	*(9)=(6)+(8)*
(ii)	Ethernet Interface 10/100 Base T with Layer-2 switching (Min 8 Interfaces per card)	Nos.	1					
ALL TOTAL OF PLANTS, EQUIPMENTS INCLUDING SPARE PARTS								-

Bidder's Name:….....
Signature of Bidder:….....
Designation: ….....
Date:….....
Company Stamp:….....

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 b: Items to be supplied from Nepal

S. No.	Item Description	Unit	Qty.	Local Currency Price	
				Unit Price NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*
	PART - A: OWNER ASSESSED QUANTITIES FOR CHANGE (DUNGESANGU) SUBSTATION				
	ELECTRICAL WORKS:				
A.1	**145 kV AIS Equipments:**				
a)	**CIRCUIT BREAKERS & SWITCHGEARS**				
1	145 kV, 1250 A, 40 kA, 3 Phase, SF6 circuit breakers complete with all accessories	Sets	2		
b)	**DISCONNECTING SWITCHES**				
1	145 kV, 3 Phase, center break disconnecting switch with grounding switch	Sets	4		
2	145 kV, 3 Phase, center break disconnecting switch with out grounding switch	Sets	6		
c)	**INSTRUMENT TRANSFORMERS:**				
1	145 kV, 8800pF, 50 VA, 132/√3 /110/√3 kV, Class 0.2/3P Capacitor Voltage Transformer complete with all accessories as per specification	Nos	6		
2	145 kV, 30 VA, 1200 A with 120 % extended rating current transformer	Nos	6		
d)	**LIGHTNING ARRESTORS:**				
1	120 kV, 10 kA Surge arrester (1 phase) including discharge counter	Nos	6		
e	**132 kV XLPE CABLE**				
1	132 kV XLPE insulated, 1Cx800 mm2 size copper cable as per technical specification including all other accessories	km	4.2		
2	Cable termination as per technical specification for interconnection with overhead transmission line for 132KV cables (including support insulators)	lot	1		
3	Straight through joints inscluding all accessories as per TS	Nos	4		
A.2	**CONTROL AND RELAY PANEL (WITH SUBSTATION AUTOMATION SYSTEM)**				

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 b: Items to be supplied from Nepal

S. No.	Item Description	Unit	Qty.	Local Currency Price	
				Unit Price NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*
	PART - A: OWNER ASSESSED QUANTITIES FOR CHANGE (DUNGESANGU) SUBSTATION				
1	132 kV line control and relay panel complete with all accessories as per technical specifications	sets	2		
A.3	**1.1 kV GRADE LOW VOLTAGE CABLES**				
1	Power Cables (PVC)	LS	1		
2	Control Cables (PVC)	LS	1		
3	Cable glands, lugs for Power & Control cables	LS	1		
A.4	**BATTERIES AND BATTERY CHARGER**				
1	Float cum boost battery charger for 110 V battery complete with all accessories as per technical specification	set	1		
2	110 V, 600 AH batteries complete with all accessories	set	1		
A.5	**GROUNDING**				

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 b: Items to be supplied from Nepal

S. No.	Item Description	Unit	Qty.	Local Currency Price	
				Unit Price NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*
	PART - A: OWNER ASSESSED QUANTITIES FOR CHANGE (DUNGESANGU) SUBSTATION				
1	Galvanized E.H.S. steel wires of size 7/3.35 for lightning shield wire in take-off and internal structures complete with all accessories	LS	1		
2	Earthing of substation with conductors (of same size used in underconstruction substation), electrode, grounding materials complete with all accessories	LS	1		
A.6	**Bus post Insulator:**				
1	132 kV Bus post insulators	Nos	12		
A.7	**ERECTION & MISCELLANEOUS MATERIALS**				
1	132 kV insulator strings, Disc insulator & accessories to complete the specified scope of works including for line tower	LS	1		
2	132 kV hardware, clamp, connectors & accessories to complete the specified scope of works including for line tower	LS	1		
3	ACSR conductors and accessories to complete the specified scope of works (The conductor should be same as used in TL)	LS	1		
4	Main Tubular bus, branch buses, connectors, expansion joint including all other accessories required to complete 132 kV double bus-bar configuration (Minimum Outer diameter and thickness of main bus 100.0 and 7.0 mm respectively and that of branches 75.0 & 5.0 mm)	LS	1		
5	Marshaling Box/Kiosk made of stanless steel with suitable size in switchyard works	LS	1		
A.8	**Illumination System**				
1	Outdoor Switchyard, Substation area, Street lighting etc as per technical specification	LS	1		

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 b: Items to be supplied from Nepal

S. No.	Item Description	Unit	Qty.	Local Currency Price	
				Unit Price NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*
	PART - A: OWNER ASSESSED QUANTITIES FOR CHANGE (DUNGESANGU) SUBSTATION				
	SUB TOTAL OF ELECTRIC EQUIPMENTS FOR CHANGE (DUNGESANGU) SUBSTATION				
A.9	**SUBSTATION AUTOMATION/ COMMUNICATION / SCADA (Based on IEC 61850)**				
a)	**SUBSTATION AUTOMATION SYSTEM:**				
1	Inclusion of complete Substation automation system for new bays including hardware and software for the substation & remote control stations alongwith associated equipments.				
1.1	132 kV System	Bays	2		
2	Integration of all 132/33/11kV Bays under present scope with the SCADA of SIEMENS (SINAUT Spectrum) at Load Dispatch Centre, Kathmandu including supply of Hardware, Software, accessories etc. as per TS Section Project.				
A.10	**COMMUNICATION AND SCADA**				
1	Digital Protection Coupler	Nos	2		

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 b: Items to be supplied from Nepal

S. No.	Item Description	Unit	Qty.	Local Currency Price	
				Unit Price NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*
	PART - A: OWNER ASSESSED QUANTITIES FOR CHANGE (DUNGESANGU) SUBSTATION				
2	Extension and interfacing of existing Communication Panel/equipment including Ethernet tributaries card Termination Equipment (Drop/Insert Multiplexer, Subscriber Line Interface Cards, Equipment Cabinets complete in all respects including establishment of Fibre Optic (FO) links for far end substation/s (Papung, Mewa hub SS) as per technical specifications	LS	1		
3	Optical Distribution Frame complete in all respects as per technical specifications	LS	1		
4	Optical Approach Cable -24 pair Fibre (DWSM -G.652D) along with Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable complete in all respects as per technical specifications	LS	1		
A.11	**CIVIL WORKS**				
a)	**Steel structure for post, beam and equipment supporting frame complete with bolts, fastner, pack washer, nuts, guest paltes and all accessories: (Extension works for 132 side)**				
1	132 kV take off gantry structures	Bays	2		
2	132 kV internal gantry structures gantry structure	Bays	2		
3	132 kV SF6 gas circuit breaker	Sets	2		
4	132 kV disconnecting switch with earth switch	Sets	4		
5	132 kV disconnecting switch with out earth switch	Sets	6		

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 b: Items to be supplied from Nepal

S. No.	Item Description	Unit	Qty.	Local Currency Price	
				Unit Price NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*
	PART - A: OWNER ASSESSED QUANTITIES FOR CHANGE (DUNGESANGU) SUBSTATION				
6	132 kV capacitor voltage transformer	Nos	6		
7	132 kV current transformer	Nos	6		
8	120 kV surge arrestor	Nos	6		
9	132 kV Bus post insulator	Nos	12		
	Total of steel structure for gantry breaker etc				
A.12	**Auxilliary Parts**				
1	**145 kV AIS Equipments:**				
1.1	145 kV, 8800 pF CVT (excluding support structure/Commom JB)	Nos	2		
1.2	145 kV, 50 VA, 1200 A with 120 % extended rating current transformer	Nos	2		
1.3	120 kV Surge Arrestor with insulating base, terminal connector, Surge counter & accessories (excluding support structures)	Nos	2		
1.4	**Circuit Breakers**				
a	Tripping Coils	Nos.	5		
b	Closing Coils	Nos.	3		
c	Spring charging motor	Nos.	1		
d	Complete set of Rubber gaskets, 'O' rings and seals for SF6 gas (two quantity of each type)	Set	1		

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 b: Items to be supplied from Nepal

S. No.	Item Description	Unit	Qty.	Local Currency Price	
				Unit Price NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*
	PART - A: OWNER ASSESSED QUANTITIES FOR CHANGE (DUNGESANGU) SUBSTATION				
e	Auxiliary relay, pressure switch, power contactors, push buttons, timers and MCBs etc. (one of each type & rating)	Set	1		
1.5	Disconnecting switches				
a	Main contact assemblies (fist anf finger)-3 Phase	Set	1		
b	Auxiliary contact assemblies	Set	1		
c	Interlocking coil set	Set	1		
2	**110 kV Battery Chargers**				
a	Fuse of each type	Set	1		
b	Ammeter	Sets	1		
c	Voltmeter	Nos	1		
d	Spare Battery Cells	Sets	1		
3	**Relay and Protection (132 kV)**				
3.1	**Line Protection**				
a	Numerical distance relay (1 no. of each type)	Set	1		
3.2	**Common Spares**				

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 b: Items to be supplied from Nepal

S. No.	Item Description	Unit	Qty.	Local Currency Price	
				Unit Price NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*
	PART - A: OWNER ASSESSED QUANTITIES FOR CHANGE (DUNGESANGU) SUBSTATION				
a	Trip circuit supervision relay	nos	1		
b	Auxiliary relays (relay of each type)	nos	2		
c	Indicating lamps of each type (50 % of used)	set	1		
d	Fuse of each type(50 % of used)	set	1		
e	Ammeter	set	1		
f	Voltmeter	set	1		
4	**COMMUNICATION AND SCADA**				
a	Digital protection coupler	Set	1		
5	**SAS**				
a	Bay Control Unit (IED) of each type	set	1		
b	Ethernet Switch of each type	set	1		
6	**COMMON SPARES**				
6.1	Bay unit Module	Nos	1		
6.2	2 wire local subscriber interface card for PABX	Nos	1		
6.3	E1 Interface card for PABX	Nos	1		
7	**Mandatory Spares of Communication Equipments**				
7.1	SDH Equipment (STM-4 MADM upto 5 MSP protected directions)				
a	Common cards, Cross-connect/control cards, Optical base card, Power supply cards, power cabling, other hardware & accessories (each).	Set	1		

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 4 b: Items to be supplied from Nepal

S. No.	Item Description	Unit	Qty.	Local Currency Price	
				Unit Price NPR	Amount NPR
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)=(4)x(5)*
	PART - A: OWNER ASSESSED QUANTITIES FOR CHANGE (DUNGESANGU) SUBSTATION				
b	**Optical Interface Cards/SFP**				
(i)	L4.1 SFP	Nos.	1		
(ii)	L4.2 SFP	Nos.	1		
c	**Tributary cards**				
(i)	E1 Interface card (Min.16 interfaces per card)	Nos.	1		
(ii)	Ethernet Interface 10/100 Base T with Layer-2 switching (Min 8 Interfaces per card)	Nos.	1		
ALL TOTAL OF PLANTS, EQUIPMENTS INCLUDING SPARE PARTS					

Bidder's Name:….....
Signature of Bidder:….....
Designation: ….....
Date:….....
Company Stamp:….....

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 5: Installation & Other Services

S. No.	Item Description	Estimated		Construction, Installation, Testing & Commissioning Services (Excluding Taxes & Duties)	
		Unit	Quantity	Unit Rate (NRs.)	Amount (NRs.)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6) = (4) x (5)*
A.1	**145 kV AIS Equipments:**				
a)	**CIRCUIT BREAKERS & SWITCHGEARS**				
1	145 kV, 1250 A, 40 kA, 3 Phase, SF6 circuit breakers complete with all accessories	Sets	2		
b)	**DISCONNECTING SWITCHES**				
1	145 kV, 3 Phase, center break disconnecting switch with grounding switch	Sets	4		
2	145 kV, 3 Phase, center break disconnecting switch with out grounding switch	Sets	6		
c)	**INSTRUMENT TRANSFORMERS:**				
1	145 kV, 8800pF, 50 VA, 132/√3 /110/√3 kV, Class 0.2/3P Capacitor Voltage Transformer complete with all accessories as per specification	Nos	6		
2	145 kV, 30 VA, 1200 A with 120 % extended rating current transformer	Nos	6		
d)	**LIGHTNING ARRESTORS:**				
1	120 kV, 10 kA Surge arrester (1 phase) including discharge counter	Nos	6		
e	**132 kV XLPE CABLE**				
1	132 kV XLPE insulated, 1Cx800 mm2 size copper cable as per technical specification including all other accessories	km	4.2		
2	Cable termination as per technical specification for interconnection with overhead transmission line for 132KV cables (including support insulators)	lot	1		
3	Straight through joints inscluding all accessories as per TS	Nos	4		
A.2	**CONTROL AND RELAY PANEL (WITH SUBSTATION AUTOMATION SYSTEM)**				
1	132 kV line control and relay panel complete with all accessories as per technical specifications	sets	2		
A.3	**1.1 kV GRADE LOW VOLTAGE CABLES**				
1	Power Cables (PVC)	LS	1		
2	Control Cables (PVC)	LS	1		
3	Cable glands, lugs for Power & Control cables	LS	1		
A.4	**BATTERIES AND BATTERY CHARGER**				
1	Float cum boost battery charger for 110 V battery complete with all accessories as per technical specification	set	1		
2	110 V, 600 AH batteries complete with all accessories	set	1		
A.5	**GROUNDING**				

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 5: Installation & Other Services

S. No.	Item Description	Estimated		Construction, Installation, Testing & Commissioning Services (Excluding Taxes & Duties)	
		Unit	Quantity	Unit Rate (NRs.)	Amount (NRs.)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6) = (4) x (5)*
1	Galvanized E.H.S. steel wires of size 7/3.35 for lightning shield wire in take-off and internal structures complete with all accessories	LS	1		
2	Earthing of substation with conductors (of same size used in underconstruction substation), electrode, grounding materials complete with all accessories	LS	1		
A.6	**Bus post Insulator:**				
1	132 kV Bus post insulators	Nos	12		

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 5: Installation & Other Services

S. No.	Item Description	Estimated		Construction, Installation, Testing & Commissioning Services (Excluding Taxes & Duties)	
		Unit	Quantity	Unit Rate (NRs.)	Amount (NRs.)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6) = (4) x (5)*
A.7	**ERECTION & MISCELLANEOUS MATERIALS**				
1	132 kV insulator strings, Disc insulator & accessories to complete the specified scope of works including for line tower	LS	1		
2	132 kV hardware, clamp, connectors & accessories to complete the specified scope of works including for line tower	LS	1		
3	ACSR conductors and accessories to complete the specified scope of works (The conductor should be same as used in TL)	LS	1		
4	Main Tubular bus, branch buses, connectors, expansion joint including all other accessories required to complete 132 kV double bus-bar configuration (Minimum Outer diameter and thickness of main bus 100.0 and 7.0 mm respectively and that of branches 75.0 & 5.0 mm)	LS	1		
5	Marshaling Box/Kiosk made of stanless steel with suitable size in switchyard works	LS	1		
A.8	**Illumination System**				
1	Outdoor Switchyard, Substation area, Street lighting etc as per technical specification	LS	1		
A.9	**SUBSTATION AUTOMATION/ COMMUNICATION / SCADA (Based on IEC 61850)**				
a)	**SUBSTATION AUTOMATION SYSTEM:**				
1	Inclusion of complete Substation automation system for new bays including hardware and software for the substation & remote control stations alongwith associated equipments.				
1.1	132 kV System	Bays	2		
2	Integration of all 132/33/11kV Bays under present scope with the SCADA of SIEMENS (SINAUT Spectrum) at Load Dispatch Centre, Kathmandu including supply of Hardware, Software, accessories etc. as per TS Section Project.				
b)	**COMMUNICATION AND SCADA**				
1	Digital Protection Coupler	Nos	2		

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 5: Installation & Other Services

S. No.	Item Description	Estimated		Construction, Installation, Testing & Commissioning Services (Excluding Taxes & Duties)	
		Unit	Quantity	Unit Rate (NRs.)	Amount (NRs.)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6) = (4) x (5)*
2	Extension and interfacing of existing Communication Panel/equipment including Ethernet tributaries card Termination Equipment (Drop/Insert Multiplexer, Subscriber Line Interface Cards, Equipment Cabinets complete in all respects including establishment of Fibre Optic (FO) links for far end substation/s (Papung, Mewa hub SS) as per technical specifications	LS	1		
3	Optical Distribution Frame complete in all respects as per technical specifications	LS	1		
4	Optical Approach Cable -24 pair Fibre (DWSM -G.652D) along with Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable complete in all respects as per technical specifications	LS	1		
A.10	**CIVIL WORKS**				
a)	**Steel structure for post, beam and equipment supporting frame complete with bolts, fastner, pack washer, nuts, guest paltes and all accessories: (Extension works for 132 side)**				
1	132 kV take off gantry structures	Bays	2		
2	132 kV internal gantry structures gantry structure	Bays	2		
3	132 kV SF6 gas circuit breaker	Sets	2		
4	132 kV disconnecting switch with earth switch	Sets	4		
5	132 kV disconnecting switch with out earth switch	Sets	6		
6	132 kV capacitor voltage transformer	Nos	6		
7	132 kV current transformer	Nos	6		
8	120 kV surge arrestor	Nos	6		
9	132 kV Bus post insulator	Nos	12		

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 5: Installation & Other Services

S. No.	Item Description	Estimated		Construction, Installation, Testing & Commissioning Services (Excluding Taxes & Duties)	
		Unit	Quantity	Unit Rate (NRs.)	Amount (NRs.)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6) = (4) x (5)*
A.11	**Concrete Foundation for equipments and Steel Structures complete with excavation, backfilling, form works, lean concrete concrete works and reinforcement bars:**				
1.1	132 kV take off gantry structures (2 bay structure)	Set	1		
1.2	132 kV internal gantry structures gantry structure	Bays	6		
1.3	132 kV SF6 gas circuit breaker	Sets	2		
1.4	132 kV disconnecting switch with earth switch	Sets	4		
1.5	132 kV disconnecting switch with out earth switch	Sets	6		
1.6	132 kV capacitor voltage transformer	Nos	6		
1.7	132 kV current transformer	Nos	6		
1.8	120 kV surge arrestor	Nos	6		
1.9	132 kV Bus post insulator	Nos	12		
A.12	**Cable Trench, Duct Bank, Conduit and Hand hole and cable trays to complete the specified job**	Lot	1		
A.13	**Drains system including RCC slab cover**	Lot	1		
1	Providing and laying NP2, 150 mm internal diameter perforated RCC hume pipes for drainage works in switchyard area at 5 meter interval with water collection pits including RCC cover slab.	RM	500		
A.14	**MISCELLANEOUS WORKS:**				
1	Clearing and stripping of substation area as per specification including new bay at Dhungesangu substation	LS	1		
2	Site grading with earth filling by borrow pit earth including compaction and leveling etc all to complete the specified works as per technical specification	CUM	1000		
A.15	**Crushed rock surfacing as per technical specification on switchyard are**				
1	Fine Sand filling (100 MM)	Cu-M	200		
2	Crushed rock surfacing	Sq-M	2000		
A.16	Asphalt Road as per technical specification	Sq-M	200		
1	Supplying and laying of 600 mm dia NP3 hume pipe in cross drainage and cable trench work	RM	50		
A.17	**Protection works:**				
1	Brick masonary works (1:4)	Cu-M	50		
2	Reinforcement concrete M20 (RCC including reinforcement steel)	Cu-M	50		
3	Stone masonary works including PCC on the top (1:4)	Cu-M	50		

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 5: Installation & Other Services

S. No.	Item Description	Estimated		Construction, Installation, Testing & Commissioning Services (Excluding Taxes & Duties)	
		Unit	Quantity	Unit Rate (NRs.)	Amount (NRs.)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6) = (4) x (5)*
4	Gabion work	Cu-M	50		
Total of Schedule 5					-

Bidder's Name:….....
Signature of Bidder:….....
Designation: ….....
Date:….....
Company Stamp:….....

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV Bay extension at Dhungesangu Substation
Price Schedule

Price Schedule No. 6: Operation & Maintenance

S. No.	Item Description	Estimated		Operationg & Maintenance Services (Excluding Taxes & Duties)	
		Unit	Quantity	Unit Rate (NRs.)	Amount (NRs.)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6) = (4) x (5)*
	Not Applicable				
Total of Schedule 6					-

Bidder's Name:….....
Signature of Bidder:….....
Designation: ….....
Date:….....
Company Stamp:….....

RASTRIYA PRASARAN GRID COMPANY LIMITED
132 kV BAY EXTENSION AT DHUNGESANGU SUBSTATION
Price Schedule

Price Schedule No. 7: General Summary

L/C : Local Currency

S. No.	DESCRIPTION	TOTAL AMOUNT
		L/C (NRs)
1	Total of Price schedule 1: Provisional Sum	
2	Total of Price Schedule 2: General Items	
3	Total of Price Schedule 3: Design Services	
4	Total of Price Schedule 4a: Construction Items: Supply and delivery of Plant and Equipments from Abroad	
	Total of Price Schedule 4b: Construction Items: Supply and delivery of Plant and Equipments from Nepal	
5	Total of Price Schedule No. 5: Construction Items	
TOTAL OF PLANT, EQUIPMENTS CONSTRUCTION WITH LOCAL TRANSPORTATION & INSURANCE without TAX and Duties		

***Note:This overall project cost shall be taken into account for the purpose of evaluation.**

Bidder's Name:….....
Signature of Bidder:….....
Designation: ….....
Date:….....
Company Stamp:….....

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	Design, Supply, Installation, Testing and Commissioning of 132kV Line Bays & Associated Underground Cabling Work at Dhungesanghu Substation	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	Design, Supply, Installation, Testing and Commissioning of 132kV Line Bays & Associated Underground Cabling Work at Dhungesanghu Substation	Lot	1.0			

Total of Procument Items

Total Item Price	
VAT	
Grand Total	