

STANDARD BIDDING DOCUMENT

(FULL TURNKEY CONTRACT)

FOR

RURAL/URBAN ELECTRIFICATION WORKS OF **XXXX
(NAME OF DISTRICT) DISTRICT OF **XXXX** (NAME OF
STATE) UNDER DEENDAYAL UPADHYAYA GRAM
JYOTI YOJANA/INTEGRATED POWER DEVELOPMENT
SCHEME**

VOLUME-I

(CONTRACT CONDITIONS & SCOPE OF WORKS)

Section-I :	Invitation for Bids (IFB)
Section-II :	Instruction to Bidders (ITB)
Section-III :	Bid Data Sheets (BDS)
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Section-VI :	Sample Forms and Procedures
Section-VII :	Scope of Works

SPECIFICATION No.:

DOCUMENT NO.:

VOLUME-I: SECTION – I
INVITATION FOR BIDS (IFB)

INVITATION FOR BIDS (IFB)

Package-XXXX for Electrification works of XXXXX district in XXXXX(State name) under Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY)/Integrated Power Development Scheme (IPDS)

(DOMESTIC COMPETITIVE BIDDING)

(SINGLE STAGE TWO ENVELOPE BIDDING)

DATE OF ISSUANCE OF IFB: DD.MM.YYYY
 SPECIFICATION NO. : XXXX/@@@/\$\$\$\$
 FUNDING : DOMESTIC

- 1.0 This invitation for bids follows the procurement notice (Invitation for Bids) for the subject package(s) which appeared in National and Regional Newspapers on DD.MM.YYYY. This shall also be available on XXXXXX (EMPLOYER's Name) website given at para 11.0 from DD.MM.YYYY.
- 2.0 XXXXX(Name of Employer) (hereinafter referred to as 'XXXXX' (Short Name of Employer) have been entrusted to execute the Project i.e. Electrification works of XXXXX district in XXXXX(State name) under Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY)/Integrated Power Development Scheme (IPDS) on behalf of XXXX(DISCOM Name)/Government of XXXX(State Name). The execution of the project shall be funded out of the proceeds of financial assistance to be received by Government of XXXX(State Name)/(DISCOM Name) from Rural Electrification Corporation Limited (REC)/Power Finance Corporation Ltd (PFC) and the ownership of the project shall remain vested with Government of XXXX(State Name). The project shall be executed by XXXX(Short Name of Employer) on turnkey basis and all eligible payment under the project shall be made from the proceeds of financial assistance to be received by Government of XXXX(State Name)/(DISCOM Name). For the purpose of all procurement activities related to the aforesaid project, XXXX(Short Name of Employer) shall be referred to as 'Employer' and Government of XXXX(State Name)/(DISCOM Name) "the Owner"
- 3.0 (XXXX) (Short Name of Employer), therefore, invites sealed bids from eligible bidders for the following package(s) for aforesaid project on Domestic Competitive Bidding basis:

Sl. No.	Package
1	Package-XXXX for Electrification works of XXXX(District Name) district in XXXX (State Name) [Spec. No.: XXXX/@@@/\$\$\$\$]

This Invitation for Bids extended through media, website or written communication or by any other means, and issuance of Bidding Documents as per para 7.0 below shall not be construed to mean that the prospective bidders to whom the Invitation for Bids has been extended and/or Bidding Documents have been issued is deemed to be an eligible bidder. The eligibility of the bidders shall be determined as per the provisions of Bidding Documents.

- 3.1 This Specification covers the following scope of works:
- The scope of work under the subject package includes site survey, planning, design, engineering, assembly manufacturing, testing, supply, loading, transportation, unloading, insurance, delivery at site, handling, storage, installation, testing, commissioning and documentation of all items/material required to complete the Electrification works in XXXXX district which inter-alia include construction of New 66/11 kV Substation, New 33/11 kV Substation, 33 kV bay extension, construction of 33 kV lines, 11 kV & LT line, Installation of distribution transformer and providing service connection to BPL consumer spread all over the district. (to be amended by Employer as per scope of their bid)

The above scope of work is indicative and the detailed scope of work is given in the Bidding Documents.

3.2 The completion period for Package-XXXX for Electrification works of XXXXX district in XXXXX(State name) under Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY)/Integrated Power Development Scheme (IPDS) shall be the period as specified in ITB Sub-Clause 24.1(c).

3.3 Bidding will be conducted through the domestic competitive bidding procedures as per the provisions of ITB/BDS and the contract shall be executed as per the provisions of the Contract.

4.0 The detailed Qualifying Requirements (QR) are given in the Bidding Document.

5.0 The complete Bidding Documents including tender drawings and technical specifications are available at XXXX(Short Name of Employer) website http://www.*****.com (Name of Website address) Interested bidders can download the Bidding Documents and commence preparation of bids to gain time.

6.0 Interested eligible bidders may obtain further information from and inspect the Bidding Documents at the office of XXXX, (Designation of Officer of Employer) at the address given at para 11.0 below from XXXX hours (IST) to XXXX hours (IST) on all working days till the sale of Bidding Documents is open as per para 7.0 below.

7.0 Interested Bidders will be required to download the Bidding Documents from E-Portal XXXXX (website address of e-procurement portal) (for submission of bid).

Bid documents can be downloaded by payment of Rs 25,000/- online or by providing DD details in the web documents. The acceptance of price bid/commercial bid shall be subjected to acceptance of documents fee.

In case of any discrepancy between the documents downloaded by the prospective bidder and the Bidding Documents (hard copy) issued by EMPLOYER official, the latter shall prevail.

The Bidding Documents are meant for the exclusive purpose of bidding against this specification and shall not be transferred to any other party or reproduced or used otherwise for any purpose other than for which they are specifically issued.

8.0 A pre-bid meeting will be held at the office of the Employer at XXXXX (Location of meeting), India on DD.MM.YYYY at XXXX hrs to clarify the bidders various issues raised in accordance with clause 6.4 of ITB.

9.0 A Single Stage Bid Envelope Bidding Procedure followed by e-bidding for price bids will be adopted and will proceed as detailed in the Bidding Documents.

9.1 Bids must be delivered in single sealed envelopes to the address below at or before XXXX hours (IST) on DD.MM.YYYY. Price breakup shall be submitted electronically. Late bids will be rejected. Bid Envelope i.e. Techno Commercial Part shall be opened on the same day i.e. DD.MM.YYYY in the presence of the bidders' representatives who choose to attend in person at the address below at 1130 hours (IST). Price Bids shall be opened in the presence of the bidders' representatives who choose to attend at the time and date at the address given in the intimation for opening of Price bids in accordance with Clause 25 of ITB.

All bids must be accompanied by a bid security of Rs. XXXXXXX/- (2% of tender value or Rs 5 (five) crore, whichever is lower).

10.0 EMPLOYER reserves the right to cancel/withdraw this invitation for bids without assigning any reason and shall bear no liability whatsoever consequent upon such a decision.

11.0 All correspondence with regard to the above shall be to the following address.

(By Post/In Person)

Name of bid documentation issuance official:

Designation of the officer:

Complete postal Address with Telephone Nos & FAX.

Telephone Nos.:- (Direct) 0091-(0)XXX-XXXXXXX
(Thru Board) 0091-(0)XXX-XXXXXXX
Fax No(s).:- 0091-(0)XXX-XXXXXXX.

For more information, visit our site at http://www.*****.com

----- End of Section-I (IFB) -----

VOLUME-I: SECTION – II INSTRUCTION TO BIDDERS (ITB)

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Volume-I: Section – II
INSTRUCTION TO BIDDERS (ITB)Preamble:

This part, Instruction to Bidders (ITB), Section II of the Bidding Documents provides the information necessary for bidders to prepare responsive bids, in accordance with the requirements of the Employer. It also provides information on bid submission, opening and evaluation and on contract award. ITB Section II contains provisions that are to be used unchanged unless part Special Condition of Contract, Section V, which consists of provisions that supplement, amend, or specify in detail, information or requirements included in ITB Section II and that are specific to each procurement, states otherwise. If there is a conflict between the provisions of ITB Section – II & Special Condition of Contract Section – V, the provisions of Special Condition of Contract, Section – V shall prevail.

However, provisions governing the performance of the Contractor, payments under the contract or matters affecting the risks, rights and obligations of the parties under the contract are not included in this section but instead under Section – IV: General Conditions of Contract and/or Section – V: Special Conditions of Contract.

Further in all matters arising out of the provisions of this Section – II and the Section–III of the Bidding Documents, the laws of the Union of India shall be the governing laws and courts of XXXXXXX (name of city is to be mentioned by Employer) shall have exclusive jurisdiction.

(A) Introduction

1.0 General Instructions

1.1 The _____***/_____**, (implementer of the project on behalf of _____**/State Govt.) hereinafter called 'Employer' will receive bids in respect of equipment to be furnished and erected as set forth in the accompanying Specifications. All bids shall be prepared and submitted by bidders in accordance with these instructions.

1.2 Source of funds: The Owner named in the Bidding Documents intends to use the capital subsidy {60% (85% in case of special category states) of cost of the infrastructures in the project} under Deendayal Upadhyay Gram Jyoti Yojana (DDUGJY)/Integrated Power Development Scheme (IPDS), a Government of India flagship program for Separation of agriculture and non-agriculture feeders and/or Strengthening and augmentation of sub-transmission & distribution, 30% (10% in case of special category states) to be procured through loan from FIs/Bank and balance 10% (5% in case of special category states) shall be contributed by Utility for this project.

1.2.1 All the payments under the contract for the package for which this invitation for Bids is issued shall be made by the Employer {who is also named as Project Implementing Agency (PIA) by Ministry of Power/GoI} named in Bidding Documents.

1.3 For the purpose of implementation of subject package, Project Implementation Agency (Central CPSUs/DISCOM/Power Deptt) shall be referred as Employer and the State Government of concerned state where the works are to be executed shall be referred as "The Owner".

2.0 Eligibility of Bidder:

2.1 This Invitation for Bids, issued by Employer is open to all firms including company(ies), Government Owned Enterprises registered and incorporated in India as per Company Act, 1956/2013 (with amendment from time to time) barring Government department as well as foreign bidders/MNCs not registered and incorporated in India and those bidders with whom business is banned by the Employer.

2.2 A Bidder shall not have a conflict of interest. Any Bidders found to have a conflict of interest shall be disqualified. The bidder may be considered to have conflict of interest with one or more parties in this bidding process, if:

2.2.1 They have a controlling partner in common,

To be inserted: (*) Name of State (**) Name of State Power Utility (***) Name of Central Public Sector Utility

- 2.2.2 They receive or have received any direct or indirect subsidy from any of them; or
- 2.2.3 They have the same legal representative for purpose of this bid; or
- 2.2.4 They have a relationship with each other, directly or through common third parties, that puts them in position to have access to information about or influence on the bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or
- 2.2.5 A bidder submits more than one bid in the bidding process, either individually [including bid submitted as agent /authorised representative on behalf of one or more manufacturer(s) or through Licensee – Licensor route, wherever permitted as per the provision of Qualification requirement for Bidders] or as partner in a joint venture, except for alternative offers permitted under Invitation to Bid. This results in disqualification of all such bids. However, this does not limit the participation of a Bidder as a sub-contractor in another Bid, or of a firm as a sub-contractor in more than one bid; or
- 2.2.6 A Bidder or any of its affiliates participated as a consultant in the preparation of the design or technical specification of the materials and services/works that are subject of the bid, or
- 2.2.7 The Bidder, directly or indirectly shall not be a dependent agency of the Employer.
- 2.2.8 A prequalification process will be conducted prior to the bidding process, or conducted during process of the bidding, this bidding is open only to prequalified Bidders.
- 2.3 This bidding is open to any manufacturer or erector who provides satisfactory evidence concerning the following that he:
 - 2.3.1 is a qualified manufacturer or erector who supply, erect, testing and commission of the type specified and has adequate technical knowledge and practical experience;
 - 2.3.2 does not anticipate change in the ownership during the proposed period of work (if such a change is anticipated, the scope and effect thereof shall be defined);
 - 2.3.3 has adequate financial stability and status to meet the financial obligation pursuant to the scope of the works (the Bidders should submit at least 2 copies of their audited profit and loss account and balance sheet for the last five years);
 - 2.3.4 has adequate field services organisation to provide the necessary field erection and management services required to successfully erect, test and commission the equipment as required by the Specifications and Documents; and
 - 2.3.5 has established quality assurance systems and organisation designed to achieve high levels of equipment reliability, both during his manufacturing and field installation activities.
- 2.4 The above stated requirements are a minimum and Employer reserves the right to request for any additional information and also reserves the right to reject the Proposal of any Bidder, if in the opinion of Employer, the qualification data is incomplete or the Bidder is found not qualified to satisfactorily perform the Contract.
- 3.0 Eligible Plant: Equipment and Services
 - 3.1 For the purposes of these Bidding Documents, the words “facilities,” “plant and equipment,” “installation services,” etc., shall be construed in accordance with the respective definitions given to them in the General Conditions of Contract.
 - 3.2 All plant and equipment to be supplied and installed and services carried out under the contract shall have their origin in our country only.
- 4.0 Cost Of Bidding
 - 4.1 The Bidder shall bear all costs and expenses associated with preparation and submission of its bid including post-bid discussions, technical and other presentations etc, and Employer will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

(B) The Bidding Documents

5.0 Contents of bidding documents:

5.1 The goods and services required, bidding procedures and Contract terms are prescribed in the Bidding Document. The Bidding Document is a compilation of the following and shall include amendments, if any, thereto:

VOLUME – I: Condition of contract:

- | | |
|--------------|---|
| Section I: | Invitation for Bid (Section - IFB) |
| Section II: | Instructions to Bidders (Section – ITB) |
| Section III: | Bid Data sheets (BDS) |
| Section IV: | General Conditions of Contract (GCC) |
| Section V: | Special Conditions of Contract (SCC) |
| Section VI: | Sample Forms and Procedures (FP) |
1. Bid Form & Price Schedule
 - 1.1 Bid Form
 - 1.2 Price Schedule
 2. Bid Security Form
 3. Form of Notification by the Employer to the Bank
 - 3.a Applicable for forfeiture of Bank Guarantee
 - 3.b Applicable for conditional claim pending extension of Bank Guarantee by the bidder.
 4. Form of 'Notification of Award of Contract'
 - 4(a) Form of 'Notification of Award of Contract' for Supply of Plant and equipment
 - 4(b) Form of 'Notification of Award of Contract' for Installation of Plant and equipment
 5. Form of Contract Agreement
 - Alternative A
 - Alternative B
 - 5.1 Appendix-1: Terms and Procedures of Payment:
 - Grid/Power Substation, and
 - 11KV, Distribution Transformer, LT and Service connection
 - 5.2 Appendix-2: Price Adjustment
 - 5.3 Appendix-3: Insurance Requirements
 - 5.4 Appendix-4: Time Schedule
 - 5.5 Appendix-5: List of Approved Subcontractors
 - 5.6 Appendix-6: Scope of Works and Supply by the Employer
 - 5.7 Appendix-7: List of Document for Approval or Review
 - 5.8 Appendix-8: Guarantees, Liquidated Damages for Non-Performance
 6. Performance Security Form
 7. Bank Guarantee Form for Advance Payment
 8. Form of Taking over Certificate
 9. Form of Indemnity Bond to be executed by the Contractor for the Equipment handed over in one lot by Employer for performance of its contract.
 10. Form of Indemnity Bond to be executed by the Contractor for the Equipment handed over in instalment by Employer for performance of its contract.
 11. Form of Authorisation Letter
 12. Form of Trust Receipt for Plant, Equipment and Materials received
 13. Form of Extension of Bank Guarantee
 14. Form of Power of Attorney for Joint Venture
 15. Form of Undertaking by the Joint Venture Partners
 16. Format for Evidence of Access to or Availability of Credit/ Facilities
 17. Form of Operational Acceptance
 18. Form of Safety Plan to be submitted by the Contractor within sixty days of award of contract
 19. Form of joint deed of undertaking by the Sub-contractor along with the bidder /contractor
 20. Form of Certificate of Financial Parameters for QR

Section VII: Scope of Works

VOLUME-II: PMS, QUALITY ASSURANCE & EVALUATION MECHANISM, BID FORMS AND PRICE SCHEDULES

Section-I: PMS, Quality Assurance & Evaluation Mechanism (QAM), Documentation & PMA
Section-II: Bid Forms
Section-III: Price Schedules

Volume-III: TECHNICAL SPECIFICATONS & DRAWINGS

Section-I: Technical Specifications
Section-II: Tender Drawings

5.2 Understanding of bid documents: A prospective Bidder is expected to examine all instructions, forms, terms, technical specifications, tender drawings and scope of works in the Bid documents and fully inform himself as to all the conditions and matters which may in any way affect the scope of work or the cost thereof. Failure to furnish all information required in the Bid document or submission of a Bid not substantially responsive to the Bid document in every respect will be at the Bidder's risk and may result in the rejection of its bid.

6.0 Clarifications on Bid Documents; and Pre-Bid Meeting:

6.1 If the prospective Bidder finds discrepancies or omissions, in specifications and document or is in doubt as to the true meaning of any part, he shall at once make a request, in writing, for an interpretation/clarification, to Employer at his mailing address indicated in Bidding Documents. Similarly, if a Bidder feels that any important provisions in the documents, such as Governing laws, Taxes and Duties, Defect Liability, Limitation of Liability, Settlement of Disputes, Arbitration, Form of Contact Agreement, Price Adjustment, Bid Guarantees, Contract Performance Guarantee, Compensation for Delay, Payments Terms, Schedule of Execution/Completion of works, will be unacceptable, such an issue should be raised as above. Employer, then, will issue interpretation(s) and clarification(s) as he may think fit in writing or modification of the Bidding Documents that it receives no later than twenty-eight (28) days prior to original deadlines prescribed for submission of bids by Employer. The Employer shall not obliged to respond to any request for clarification received later than the above period. Further, mere request for clarification received from the Bidder shall not be a ground for seeking extension in the deadline for submission of bids. Written copies of Employer's response (including an explanation of the query but not identification of its source) will be sent to all prospective bidders that have received the Bidding Documents / uploaded to the e-portal under amendment or addendum.

6.2 Verbal clarification and information given by Employer or his employee(s) or his representative(s) shall not in any way be binding on Employer.

6.3 LOCAL CONDITIONS: It will be imperative on each Bidder to fully inform himself of all local conditions and factors, which may have any effect on the execution of the Contract covered under these documents and specifications. Employer shall not entertain any request for clarifications from the Bidders, regarding such local conditions. It must be understood and agreed that such factors have properly been investigated and considered while submitting the Proposals. No claim for financial adjustment to the Contract, awarded under these specifications and documents, will be entertained by Employer. Neither any change in the time schedule of the Contract nor any financial adjustments arising thereof shall be permitted by the Employer, which are based on the lack of such clear information or its effect on the cost of the Works to the Bidder.

6.4 The bidder's designated representative(s) is/are invited to attend a pre-bid meeting, which, if convened, will take place at the venue and time specified in the Biding Documents. The purpose of the meeting shall be to clarify any issue regarding the Biding Documents in general and the Technical Specifications in particular. The Bidder is requested, as far as possible to submit any question in writing, to reach the Employer not later than one week before the meeting. Minutes of the Meeting, including the text of the questions raised (without identifying the name of the bidders) and the

responses given, together with any responses prepared after the meeting, will be transmitted without any delay to all the purchasers of the Bidding Documents.

- 6.5 Non-attendance at the pre-bid meeting will not be a cause for disqualification of a bidder.
- 7.0 Amendment to Bidding Document
- 7.1 At any time prior to the deadline for submission of bids, the Employer may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective Bidder, modify the Bidding Document by amendment (s).
- 7.2 The amendment will be uploaded in e-portal (where tender is already uploaded) or notified by email to all prospective Bidders. Bidders are required to regularly check / visit the web-portal for e-procurement and to immediately acknowledge receipt of any such amendments, and it will be assumed that the information contained therein will have been taken into account by the Bidder in its bid. The Employer will bear no responsibility or liability arising out of non-receipt of the same in time or otherwise.
- 7.3 In order to afford prospective Bidders reasonable time in which to take the amendment into account in preparing their bids, the Employer may, at its discretion, extend the deadline for the submission of bid, in such cases, the Employer shall notify / upload amended / extended deadline on web-portal for e-procurement and website of the employer.
- 7.4 All notifications and clarifications also be uploaded by Employer on his web portal / tender portal.
- 7.5 Such amendments, clarifications, etc, shall be binding on the Bidders and will be given due consideration by the Bidders while they submit their bids and invariably enclose such documents as a part of the bid.

(C) Preparation of Bids

8.0 Language of Bid

The bid prepared by the Bidder and all correspondences and documents relating to the bid, exchanged by the Bidder and Employer shall be written in the English language, provided that any printed literature furnished by the Bidder may be written in another language so long as accompanied by an English translation of its pertinent passages. Failure to comply with this may disqualify a bid. For purposes of interpretation of the bid, the English translation shall govern.

9.0 Documents Comprising The Bid

- 9.1 The bidding shall be e-tendering basis. On due date of submission of bids, bids shall be submitted by the Bidder under "Single Stage – Bid Envelope" procedure of bidding. Under this procedure, the bid submitted by the Bidder in one envelope – Bid Envelope (also referred to as Techno - Commercial Part). The Bid envelope shall be submitted by bidders at notified date and time in hard copies. Price bid in form of Price schedule shall be uploaded by bidder on schedule date and time of submission of bids. It shall be opened, in presence of eligible bidders on notified date, time and venue.

The price schedule shall be uploaded by the bidder on web portal on which the NIT is floated on due date and time for submission of bids. The locked price bid shall be opened on notified date and time in presence of participating bidders who have qualified technically and commercially. The price breakup shall be uploaded by bidders on-line on web portal on due date of submission of bids. The price bids shall be locked and opened on notified date and time pertains to technically and commercially cleared bidders only in presence of participating bidders. Due intimation shall be given to technically and commercially cleared bidders about date and time of opening of on-line bids. The bids shall comprise of the following documents:

Bid Envelope:

- (a) Bid Form (Bid Envelope) duly completed and signed by the Bidder, together with all Attachments (available in Volume-II). All Attachments have been identified in ITB Sub-Clause 9.3 below.

(b) Technical Data Sheets (available in Volume-II), if any, duly completed by the Bidder.

9.2 Alternative bids shall not be accepted,

9.3 Each Bidder shall submit with its Techno - Commercial Part (Bid Envelope) the following attachments:

- a. Attachment 1: Bid Security (If required): A bid security in sealed separate Packet shall be furnished in accordance with ITB Clause 13 & ITB Clause 16.
- b. Attachment 2: Power of Attorney: A power of attorney, duly notarized, indicating that the person(s) signing the bid has (ve) the authority to sign the bid and thus that the bid is binding upon the Bidder during full period of its validity, in accordance with ITB Clause 14.
- c. Attachment 3: Bidder's Eligibility and Qualifications: In the absence of prequalification, documentary evidence establishing that the Bidder is eligible to bid in accordance with ITB Clause 2 and is qualified to perform the contract in accordance with Annexure – A (BDS), if its bid is accepted.

The documentary evidence of the Bidder's eligibility to bid shall establish to the Employer's satisfaction that the Bidder, at the time of submission of its bid, is eligible as defined in ITB Clause 2.

The documentary evidence of the Bidder's qualifications to perform the contract, if its bid is accepted, shall establish to the Employer's satisfaction that the Bidder has the financial, technical, production, procurement, shipping, installation and other capabilities necessary to perform the contract, and, in particular, meets the experience and other criteria outlined in the Qualification Requirement for the Bidders in Annexure – A (BDS) and shall also include the complete annual reports together with Audited statement of accounts of the company for last five years of its own (separate) immediately preceding the date of submission of bid.

[Note I. In the event the Bidder is not able to furnish the above information of its own (i.e., separate), being a subsidiary company and its accounts are being consolidated with its Group/ Holding/ Parent company, the Bidder should submit the audited balance sheet, income statement, other information pertaining to it only (not of its Group/Holding/Parent company) duly certified by any one of the authority [(i) Statutory Auditor of the Bidder/(ii) Company Secretary of the Bidder a (iii) A certified Public Accountant] certifying that such information/documents are based on the audited accounts as the case may be.

Note II. Similarly, if the Bidder happens to be a Group/Holding/ Parent company, the Bidder should submit the above documents/information of its own (i.e., exclusive of its subsidiaries) duly certified by any one of the authority mentioned in Note I above certifying that these information/documents are based on audited accounts, as the case may be.]

Unless otherwise mentioned in BDS, bids submitted by a joint venture having not more than three partners with one partner as lead partner, if allowed as per stipulated Qualification Requirements in Annexure-A (BDS), shall comply with the following requirements:

- i. The bid shall include all the information required for Attachment 3 as described above for each joint venture partner.
- ii. The bid shall be signed so as to be legally binding on all partners.
- iii. One of the partners responsible for performing a key component of the contract shall be designated as leader; this authorization shall be evidenced

by submitting with the bid a power of attorney signed by legally authorized signatories as per Form-14 of Volume-I : Section-VI (Sample Forms and Procedures).

- iv. The leader shall be authorized to incur liabilities and receive instructions for and on behalf of any and all partners of the joint venture, and the entire execution of the contract, including payment, shall be done exclusively with the leader, provided otherwise requested by the joint venture and agreed between the Employer and the leader.
 - v. All partners of the joint venture shall be liable jointly and severally for the execution of the contract in accordance with the contract terms.
 - vi. A copy of the agreement entered into by the joint venture partners shall be submitted with the bid as per Form-15 of Volume-I : Section-VI (Sample Forms and Procedures), including interalia delineation of responsibilities and obligations of each partners appended thereto, notwithstanding the joint and several liability.
 - vii. The joint venture agreement should indicate precisely the responsibility of all members of JV in respect of planning, design, manufacturing, supply, installation, commissioning and training.
 - viii. All members of JV should have active participation in execution during the currency of the contract. This should not be varied/modified subsequently without prior approval of the Employer; and
 - ix. In order for a joint venture to qualify, each of its partners or combination of partners must meet the minimum criteria listed in the Qualification Requirement for the Bidder in enclosed Annexure-A (BDS) for an individual Bidder for the component of the contract they are designated to perform. Failure to comply with this requirement will result in rejection of the joint venture bid.
 - x. A firm can be a partner in only one joint venture; bids submitted by joint ventures or consortia including the same firm as partner will be rejected.
 - xi. In the case of a Bidder who offers to supply and/or install plant and equipment under the contract that the Bidder did not manufacture or otherwise produce and/or install, the Bidder shall (i) have the financial and other capabilities necessary to perform the contract; (ii) have been duly authorized by the manufacturer or producer of the related plant and equipment or component as per proforma in attachment 8 to supply and/or install that item in the Employer's country; and (iii) be responsible for ensuring that the manufacturer or producer complies with the requirements of ITB Sub-Clause 3.2 and meets the minimum criteria listed for an individual Bidder for that item.
- d. Attachment 4: Eligibility and Conformity of the Facilities- Documentary evidence established in accordance with ITB Clause 3 that the facilities offered by the Bidder in its bid are eligible and conform to the Bidding Documents.

The documentary evidence of the eligibility of the facilities shall consist of a statement on the country of origin of the plant and equipment offered, which shall be confirmed by a certificate of origin issued at the time of shipment.

- e. Attachment 5: Subcontractors Proposed by the Bidder: The Bidder shall include in its bid details of all major items of supply or services that it proposes to purchase or sublet, and shall give details of the name and nationality of the proposed Subcontractor, including vendors, for each of those items. Bidders are free to list more than one Subcontractor against each item of the facilities. Their participation

should be confirmed with a letter of intent between the parties, as needed, in Attachment 8. Quoted rates and prices will be deemed to apply to whichever Subcontractor is appointed, and no adjustment of the rates and prices will be permitted.

The Bidder shall be responsible for ensuring that any Subcontractor proposed complies with the requirements of ITB Clause 2, and that any plant, equipment or services to be provided by the Subcontractor comply with the requirements of ITB Clause 3 and Qualification Requirement for the Bidder, enclosed as Annexure-A(BDS).

The Employer reserves the right to delete any proposed Subcontractor from the list prior to award of contract, and after discussion between the Employer and the Contractor, the Appendix-5 of Volume-I:Section VI - Form of Contract Agreement shall be completed, listing the approved Subcontractors for each item concerned.

- f. Attachment 6: Deviations: In order to facilitate evaluation of bids, deviations, if any, from the terms and conditions or Technical Specifications shall be listed in Attachment 6 to the bid. The Bidder is required to provide the cost of withdrawal for such deviations. However, the attention of the bidders is drawn to the provisions of ITB Sub-Clause 22.3 regarding the rejection of bids that are not substantially responsive to the requirements of the Bidding Documents.

Bidder's attention is also drawn to the provisions of ITB Sub-Clause 22.3.1.

- g. Attachment 8: Manufacturer's Authorisation Form
- h. Attachment 9: Work Completion Schedule.
- i. Attachment 10: Guarantee Declaration.
- j. Attachment 11: Information regarding ex-employees of Employer in Bidder's firm.
- k. Attachment 12: Price Adjustment Data
- l. Attachment 14: Integrity Pact: The Bidder shall complete the accompanying Integrity Pact, which shall be applicable for bidding as well as contract execution, duly signed on each page by the person signing the bid and shall be returned by the Bidder in two (2) originals alongwith the Techno - Commercial Part in a separate packet, duly superscripted with 'Integrity Pact'. The Bidder shall submit the Integrity Pact on a non-judicial stamp paper of Rs. 100/-.

If the Bidder is a joint venture, the Integrity Pact shall be signed by all the partners or consortium members.

Bidder's failure to submit the Integrity Pact duly signed in Original alongwith the Bid or subsequently pursuant to ITB Sub-Clause 21 .1 shall lead to outright rejection of the Bid.

- m. Attachment 15: Option for Initial Advance (either Interest Bearing Initial Advance or No Initial Advance) and Information for E-payment, PF details and declaration regarding Micro/Small & Medium Enterprises

In this Attachment, the Bidder is required to clearly mention whether the Bidder would opt for Interest bearing initial advance in addition to providing the other information as above.

- n. Attachment 16: Additional Information:
- i. Certificate from their Banker(s) (as per prescribed formats in Form 16, Volume-I : Section-VI (Sample Forms and Procedures)) indicating various fund based/non fund based limits sanctioned to the Bidder and the extent of utilization as on date. Such certificate should have been issued not earlier

than three months prior to the date of bid opening. Wherever necessary the Employer may make queries with the Bidders' Bankers.

ii. Detailed information on any litigation or arbitration arising out of contracts completed or under execution by it over the last five years. A consistent history of awards involving litigation against the Bidder or any partner of JV may result in rejection of Bid.

iii. Any other information which the Bidder intends to furnish.

o. Attachment 17: Declaration for tax exemptions, reductions, allowances or benefits

p. Attachment 18: Declaration

q. Attachment 19: Bank Guarantee verification checklist

11.0 Bid Form and Price Schedules:

The Bidder shall complete the Bid Form(s) and submit it in hard copy on due date and time of submission of bid. The appropriate Price Schedules furnished in the Bidding Documents as indicated therein, shall be uploaded on web portal on due date and time of submission of bids.

11.0 Bid Prices:

11.1 Unless otherwise specified in the Technical Specifications, bidders shall quote for the entire facilities on a "single responsibility" basis such that the total bid price covers all the Contractor's obligations mentioned in or to be reasonably inferred from the Bidding Documents in respect of the design, manufacture, including procurement and subcontracting (if any), delivery, construction, installation and completion of the facilities. This includes all requirements under the Contractor's responsibilities for testing, pre-commissioning and commissioning of the facilities and, where so required by the Bidding Documents, the acquisition of all permits, approvals and licenses, etc.; the operation, maintenance and training services and such other items and services as may be specified in the Bidding Documents, all in accordance with the requirements of the General Conditions of Contract. Items against which no 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 prices for other items.

11.2 Bidders are required to quote the price for the commercial, contractual and technical obligations outlined in the Bidding Documents. If a Bidder wishes to make a deviation, such deviation shall be listed in Attachment 6 of its bid. The Bidder is required to provide the cost of withdrawal for such deviations.

11.3 Bidders shall give a breakdown of the prices in the manner and detail called for in the Price Schedules. Where no Price Schedules are included in the Bidding Documents, Bidders shall present their prices in the following manner:

Separate numbered Schedules shall be up-loaded for each of the following elements. The total amount from each Schedule 1 to 4 shall be summarized in a grand summary of Price Proposal (Schedule 5) giving the total bid price(s) to be entered in the Bid Form.

- Schedule 1 Plant and Equipment to be supplied
- Schedule 2: Transportation, Insurance and other incidental services applicable for supply of Plant & Equipment
- Schedule 3: Installation Services for Erection, Testing and Commissioning including Local Transportation,
- Schedule 4: Taxes and Duties not included in Schedule 1 to 3

Schedule 5: Grand Summaries (Schedule Nos. 1 to 4)

Bidders shall note that the plant and equipment included in Schedule No. 1 above exclude materials used for civil, building and few other construction/erection works. All such materials shall be included and priced under Schedule No. 3, Installation Services.

11.3.1 It shall be the responsibility of the bidders to pay all statutory taxes, duties and levies to the concerned authorities for such surplus material, which would otherwise have been, lawfully payable. The bidders shall submit an indemnity bond to keep Employer harmless from any liability, before release of such material to the bidder by Employer.

11.3.2 Set/Lot/Lump-sum shall be governed as per the requirement of the corresponding item description read in conjunction with relevant provisions of Technical Specifications.

11.4 In the schedules, Bidder shall give the required details and a break -own of their price as follows:

- a. Plant and equipment shall be quoted on an EXW (ex-factory, ex-works, ex-warehouse or off-the-self, as applicable) basis and to be quoted in Schedule 1.

In respect of direct transaction between the Employer and the Contractor, EXW price shall be exclusive of all cost as well as duties and taxes (viz., customs duties & levies, duties, sales tax/VAT etc.) paid or payable on components, raw materials and any other items used for their consumption incorporated or to be incorporated in the Plant & Equipment.

Sales tax/VAT, excise duty, local tax and other levies for equipment/items under direct transaction including octroi/entry tax as applicable for destination site/state shall not be included in the EXW price but shall be indicated wherever applicable in respective column of Schedule 4.

Whenever EXW price is quoted exclusive of excise duty and/or VAT, then the due credit under the CENVAT (Central Value Added Tax)/VAT scheme as per the relevant Government policies wherever applicable shall be taken into account by the Bidder while quoting bid price.

In respect of bought-out finished items, which shall be dispatched directly from the sub-vendor's works to the Employer's site (sale-in-transit), EXW price shall be inclusive of all cost as well as duties and tax (viz., custom duties & levies, duties, sales tax/VAT etc.) paid or payable. While quoting the EXW price, inclusive of excise duty and/or VAT, the due credit under the CENVAT (Central Value Added Tax)/VAT scheme as per the relevant Government policies wherever applicable shall be taken into account by the Bidder.

Imported goods shall not be acceptable. Only indigenous goods shall be acceptable in the contract.

However, octroi/entry tax as applicable for destination site/state shall not be included in the EXW price but shall be indicated separately in respective column of Schedule 4.

Requisite Sales Tax Declaration forms for all the equipment/items to be supplied from within India shall be furnished by the Employer.

- b. Local transportation, insurance and other Services incidental to delivery of the Plant and Equipment to be supplied shall be quoted separately in Schedule 2.
- c. Installation Charges shall be quoted separately (Schedule 3) and shall include rates and prices for all labour, Contractor's equipment, temporary works, materials, consumables and all matters and things of whatsoever nature, provision of operations and maintenance manuals, etc. wherever identified in the Bidding Documents as necessary for the proper execution of all installation services except those priced in other Schedules.
- d. ~~The break up of Training Charges shall be furnished separately in Schedule 4 for the training. Similarly, the break up of Type test charges shall be furnished separately in Schedule 7. – Not Applicable~~

- e. The bidder shall include the Sales Tax/VAT on Works Contract, Turnover Tax or any other similar taxes under the Sales Tax/VAT Act for services to be performed, as applicable in their quoted bid price and Employer would not bear any liability on this account. Employer on behalf of the Owner shall, however, deduct such taxes at source as per the rules and issue Tax Deducted at Source (TDS) Certificate to the bidder.
- f. The Bidder shall include Service Tax and surcharge/cess etc. on it as applicable in their quoted bid price and Employer would not bear any liability whatsoever on this account. Employer (or the Employer on behalf of the Owner) shall, however, deduct such tax at source as per the rules and issue necessary Certificate to the Contractor.
- g. The Bidder shall include insurance charges in its bid prices as per insurance requirement mentioned in Section – IV: General Conditions of Contract (GCC) and Appendix-3: Insurance Requirements to Form of Contract Agreement as contained in Volume-I : Section VI (Sample Forms and Procedures) of the Bidding Documents. Bidder shall further note that the Employer shall not be liable to make any payment/ reimbursement to the Contractor whatsoever for insurance of Contractor's Plant and Machinery.

Discount(s)/rebate(s) offered by the bidder shall be indicated as a percentage of price component(s). Bidder shall also indicate in his bid, the price component(s) on which the discount is to be applied.

11.5 The prices shall be in accordance with the following:

The prices shall be in accordance with Appendix-2 of section-VI: Sample forms and procedures

12.0 Bid Currencies

12.1 Prices shall be quoted in Indian Rupees Only.

13.0 BID security:

13.1 The Bidder shall furnish, as part of its bid, a bid security in the amount and currency as stipulated in the Bid Documents. The bid security must be submitted in the form provided in the Bidding Documents.

13.2 The bid security shall, at the bidder's option, be in the form of a crossed bank draft/pay orders/bank guarantee in favour of Employer from a reputed (i) Public Sector Bank located in India; or (ii) Scheduled Commercial Indian Private Bank as per the attached list only [List is placed at Annexure-I to Section-III (BDS)]. Bid security shall remain valid for a period of thirty (30) days beyond the original bid validity period, and beyond any extension subsequently requested under ITB Sub-Clause 14.2. In case of submission of the Bid Security in form of Bank Guarantee, bid security shall be submitted in standard format (Bid security form) provided at Volume-I:Section-VI "Sample forms and procedures".

The Bid Security shall be in favour of XXXXX (Name of Employer) payable at XXXX (Location/City of payment).

13.3 Any bid not accompanied by a bid security or an acceptable bid security shall be rejected by the Employer as being nonresponsive, pursuant to ITB Sub-Clause 22.4. The bid security of a joint venture must be in the name of all the partners/lead partner in the joint venture submitting the bid.

13.4 The bid securities of unsuccessful bidders will be returned as promptly as possible, but not later than twenty-eight (28) days after the expiration of the bid validity period.

13.5 The successful Bidder shall be required to keep its bid security valid for a sufficient period till the performance security(ies) pursuant to ITB Clause 34 are furnished to the satisfaction of the Employer.

To be inserted: (*) Name of State (**) Name of State Power Utility (***) Name of Central Public Sector Utility

The bid security of the successful Bidder will be returned when the Bidder has signed the Contract Agreement, pursuant to ITB Clause 33, and has furnished the required performance security, pursuant to ITB Clause 34.

- 13.6 The bid security may be forfeited
- (a) If the Bidder withdraws its bid during the period of bid validity specified by the Bidder in the Bid Form; or
 - (b) In case the Bidder does not withdraw the deviations proposed by him, if any, at the cost of withdrawal stated by him in the bid and/or accept the withdrawals/rectifications pursuant to the declaration/confirmation made by him in Attachment – Declaration of the Bid; or
 - (c) If a Bidder does not accept the corrections to arithmetical errors identified during preliminary evaluation of his bid pursuant to ITB Sub-Clause 27.2; or
 - (d) If, as per the requirement of Qualification Requirements the Bidder is required to submit a Deed of Joint Undertaking and he fails to submit the same, duly attested by Notary Public of the place(s) of the respective executant(s), within ten days from the date of intimation of post – bid discussion; or
 - (e) In the case of a successful Bidder, if the Bidder fails within the specified time limit
 - (i) to sign the Contract Agreement, in accordance with ITB Clause 33, or
 - (ii) to furnish the required performance security(ies), in accordance with ITB Clause 34 and/or to keep the bid security valid as per the requirement of ITB Sub-Clause 13.5.
- 13.7 No interest shall be payable by the Employer on the above Bid Security.
- 14.0 Period of Validity of Bid
- 14.1 Bids shall remain valid for the period of six months after the date of opening of Techno - Commercial Part i.e. Bid Envelope, prescribed by the Employer, pursuant to ITB Sub-Clause 20.1. A bid valid for a shorter period shall be rejected by the Employer as being non-responsive.
- 14.2 In exceptional circumstance, the Employer may solicit the Bidder's consent to an extension of the bid validity period. The request and responses thereto shall be made in writing or by e-mail. If a Bidder accepts to prolong the period of validity, the bid security shall also be suitably extended. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request will not be required or permitted to modify its bid.
- 15.0 Format and Signing of Bid
- 15.1 The Bidder shall prepare an original and two number of copies of the bid, clearly marking each one as "Original Bid", "Copy No. 1", "Copy No. 2", as appropriate. In the event of any discrepancy between them, the original shall govern.
- 15.2 The original and both the copies of the bid, each consisting of the documents listed in ITB Clause 9, shall be typed or written in indelible ink and shall be signed by the Bidder or a person or persons duly authorized to bind the Bidder to the contract. The latter authorization shall be indicated by written power of attorney accompanying the bid and submitted as Attachment 2 to the Bid under ITB Sub-Clause 9.3. All pages of the bid, except for unamended printed literature, shall be initialed by the person or persons signing the bid and shall be serially numbered.
- 15.3 The bid shall contain no alterations, omissions or additions, unless such corrections are initialed by the person or persons signing the bid.

(D) Submission of Bids

16.0 Sealing and Marking of Bids

16.1 The Bidder shall seal the original and each copy of the bid in separate envelopes, duly marking the envelopes as "Original Bid" and "Copy No. [number]" and each containing two inner separately sealed envelopes marked Bid Envelope (Techno – Commercial Part) containing the documents mentioned at ITB Clause 9 in the following manner. These envelopes shall then be sealed in an outer envelope.

Bid Envelope (Techno – Commercial Part) consisting two inner envelopes with following Packets:

Inner Envelope-1:

- a) Packet No.-I mentioning on the envelope the following: "Packet No.-I: Integrity Pact (Part of Bid Envelope Bid)"
- b) Packet No.-II : Bid Price (Cost of bid document, if not paid ON-LINE or proof of cost of bid document paid).
- c) Packet No.-III : Bid Security

Inner Envelope-2:

- a) Packet No.-I: Bid Form (Containing Pre-Qualification Requirements' documents as per 16 Nos. attachments as Attachment -7 and Attachment 13 of Bid forms not required)
- b) Packet No.-II : Techno-commercial offers (copy of entire bid document duly signed and stamped as token of unconditional acceptance to the terms and conditions of the contracts, technical specification, scope of contract, tender drawings, etc as per bid documents)

Inner Envelope-1 and Inner Envelope-2 duly sealed and stamped shall be sealed in an outer envelope named as Bid Envelope.

16.2 The inner and outer envelopes shall

- (a) be addressed to the Employer at the address given in the BDS, and
- (b) bear the contract name indicated in the BDS, the Invitation for Bids title and number indicated in the BDS, and the statement "Do Not Open Before [date]," to be completed with the time and date specified in the BDS, pursuant to ITB Sub-Clause 20.1.

16.3 All the inner envelopes shall also indicate the name and address of the Bidder so that the bid can be returned unopened in case it is declared "late."

16.4 If the outer envelope is not sealed and marked as required by ITB Sub-Clause 16.2 above, the Employer will assume no responsibility for the bid's misplacement or premature opening. If the outer envelope discloses the Bidder's identity, the Employer will not guarantee the anonymity of the bid submission, but this disclosure will not constitute grounds for bid rejection.

17.0 Deadline for Submission of Bids

17.1 Bids must be received by the Employer at the address specified under ITB Sub-Clause 16.2 no later than the time and date stated in the BDS. In the event of the specified date for the submission of bids being declared a holiday for the Employer, the bids will be received upto the appointed time on the next working day. Bids once received by the Employer shall not be returned except otherwise provided in the Bidding Documents.

- 17.2 The Employer may, at its discretion, extend this deadline for submission of bids by amending the Bidding Documents in accordance with ITB Sub-Clause 7.3 for the reasons specified therein at any time prior to opening of bids by the Employer pursuant to ITB Clause 20, in which case all rights and obligations of Employer and bidders will thereafter be subject to the deadline as extended.
- 18.0 Late Bids
- 18.1 Any bid received by the Employer after the bid submission deadline prescribed by the Employer, pursuant to ITB Clause 17, will be rejected and returned unopened to the Bidder.
- 19.0 Modification and Withdrawal of Bids
- 19.1 The Bidder may modify or withdraw its bid after submission, provided that modification or written notice of withdrawal is received by the Employer prior to the deadline prescribed for bid submission.
- 19.2 The Bidder's modifications shall be prepared, sealed, marked and dispatched as follows:
- (a) The Bidders shall provide an original and two number of copies of any modifications to its bid, clearly identified as such, in two inner envelopes duly marked "Bid Modifications Envelope —Original" and "Bid Modifications Envelope —Copies." The inner envelopes shall be sealed in an outer envelope, which shall be duly marked "Bid Modifications."
 - (b) Other provisions concerning the marking and dispatch of bid modifications shall be in accordance with ITB Sub-Clauses 16.2, 16.3 and 16.4.
- 19.3 A Bidder wishing to withdraw its bid shall notify the Employer prior to the deadline prescribed for bid submission through withdrawal option on web portal for e-procurement. The notice of withdrawal shall
- (a) be addressed to the Employer at the address named in the BDS, and
 - (b) bear the contract name, the IFB number, and the words "Bid Withdrawal Notice." Bid withdrawal notices received after the bid submission deadline will be ignored, and the submitted bid will be deemed to be a validly submitted bid.
- 19.4 No bid may be withdrawn in the interval between the bid submission deadline and the expiration of the bid validity period specified in ITB Clause 14. Withdrawal of a bid during this interval may result in the Bidder's forfeiture of its bid security, pursuant to ITB Sub-Clause 13.6.
- (E). Bid Opening and Evaluation
- 20.0 Opening of Bid Envelope by Employer
- 20.1 The Employer will open the Bid Envelope i.e. Techno – Commercial Part in public, including withdrawals and modifications made pursuant to ITB Clause 19, in the presence of bidders' designated representatives who choose to attend, at the time, date, and location stipulated in the BPS. The bidders' representatives who are present shall sign a register evidencing their attendance. In the event of the specified date for the submission of bids being declared a holiday for the Employer, the bids will be received upto the appointed time on the next working day.
- 20.2 Envelopes marked "Withdrawal" shall be opened first and the name of the Bidder shall be read out. Bids for which an acceptable notice of withdrawal has been submitted pursuant to ITB Clause 19 shall be returned unopened.

20.3 For all other Bids, the bidders' names, deviation having cost of withdrawal, if any, the presence of bid security, Integrity Pact and any such other details as the Employer may consider appropriate, will be announced by the Employer at the opening. Subsequently, all envelopes marked "Modification" shall be opened and the submissions therein read out in appropriate detail. No bid shall be rejected at bid opening except for late bids pursuant to ITB Clause 18. Such bids shall be returned to the Bidder unopened. However, opening of bid, whether or not accompanied with the bid security and/or Integrity Pact, shall not be construed to imply its acceptability which shall be examined in detail pursuant to the provisions contained in this Section-II.

On behalf of Employer, the Integrity Pact will be signed by its representative at the time of Bid Opening. One original of the Integrity Pact will be retained by Employer and the other original will be returned to the representative of the bidders present during bid opening. If the Bidder's representative is not present during the Bid Opening, the other original shall be sent to the bidder by post/courier.

20.4 The Employer shall prepare minutes of the bid opening in the form of Bid Opening Statement, including the information disclosed to those present in accordance with ITB Sub-Clause 20.3.

20.5 Bids not opened and read out at bid opening shall not be considered further for evaluation, irrespective of the circumstances and shall be returned to the Bidder unopened.

21.0 Clarification of Bids

21.1 During bid evaluation, the Employer may, at its discretion, ask the Bidder for a clarification of its bid. In case of erroneous/non submission of documents related to/identified in ITB Sub-Clause 9.3 (b), (n) and (r) or Deed of Joint Undertaking pursuant to ITB Sub-Clause 9.3 (c) & (e), required to be submitted by the Bidder as per the provisions of the Bidding Documents, the Employer may give the Bidder not more than 7 working days' notice to rectify/furnish such documents, failing which the bid shall be rejected. The request for clarification and the response shall be in writing, and no change in the price or substance of the bid shall be sought, offered or permitted.

22.0 Preliminary Examination of Bid Envelope

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

22.2 The Employer may waive any minor informality, nonconformity or irregularity in a bid that does not constitute a material deviation, whether or not identified by the Bidder in Attachment 6 to its bid, and that does not prejudice or affect the relative ranking of any Bidder as a result of the technical and commercial evaluation, pursuant to ITB Clause 24.

22.3 Prior to the detailed evaluation, the Employer will determine whether each bid is of acceptable quality, is complete and is substantially responsive to the Bidding Documents. Any deviations, conditionality or reservation introduced in Attachment-6 and/or in the Bid Form, Technical Data Sheets and covering letter, or in any other part of the bid will be reviewed to conduct a determination of the substantial responsiveness of the bidder's bid. For purposes of this determination, a substantially responsive bid is one that conforms to all the terms, conditions and specifications of the Bidding Documents without material deviations, objections, conditionalities or reservations. A material deviation, objection, conditionality or reservation is one (i) that affects in any substantial way the scope, quality or performance of the contract; (ii) that limits in any substantial way, inconsistent with the Bidding Documents, the Employer's rights or the successful Bidder's obligations under the contract; or (iii) whose rectification would unfairly affect the competitive position of other bidders who are presenting substantially responsive bids.

22.3.1 Bids containing deviations from critical provisions relating to GCC Clauses 2.14 (Governing Law), 8 (Terms of Payment), 9.3 (Performance Security), 10 (Taxes and duties), 21.2 (Completion Time Guarantee), 22 (Defect Liability), 23 (Functional Guarantee), 25 (Patent Indemnity), 26 (Limitation of Liability), 38 (Settlement of Disputes), 39 (Arbitration) and Appendix 2 to the Form of Contract Agreement (Price Adjustment) will be considered as non-responsive.

22.3.2 Regarding deviations, conditionality or reservations introduced in the bid, which will be reviewed to conduct a determination of substantial responsiveness of the Bidder's bid as stated in ITB Sub-Clause 22.3, the order of precedence of these documents to address contradictions, if any, in the contents of the bid, shall be as follows:

- I. Covering Letter
- II. Bid Form
- III. Attachment-6: Deviations
- IV. Technical Data Sheet

Contents of the document at Sr. No. I above will have overriding precedence over other documents (Sr. No. II to V above). Similarly, contents of document at Sr. No. II above will have overriding precedence over other documents (Sr. No. III to IV above), and so on.

22.4 If a bid is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by the Bidder by correction of the nonconformity. The Employer's determination of a bid's responsiveness is to be based on the contents of the bid itself without recourse to extrinsic evidence.

23.0 Qualification

23.1 The Employer will ascertain to its satisfaction whether Bidders determined having submitted substantially responsive bids are qualified, as per the Qualification Requirement specified in Annexure – A (BDS) to satisfactorily perform the contract. The Employer shall be the sole judge in this regard and the Employer's interpretation of the Qualification Requirement shall be final and binding.

23.2 The determination will take into account the Bidder's financial, technical capabilities including production capabilities, in particular the Bidder's contract work in hand, future commitments & current litigation and past performance during execution of contracts that have been awarded by the Employer on the Bidder. It will be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder in Attachment 3 to the bid, as well as such other information as the Employer deems necessary and appropriate. This shall, however, be subject to assessment that may be carried out, if required, by the Employer as per the provisions of Annexure -A (BDS).

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

23.4 An affirmative determination will be a prerequisite for the Employer to evaluate the Techno - Commercial Part and to intimate successful bidders to be present on new date, time & location to open the online price schedules of the Bidder. A negative determination will result in rejection of the Bidder's bid.

23.5 The bid from those bidders shall not be accepted who failed to submit Performance Security on issue of Letter of Intent (LoI)/Letter of Award (LoA) for any other contract of Employer in past 3 years.

24.0 Evaluation of Techno - Commercial Part (Bid envelop)

24.1 The Employer will carry out a detailed evaluation of the bids of the qualified bidders in order to determine whether the technical aspects are in accordance with the requirements set forth in the Bidding Documents. In order to reach such a determination, the Employer will examine the information supplied by the bidders, pursuant to ITB Clause 9, and other requirements in the Bidding Documents, taking into account the following factors:

- (a) overall completeness and compliance with the Technical Specifications and Drawings; deviations from the Technical Specifications as identified in Attachment 6 to the bid and those deviations not so identified; suitability of the facilities offered in relation to the environmental and climatic conditions prevailing at the site; and quality, function and operation of any process control concept included in the bid. The bid that does not meet

minimum acceptable standards of completeness, consistency and detail will be rejected for non-responsiveness.

- (b) Achievement of specified performance criteria by the facilities
- (c) Compliance with the time schedule called for in the corresponding Appendix to the Form of Contract Agreement and evidenced as needed in a milestone schedule provided in the bid;

Time schedule (program of performance)

The plant and equipment covered by this bidding shall have the 'Taking Over' by the Employer after successful Completion within the period specified in BDS. Bidders are required to base their prices on the time schedule given in Appendix 4 [Volume-I : Section-VI (Sample Forms and Procedures)] to the Form of Contract Agreement (Time Schedule) or, where no time schedule is given in Appendix 4, on the Completion date(s) given above. No credit will be given to earlier completion. Bids offering completion beyond the specified period are liable to be rejected.

- (d) Type, quantity and long-term availability of mandatory and recommended spare parts and maintenance services
- (e) Any other relevant technical factors that the Employer deems necessary or prudent to take into consideration.
- (f) Any deviations to the commercial and contractual provisions stipulated in the Bidding Documents.
- (g) Details furnished by the bidder in response to the requirements specified in Volume-II of the Bidding Documents.
- (h) The acceptability of the vendors and subcontractors proposed in Attachment 5 to be used by the Bidder will be evaluated. Should a vendor or subcontractor, for the items other than those covered under Annexure-A (BDS), be determined to be unacceptable, the bid will not be rejected, but the Bidder will be required to substitute an acceptable vendor or subcontractor without any change to the bid price.
- (i) The no load and load losses of transformer shall not exceed the values given in IS 1180 (Part-I):2014 & IS 2026 (with up-to-date amendments, if any). In case, Technical Losses found to be more than specified values, transformers shall be rejected.
- (j) Bank Guarantee submitted against Bid Security shall be verified independently from issuing bank. On receipt of certification from issuing bank, eligibility of bidder shall be decided for opening of price bid.

25.0 Opening of Price Schedules (ON-LINE) by Employer

- 25.1 Price Part of only those Bidders shall be opened on-line who are determined as having submitted substantially responsive bids and are ascertained to be qualified to satisfactorily perform the Contract, pursuant to ITB Clause 23 and 24. Such Bidders shall be intimated about the date and time for opening of Price Part by the Employer. A negative determination of the bids pursuant to ITB Clause 23 and 24, shall be notified by the Employer to such Bidders and the price bid uploaded by them shall not be opened.
- 25.2 The Employer will on-line open Price Bid at the specified time and date in the presence of bidders' designated representatives who choose to attend, at the time, date, and location stipulated in the intimation for opening of price bid. The bidders' representatives who are present shall sign a register evidencing their attendance.

- 25.3 The bidders' names, the Bid Prices or any discounts, and any such other details as the Employer may consider appropriate, will be announced by the Employer at the opening. The prices and details as may be read out during the bid opening and recorded in the Bid Opening Statement would not be construed to determine the relative ranking amongst the Bidders, or the successful Bidder, and would not confer any right or claim whatsoever on any Bidder. The successful Bidder (also referred to as the L₁ Bidder) shall be determined as per the provisions of this Section – II and considered for award of contract as provided in ITB Clause 30.
- 25.4 The Employer shall prepare minutes of the bid opening, including the information disclosed to those present in accordance with ITB Sub-Clause 25.3.
- 25.5 Bids not opened and read out at bid opening shall not be considered further for evaluation, irrespective of the circumstances.

26.0 Conversion to Single Currency

- 26.1 This shall not be applicable as domestic firms are required to quote the prices in Indian Rupees only.

27.0 Evaluation of Price Bids

- 27.1 The Employer will examine the Price Bids to determine whether they are complete, whether any computational errors have been made and whether the bids are generally in order.

The Price Bids containing any deviations and omissions from the contractual and commercial conditions and the Technical Specifications which have not been identified in the Bid Envelope are liable to be rejected.

- 27.2 Arithmetical errors will be rectified on the following basis. If there is a discrepancy between the unit price and the total price, which is obtained by multiplying the unit price and quantity specified by the Employer, the unit price shall prevail, and the total price shall be corrected. However, in case of items quoted without indicating any quantity or the items for which the quantities are to be estimated by the Bidder, the total price quoted against such items shall prevail. If there is a discrepancy between words and figures, the amount in words will prevail.

The prices of all such item(s) against which the Bidder has not quoted rates/amount (viz., items left blank or against which '-' is indicated) in the Price Schedules will be deemed to have been included in other item(s).

If the discount(s)/rebate(s) offered by the Bidder is a percentage discount and the price component(s) on which the said discount is not indicated in the bid, the same shall be considered on the total bid price [i.e. proportionately on each price component], in the event of award. However, if lump-sum discount is offered, the same shall be considered in full on the Ex-works price component (by proportionately reducing Ex-works price of individual items), in case of award. Further, Conditional discounts/rebates, if any, offered by the bidder shall not be taken into consideration for evaluation. It shall, however, be considered in case of award.

In respect of taxes, duties and other levies indicated by the Bidder in the Bid, which are reimbursable in line with the provisions of the Bidding Documents, the applicable rate and amount thereof shall be ascertained by the Employer based on which, if required, necessary rectification and arithmetical correction shall be carried out by the Employer. The rate and amount so ascertained by the Employer shall prevail.

The subtotal, total price or the total bid price to be identified in Bid Form for this purpose, irrespective of the discrepancy between the amount for the same indicated in words or figures shall be rectified in line with the procedure explained above.

If the Bidder does not accept the correction of errors as per this clause, its bid will be rejected and the amount of Bid Security forfeited.

The Bidder should ensure that the prices furnished in various price schedules are consistent with each other. In case of any inconsistency in the prices furnished in the specified price schedules to be identified in Bid Form for this purpose, the Employer shall be entitled to consider the highest price for the purpose of evaluation and for the purpose of award of the Contract use the lowest of the prices in these schedules.

- 27.3 The comparison shall be on the total price in Price Schedule No. 5 Grand Summary (Total of Schedule Nos. 1 to 4).

The comparison shall also include the applicable taxes, duties and other levies, which are reimbursable in line with the provisions of the Bidding Documents.

The Employer's comparison will also include the costs resulting from application of the evaluation procedures described in ITB Sub-Clause 27.4 & 27.5.

- 27.4 The Employer's evaluation of a bid will take into account, in addition to the bid prices indicated in Price Schedule Nos. 1 through 4 (online price schedules), the following costs and factors that will be added to each Bidder's bid price in the evaluation using pricing information available to the Employer, in the manner and to the extent indicated in ITB Sub-Clause 27.5 and in the Technical Specifications:

- (a) the cost of all quantifiable deviations and omissions from the contractual and commercial conditions and the Technical Specifications as identified in the evaluation of Bid Envelope, and other deviations and omissions not so identified;
- (b) ~~the functional guarantees of the facilities offered~~ - deleted
- (c) the performance of the equipment offered;

Bidder shall state the guaranteed performance or efficiency of the Equipment, named in the BPS, in response to the Technical Specifications. Equipment offered shall have a minimum (or a maximum, as the case may be) level of guarantees specified in the Technical Specifications to be considered responsive. Bids offering plant and equipment with guarantees less (or more) than the minimum (or maximum) specified shall be rejected.

- (d) the extra cost of work, services, facilities, etc., required to be provided by the Employer or third parties;
- (e) any other relevant factors listed in BPS.

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.

- 27.5 Pursuant to ITB Sub-Clause 27.4, the following evaluation methods will be followed:

- (a) Contractual and commercial deviations

The evaluation shall be based on the evaluated cost of fulfilling the contract in compliance with all commercial, contractual and technical obligations under this Bidding Documents. In arriving at the evaluated cost, towards deviations identified in the evaluation of bid, the cost of withdrawal indicated by the bidder in Attachment-6 of the Bid Form will be used. If such a price is not given, the Employer will make its own assessment of the cost of such a deviation for the purpose of ensuring fair comparison of bids.

- (b) Functional Guarantees of the facilities

For the purposes of evaluation, the adjustment specified in the Technical Specifications will be added to the bid price for each drop (or excess) in the responsive functional guarantees offered by the Bidder, below (or above) either a norm of one hundred (100) or the value committed in the responsive bid with the most performing functional guarantees, as specified in the Technical Specifications.

- (c) Performance Guarantees of the Equipment

For the purposes of evaluation, the adjustment specified in the BDS will be added to the bid price.

(d) Work, services, facilities, etc., to be provided by the Employer

Where bids include the undertaking of work or the provision of services or facilities by the Employer in excess of the provisions allowed for in the Bidding Documents, the Employer shall assess the costs of such additional work, services and/or facilities during the duration of the contract. Such costs shall be added to the bid price for evaluation.

27.6 Any adjustments in price that result from the above procedures shall be added, for purposes of comparative evaluation only, to arrive at an "Evaluated Bid Price." Bid prices quoted by bidders and rectified as per ITB Sub Clause 27.2 shall remain unaltered.

28.0 Purchase/ Domestic preference:

No preference shall be given to any bidder

29.0 Confidentiality and Contacting the Employer

29.1 After the public opening of bids, information relating to the examination, clarification, and evaluation of bids and recommendations concerning awards shall not be disclosed to Bidders or other persons not officially concerned with this process until the publication of contract award. 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 its bid, it should do so in writing.

29.2 Any effort by a Bidder to influence the Employer in the Employer's bid evaluation, bid comparison or contract award decisions may result in rejection of the Bidder's bid. The Employer shall be the sole judge in this regard.

(F). Award of Contract

30.0 Award Criteria

30.1 Subject to ITB Clause 31, the Employer will award the contract to the successful Bidder (also referred to as the L₁ Bidder) whose bid has been determined to be substantially responsive and to be the lowest evaluated bid, further provided that the Bidder is determined to be qualified, as per the Qualification Requirement specified in Annexure-A (BDS) to perform the contract satisfactorily.

30.2 The Employer may request the Bidder to withdraw any of the deviations listed in the winning bid.

At the time of Award of Contract, if so desired by the Employer, the bidder shall withdraw the deviations listed in Attachment 6 to the Bid Form at the cost of withdrawal stated by him in the bid. In case the bidder does not withdraw the deviations proposed by him, if any, at the cost of withdrawal stated by him in the bid, his bid will be rejected and his bid security forfeited.

Bidder would be required to comply with all other requirements of the Bidding Documents except for those deviations which are accepted by the Employer.

30.3 The Employer reserves the right to vary the quantity of any of the spares and/or delete any items of spares altogether at the time of Award of Contract.

30.4 The mode of contracting with the successful bidder will be as per stipulation outlined in GCC Sub-Clause 2.1 and briefly indicated below:

30.4.1 The award shall be made as follows:

- (i) First Contract: For supply of all equipment and materials including applicable taxes and duties.
- (ii) Second Contract: For providing all services i.e. inland transportation for delivery at site, insurance, unloading, storage, handling at site, installation, Testing and Commissioning

including performance testing in respect of all the equipment supplied under the "First Contract" and any other services specified in the Contract Documents.

Both contracts will contain a cross fall breach clause specifying that breach of one will constitute breach of the other.

30.5 Contract Agreement Documentation: The sequence of contract agreement documentation is given here under:

- a. Issuance of Letter of Intent (LoI) by owner and its unconditional acceptance by the bidder within two weeks from date of issuance of LoI
- b. Mutual agreement on PERT chart / Project Execution Plan duly signed and accepted by turnkey contractor and Employer within two weeks from date of acceptance of LoI
- c. Submission of Contract Performance Security, within 28 days from date of LoI, against supply & erection contract as per clause 9.3.1 of GCC
- d. Letter of Award by owner and its unconditional acceptance by the bidder. Letter of Award shall be issued only after mutual agreement & acceptance on PERT chart/Project execution plan (as per 30.5 (b) above) and on timely submission of Contract Performance Security against supply & erection contracts. The acceptance of LoA should be provided with 2 weeks from date of issue of LoA. LoA shall include details of
 - i. Pre-bid discussion
 - ii. Post-bid negotiation/discussions
 - iii. PERT chart
 - iv. Contract Performance Guarantee
- e. Contract Agreement shall be signed, on unconditional acceptance of Letter of Award by turnkey contractor, within 14 days from date of issue of Letter of Award and submission and acceptance of contract performance guarantees (against supply as well as erection contracts).

31.0 Employer's Right to Accept any Bid and to Reject any or all Bids

- 31.1 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 award of contract, without thereby incurring any liability to the affected Bidder or bidders or any obligation to inform the affected Bidder or bidders of the grounds for the Employer's action.

32.0 Notification of Award

- 32.1 Prior to the expiration of the period of bid validity, the Employer will notify the successful Bidder in writing through Letter of Intent (LoI), that its bid has been technically and commercially accepted. The bidder shall provide unconditional acceptance of LoI within 2 weeks. Bidder will also submit PERT Chart/Project Execution Plan within 2 weeks from date of LoI. PERT Chart/Project Execution Plan shall be signed, accepted and mutually agreed by successful bidder and owner within 2 weeks from date of acceptance by LoI. Contract Performance Security shall be submitted by the successful bidder within 28 days from date of LoI. Thereafter, detailed letter of award shall be issued by owner. On unconditional acceptance of Letter of Award, contract agreement shall be signed on submission and acceptance of contract performance security. The notification of award (Letter of Intent) will constitute the formation of the contract.

- 32.2 The Employer shall publish the results on its website, identifying the bid and Specification numbers and the following information: (i) name of each Bidder who submitted a Bid; (ii) bid prices as read out at bid opening; (iii) name and evaluated prices of each Bid that was evaluated; (iv) name of bidders whose bids were rejected and the reasons for their rejection; and (v) name of the winning Bidder, and the price it offered, as well as the duration and summary scope of the contract awarded.

The Employer shall promptly respond in writing to any unsuccessful Bidder who, after notification of award in accordance with above, requests in writing the grounds on which its bid was not selected.

The Employer shall verify all the credentials submitted by the winning bidder in their bid from the document issuing authority/organisation to check their correctness and validity before execution of agreement.

32.3 Upon the successful Bidder's furnishing of the performance security pursuant to ITB Clause 34 and their independent verification from issuing bank and acceptance thereof, the Employer will promptly discharge the bid securities, pursuant to ITB Sub-Clause 13.4 & 13.5.

33.0 Signing the Contract Agreement

33.1 At the same time as the Employer notifies the successful Bidder that its bid has been accepted through Letter of Award, the Employer in consultation with the Bidder will prepare the Contract Agreement provided in the Bidding Documents, incorporating all agreements between the parties.

33.2 On unconditional acceptance of Letter of Award, contract agreement shall be signed on submission and acceptance of contract performance security within 2 weeks from date of issue of Letter of Award.

34.0 Performance Security

34.1 Within twenty-eight (28) days after receipt of the Notification of Award through LoI, the successful Bidder shall furnish the performance security for 10% (Ten percent) of the contract price in line with the requirement of Qualification Requirements, in the amount given in the BDS and in the form provided in Volume-I : Section VI, Sample Forms and Procedures, of the Bidding Documents. The performance security of a joint venture shall be in the name of joint venture.

34.2 Failure of the successful Bidder to comply with the requirements of ITB Clause 33 or Clause 34.1 shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security, in which event the Employer may make the award to the next lowest evaluated Bidder or call for new bids.

34.3 Till receipt and acceptance of contract performance securities of successful bidder, validity of all bids shall be kept valid to facilitate action as per clause 34.2 above.

35.0 Fraud and Corruption

It is the Employer's policy that requires the Bidders, suppliers and contractors and their subcontractors under the contracts to observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, the Employer:

(a) defines, for the purpose of this provision, the terms set forth below as follows:

- (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 Employer's 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 Employer's inspection and audit rights.
- (b) 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 in competing for the contract in question;
- (c) will sanction a firm or individual, including declaring ineligible, either indefinitely or for a stated period of time, to be awarded a contract 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 contract; and
- (d) will have the right to require that the provision be included in Bidding Documents and in contracts, requiring Bidders, suppliers, and contractors and their sub-contractors to permit the Employer to inspect their accounts and records and other documents relating to bid submission and contract performance and to have them audited by auditors appointed by the Employer.

----- End of Section-II (ITB) -----

VOLUME-I: SECTION – III

BID DATA SHEETS (BDS)

BID DATA SHEETS (BDS)

The following bid specific data for the Plant and Equipment to be procured shall amend and/or supplement the provisions in the Instruction to Bidders (ITB)

Sl. No.	ITB Clause Ref. No.	Bid Data Details
1.	ITB 1.1	The Owner is: XXXXX (Name and Address of Owner)
2.	ITB 1.1	The Employer is: XXXXX (Name and Address of Employer) Kind Attn.: Telephone Nos.: Mobile: Fax No.:
3.	ITB 1.1	Supplementing ITB 1.1 with the following: For the purpose of execution of the contract, the contractual activities shall be performed by the Employer "for and on behalf of the Owner" except in cases where the Owner itself is statutorily required to do so.
4.	ITB 2.1, 2.2, 2.3 & 3.2	Replace the word "Employer" with "Employer/Owner".
5.	ITB 6.1	Address of the Employer: Kind Attn.: Telephone Nos.: Mobile: Fax No.: Email Address:
6.	ITB 6.4	<u>Venue, date and time for Pre-bid Meeting:</u> The Bidder's designated representative is invited to attend a pre-bid meeting, which will take place at the venue and time as given below: Venue: XXXXX (Name and Address of Employer) Kind Attn.: Telephone Nos.: Mobile: Fax No.: Email Address: Date: Time:
7.	ITB 9.2	Alternative bids shall not be permitted
8.	ITB 9.3 (n)	Supplementing ITB clause 9.3(n) with the following: (iv) Bidder shall also furnish information/documentation in support that the Bidder have adequate design infrastructure and erection facilities and capacity and procedures including quality control related to the work. (v) The Bidder shall furnish the CV and experience details of a project manager with 15

Sl. No.	ITB Clause Ref. No.	Bid Data Details
		years' experience in executing such contract of comparable nature including not less than five years as manager
9.	ITB 13.1	Amount of Bid Security: (2% of tender value or Rs 5 (five) crore, whichever is lower)
10.	ITB 16.2(a), ITB 16.2(b), ITB 17.1, ITB 19.3 (a) and ITB 20.1	Address for submission of Bids and its modification and withdrawal, if any; Address in Person or by Post: XXXXX (Name of Employer's representative along with full address) Deadline for submission of Bids and its modification and withdrawal, if any Upto (time of submission) on (Date of submission) (Indian Standard Time) Address for Bid Opening: XXXXX (Name of Employer with address) Time and date for Bid Opening – Bid Envelope: Date : Time: (Indian Standard Time) (a) Bid Title: (insert Name of the Package & Specification No.) <u>BID ENVELOPE</u> (b) Do not open before hours (Indian Standard Time) on ___/___/20__.
11.	ITB 16.3	Supplementing ITB clause 16.3 with the following: In case, pursuant to Ministry of Finance, GOI's Circular dated 17th July, 2012, the Bank Guarantee is issued using SFMS Platform by the bank's located in India, the copy of such Bank Guarantee shall be submitted by the bidder along with the Bid Envelope.
12.	ITB 24.1 (c)	The Time for Completion for all the Packages shall be 24 (Twenty Four) months from the date of Notification of Award.
13.	ITB 27.2	Supplementing ITB clause 27.2 with the following: The total charges for Supply, F&I, Erection, Testing & Commissioning for BPL service connection including Taxes & Duties should not be more than Rs. 3000/- per connection. In case, the charges quoted for the above exceed Rs. 3000/- per service connection then payment shall be restricted to Rs. 3000/-, which shall also be considered in evaluation.
14.	ITB 27.4 (b)	Deleted as Functional Guarantees are not applicable.
15.	ITB 27.4(c)	Deleted.
16.	ITB 27.5 (b)	Deleted.

Sl. No.	ITB Clause Ref. No.	Bid Data Details
17.	ITB 27.5 (c)	Deleted.
18.	ITB 34.1	In addition to the Performance Security of 10% of the Contract Price, the successful bidder is required to furnish additional performance security(ies), if applicable, as per Clause no. 4 of Joint Deed of Undertaking mentioned at Sl. No. 19 of Section – VI : Sample Forms and Procedures.

----- End of Section-III (BDS) --

QUALIFICATION OF THE BIDDER for Electrification works of XXXXX district in XXXXX(State name) under Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY)/Integrated Power Development Scheme (IPDS)

Qualification of bidder will be based on meeting the minimum pass/fail criteria specified in 1.0 Pre-qualifying criteria Part-A and 2.0 Pre-qualifying criteria Part-B as demonstrated by the Bidder's responses in the corresponding Bid Schedules. The bidder shall also be required.

Subcontractors' technical experience and financial resources shall not be taken into account in determining the Bidder's compliance with the qualifying criteria. The bid can be submitted by an Indian individual firm only or by Joint Venture firm having Indian partner firms only.

Notwithstanding anything stated herein above, the Employer reserves the right to assess the capacity and capability of the bidder, should the circumstances warrant such assessment in an overall interest of the Employer. The employer reserves the right to waive minor deviations if they do not materially affect the capability of the Bidder to perform the contract.

1.0 Pre-qualification criteria – Part A:

1.01 Technical:

(I) Part I: Supply, Erection, Testing & Commissioning of New/Augmentation of existing 33/11KV or 66/11 KV power substation¹ and new/Augmentation of its associated 33 or 66 KV Lines

i. The bidder must have successfully erected, tested and commissioned substation of 33 KV/11 KV or 66/11KV voltage class and its associated 33 KV/66 KV lines(as the case may be in bid) in a single turnkey contract in last 7 years as on the date of bid opening, having installation of at least 50% of the transformation capacity considered in proposed bid (i.e. Sum of KVA ratings of Power transformers proposed in the present bid) and 50% of length of 33 KV lines considered in proposed bid, and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

Or

ii. The bidder must have successfully erected, tested and commissioned substation of 33 KV/11 KV or 66/11KV voltage class and its associated 33 KV/66 KV lines (as the case may be in bid) in TWO turnkey contracts in last 7 years as on the date of bid opening, each having installation of at least 40% of the transformation capacity considered in proposed bid (i.e. Sum of KVA ratings of Power transformers proposed in the present bid) and 40% of length of 33 KV lines considered in proposed bid, and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

Or

iii. The bidder must have successfully erected, tested and commissioned substation of 33 KV/11 KV or 66/11KV voltage class and its associated 33 KV/66 KV lines (as the case may be in bid) in THREE turnkey contracts in last 7 years as on the date of bid opening, each having installation of at least 30% of the transformation capacity considered in proposed bid (i.e. Sum of KVA ratings of Power transformers proposed in the present bid) and 30% of length of 33 KV lines considered in proposed bid, and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

¹ Depending on the state practice to use 66 KV or 33 KV as sub-transmission voltage gradient

- iv. Bids may also be submitted by joint venture firms (having not more than three partners with one partner as lead partner) wherein
- a) All the partners should jointly meet qualification requirements set forth in para I(i) or I(ii) or I (iii) above,

AND

- b) The lead partner should have successfully erected, tested and commissioned electrical works of 33 KV/11 KV or 66 KV/11 KV substation and its associated 33 KV/ 66 KV lines (as the case may be in bid) in a single turnkey contract in last 7 years as on the date of bid opening, having installation of at least 40% of the transformation capacity considered in proposed bid for 33/11 KV or 66/11KV substation (i.e. Sum of KVA ratings of Power transformers proposed in the present bid) and 40% of length of 33 KV lines / 66 KV lines considered in proposed bid, and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

AND

- c) Each of the other partners should have successfully erected, tested and commissioned electrical works of 33 KV / 11 KV or 66 KV / 11 KV substation and its associated 33 KV / 66 KV lines (as the case may be in bid) in a single turnkey contract in last 7 years as on the date of bid opening, having installation of at least 25% of the transformation capacity considered in proposed bid (i.e. Sum of KVA ratings of Power transformers proposed in the present bid) and 25% of length of 33 KV lines / 66 KV lines considered in proposed bid, and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

Bidder's experience in higher voltage capacity substation or line will also be considered fit for above calculation. That means, if a Bidder is having experience of erection, testing and commissioning, through turnkey contract in past 7 years of 200 Kms 132 KV lines and 50 MVA capacity EHT substation, he shall be eligible for 33/11 KV or 66/11 KV substation part of up-to 100 MVA capacity and lines up-to 400 kms length.

- (II) Part II: Supply, Erection, Testing and Commissioning of New/Augmentation of existing 22 KV or 11 KV & LT Lines, New/Augmentation of existing 11/0.4 KV Distribution Transformer substation and Single Phase Electricity Connections including Service Line & Internal House wiring for BPL Households and HT/LT metering

- i. The bidder must have successfully erected, tested & commissioned transmission lines/feeders 22 KV or 11 KV voltage class (as the case may be in bid) in a single turnkey contract in last 7 years as on the date of bid opening, having installation of at least 50% of the Distribution Transformer Capacity considered in proposed bid (i.e. Sum of KVA ratings of Distribution transformers proposed in the present bid) and 50% of length of lines considered in proposed bid (i.e. sum of 22 / 11 KV and LT lines proposed in the bid), and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

Or

- ii. The bidder must have successfully erected, tested & commissioned transmission lines/feeders 22 KV or 11 KV voltage class (as the case may be in bid) in TWO turnkey contracts in last 7 years as on the date of bid opening, each having installation of at least 40% of the Distribution Transformer Capacity considered in proposed bid (i.e. Sum of KVA ratings of Distribution transformers proposed in the present bid) and 40% of length of lines considered in proposed bid (i.e. sum of 22 / 11 KV and LT lines proposed in the bid), and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

OR

- iii. The bidder must have successfully erected, tested & commissioned transmission lines/feeders 22 KV or 11 KV voltage class (as the case may be in bid) in THREE turnkey contract in last 7 years as on the date of bid opening, each having installation of at least 30% of the Distribution Transformer Capacity considered in proposed bid (i.e. Sum of KVA ratings of Distribution transformers proposed in the present bid) and 30% of length of lines considered in proposed bid (i.e. sum of 22 / 11 KV and LT lines proposed in the bid), and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,
- iv. Bids may also be submitted by joint venture firms (having not more than three partners with one partner as lead partner) wherein
 - a) All the partners should jointly meet qualification requirements set forth in para II (i) or II (ii) or II (iii) above,

AND

- b) The lead partner should have successfully erected, tested & commissioned transmission lines/feeders of 22 KV or 11 KV voltage class (as the case may be in bid) in a single turnkey contract in last 7 years as on the date of bid opening, having installation of at least 40% of the Distribution Transformer Capacity considered in proposed bid (i.e. Sum of KVA ratings of Distribution transformers proposed in the present bid) and 40% of length of lines considered in proposed bid (i.e. sum of 11 or 22 KV and LT lines proposed in the bid), and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

AND

- c) Each of the other partners should have successfully erected, tested & commissioned transmission lines/feeders of 22 KV or 11 KV voltage class (as the case may be in bid) in a single turnkey contract in last 7 years as on the date of bid opening, having installation of at least 25% of the Distribution Transformer Capacity considered in proposed bid (i.e. Sum of KVA ratings of Distribution transformers proposed in the present bid) and 25% of length of lines considered in proposed bid (i.e. sum of 11 or 22 KV and LT lines proposed in the bid), and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

Bidder's experience in higher voltage capacity substation or line will also be considered fit for above calculation. That means, if a Bidder is having experience of erection, testing and commissioning, through turnkey contract in past 7 years of 200 Kms 132 KV lines and 50 MVA capacity EHT substation, he shall be eligible for 11/0.4 KV Distribution substation part having sum of transforming capacity of up-to 100 MVA capacity and 11 KV + LT lines length up-to 400 kms.

(III) Part III: Combined Part of Part-I & II above

- i. The bidder must have successfully erected, tested & commissioned Sub-Station & transmission lines/feeders of [33 KV or 66 KV class] and [11 KV or 22 KV class] (as the case may be in bid) in a single turnkey contract in last 7 years as on the date of bid opening, having installation of at least 50% of the transformation capacity considered in proposed bid (i.e. Sum of KVA ratings of Power transformers for 33 KV/66 KV class and Sum of KVA ratings of Distribution transformers for 11 KV/22 KV class, as proposed in the present bid) and 50% of length of [33 KV/66 KV lines] and [sum of {11KV or 22KV and LT lines}], considered in proposed bid, and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

OR

- ii. The bidder must have successfully erected, tested & commissioned Sub-Station & transmission lines/feeders of [33 KV or 66 KV class] and [11 KV or 22 KV class] (as the case may be in bid) in TWO turnkey contract in last 7 years as on the date of bid opening, each having installation of at least 40% of the transformation capacity considered in proposed bid (i.e. Sum of KVA ratings of Power transformers for 33 KV/66 KV class and Sum of KVA ratings of Distribution transformers for 11 KV/22 KV class, as proposed in the present bid) and 40% of length of [33 KV/66 KV lines] and [sum of {11KV or 22KV and LT lines}], considered in proposed bid, and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

OR

- iii. The bidder must have successfully erected, tested & commissioned Sub-Station & transmission lines/feeders of [33 KV or 66 KV class] and [11 KV or 22 KV class] (as the case may be in bid) in THREE turnkey contracts in last 7 years as on the date of bid opening, each having installation of at least 30% of the transformation capacity considered in proposed bid (i.e. Sum of KVA ratings of Power transformers for 33 KV/66 KV class and Sum of KVA ratings of Distribution transformers for 11 KV/22 KV class, as proposed in the present bid) and 30% of length of [33 KV/66 KV lines] and [sum of {11KV or 22KV and LT lines}], considered in proposed bid, and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,
- iv. Bids may also be submitted by joint venture firms (having not more than three partners with one partner as lead partner) wherein

All the partners should jointly meet qualification requirements set forth in para III (i) or III (ii) above

AND

The lead partner should have successfully erected, tested and commissioned sub-station & transmission line/feeder of [33 KV or 66 KV] and [11 KV or 22 KV class](as the case may be in bid) in a single turnkey contract in last 7 years as on the date of bid opening, having installation of at least 40% of the transformation capacity considered in proposed bid (i.e. Sum of KVA ratings of Power transformers for 33 KV/66 KV class and Sum of KVA ratings of Distribution transformers for 11 KV/22 KV class, as proposed in the present bid) and 40% of length of [33 KV/66 KV lines] and [sum of {11KV or 22KV and LT lines}] lines considered in proposed bid, and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

AND

each of the other partner(s) should have successfully erected, tested and commissioned sub-station & transmission line/feeder of [33 KV or 66 KV] and [11 KV or 22 KV class](as the case may be in bid) in a single turnkey contract in last 7 years as on the date of bid opening, having installation of at least 25% of the transformation capacity considered in proposed bid (i.e. Sum of KVA ratings of Power transformers for 33 KV/66 KV class and Sum of KVA ratings of Distribution transformers for 11 KV/22 KV class, as proposed in the present bid) and 25% of length of [33 KV/66 KV lines] and [sum of {11KV or 22KV and LT lines}] lines considered in proposed bid, and the system so created must be in satisfactory operation for at least one (1) year as on date of opening of bid,

Bidder's experience in higher voltage capacity substation or line will also be considered fit for above calculation. That means, if a Bidder is having experience of erection, testing and commissioning, through turnkey contract in past 7 years of 200 Kms 132 KV lines and 50 MVA capacity EHT substation, he shall be eligible for sum of transformation capacities under 33/11 KV or 66/11 KV substation or 11/0.415 KV distribution transformer part up-to 100 MVA and 66KV or 33KV or 11KV or LT lines length up-to 400 kms.

1.01.1 For Bidder to qualify for more than one projects, the technical requirements of bidder shall be as per following:

S. No.	Description	Unit	Project1	Project2	Project3	QR for technical requirement of a bidder participating in all 3 projects
Part-I						
1	66 KV + 33 KV+ higher voltage	Km	500	200	150	500
2	sum of 33/11 KV and 66/11 KV substation	MVA	50	20	80	80
Part-II						
3	sum of 22 KV+11 KV+ LT line length	Km	1000	2000	3000	3000
4	sum of DTR transformation	MVA	2000	8000	5000	8000
Part-III						
1	66 KV + 33 KV+ higher voltage	Km	500	200	150	500
2	sum of 33/11 KV and 66/11 KV substation	MVA	50	20	80	80
3	sum of 22 KV+11 KV+ LT line length	Km	1000	2000	3000	3000
4	sum of DTR transformation	MVA	2000	8000	5000	8000

1.01.2 The bidder should possess "A" Class license issued by the Electrical inspectorate of Govt of (...) ² /Central Inspectorial organization of Govt. of India/ other state Govt. In case bid submitted joint venture firm, any of partner should possess "A" class electrical license as stated above.

1.01.3 Work experiences of the bidder as per above shall be considered only if the works have been executed under Govt./semi-Govt./autonomous body of Central/State Govt./Electricity Power Utility/ Power Deptt. in India only.

1.02 Commercial:

For the purpose of this bid, the bidder shall meet the following requirements:

1.02.1 For the purpose of this particular bid, bidder shall meet the following minimum commercial criteria in past 5 years (up to 31.03.2015):

- i. Experience in single completed work of projects execution in electrical Transmission or sub-transmission & distribution sector costing not less than the amount equal to 50% of the estimated amount of the project.

Or

- ii. Experience in two completed work of projects execution each in electrical Transmission or sub-transmission & distribution sector costing not less than the amount equal to 40% of the estimated amount of the project individually.

Or

² Name of state where work is to be executed.

- iii. Experience in three completed work of projects execution each in electrical Transmission or sub-transmission & distribution sector costing not less than the amount equal to 30% of the estimated amount of the project individually.

In case a bidder is quoting for more than one project, Pre-Qualification requirement shall be examined on the basis of sum of project wise requirements of experience of all quoted projects

- 1.02.2 Net Worth for the each of the last three Financial Years should be positive. Net worth means the sum total of the paid up capital and free reserves (excluding reserves created out of revaluation) reduced by aggregate value of accumulated losses (including debit balance in profit and loss account for current year) and intangible assets.
- 1.02.3 Minimum Average Annual Turnover (MAAT) for best three years out of last five financial years of the bidder should not be less than Rs. _____ Lakhs i.e. 30% of the estimated cost of the project. In case a bidder is quoting for more than one project, Pre-Qualification requirement shall be examined on the basis of sum of project wise requirements of MAAT of all quoted projects.
- 1.02.4 Bidder shall have liquid assets (LA) and/ or evidence of access to or availability of fund based credit facilities of not less than Rs. _____ Lakhs i.e. 10% of the estimated cost of the project and the Banker should confirm that the Credit facility is earmarked for the Work specified under Bid on receipt of the Bid. Liquid assets would include cash (and equivalents), bank deposits, securities that can be freely traded and receivables which has general certainty of getting received. In case a bidder is quoting for more than one project, Pre-Qualification requirement shall be examined on the basis of sum of project wise requirements of LA of all quoted projects.
- 1.02.5 In case a bid is submitted by a Joint Venture (JV), all the partners of the JV shall meet, individually, the qualification set forth at para 1.02.1 & 1.02.2 above and collectively the requirement of para 1.02.3 & 1.02.4 above. The figures for each of the partner of the joint venture shall be added together to determine the bidder's compliance with the minimum qualifying criteria set out in para 1.02.3 & 1.02.4 above; however in order for a joint venture to qualify, the partner(s) of joint venture must meet the following minimum criteria:
- 1.02.5.1 At least one partner shall meet, not less than 40% of the minimum criteria given at Para 1.02.3 & 1.02.4 above
- AND
- 1.02.5.2 Each of the other partner(s) shall meet not less than 25% of the criteria given at Para 1.02.3 & 1.02.4 above
- 1.02.6 Failure to comply with this requirement will result in rejection of the joint venture's bid. Sub contractors' experience and resources shall not be taken into account in determining the bidder's compliance with qualifying criteria.
- 1.02.7 One of the partners shall be nominated as lead partner, and the lead partner shall be authorized to incur liabilities and receive instruction for and on behalf of any and all partners of the joint venture and the entire execution of the contract including receipt of payment shall be done exclusively through the lead partner. This authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the partners as per proforma in section "Annexure" of Special Conditions of Contract-Vol.-IA.
- 1.02.8 All partner of the joint venture shall be liable jointly and severally for the execution of the contract in accordance with the contract terms and a copy of the agreement entered into by the joint venture partners having such a provision shall be submitted with the bid.
- 1.02.9 A statement to this effect shall be included in the authorization mentioned under para 1.02.7 above as well as in the Bid Form and in the Contract Form (in case of a successful bid);

2.0 Pre-qualification criteria – Part B:

The Bidder shall also furnish following documents/details with its bid:

2.01.1 A certificate from banker (as per format) indicating various fund based/non fund based limits sanctioned to the bidder and the extent of utilization as on date Such certificate should have been issued not earlier than three months prior to the date of bid opening. Wherever necessary, the employer may make queries with the Bidders' bankers.

2.01.2 The complete annual reports together with Audited statement of accounts of the company for last five years of its own (separate) immediately preceding the date of submission of bid.

2.01.3 Note:

2.01.3.1 In the event the bidder is not able to furnish the information of its own (i.e. separate), being a subsidiary company and its accounts are being consolidated with its group/holding/parent company, the bidder should submit the audited balance sheets, income statements, other information pertaining to it only (not of its group/Holding/Parent Company) duly certified by any one of the authority [(i) Statutory Auditor of the bidder /(ii) Company Secretary of the bidder or (iii) A certified Public Accountant] certifying that such information/documents are based on the audited accounts as the case may be.

2.01.3.2 Similarly, if the bidder happens to be a Group/Holding/Parent Company, the bidder should submit the above documents/information of its own (i.e. exclusive of its subsidiaries) duly certified by any one of the authority mentioned in Note - 2.01.3.1 above certifying that these information/ documents are based on the audited accounts, as the case may be.

2.01.4 Litigation History:

2.01.4.1 The bidder should provide detailed information on any litigation or arbitration arising out of contracts completed or under execution by it over the last five years. A consistent history of awards involving litigation against the Bidder or any partner of JV may result in rejection of Bid.

2.01.4.2 Notwithstanding anything stated hereinabove, the Employer reserves the right to assess the capacity and capability of the bidder, should the circumstances warrant such assessment in an overall interest of the Employer. The Employer reserves the right to waive minor deviations if they do not materially affect the capability of the Bidder to perform the contract.

LIST OF ELIGIBLE SCHEDULED COMMERCIAL PRIVATE INDIAN BANKS

Sl. No.	Name of Banks
1	HDFC Bank Ltd.
2	Axis Bank Ltd.
3	Kotak Mahindra Bank Ltd.
4	Federal Bank Ltd.
5	Indusind Bank Ltd.
6	Development Credit Bank Ltd.
7	ING Vysya Bank Ltd.
8	Karnataka Bank Ltd.
9	Karur Vysya Bank Ltd.
10	Ratnakar Bank Ltd.
11	South Indian Bank Ltd.
12	Yes Bank Ltd.
13	ICICI Bank
14	IDFC Bank

VOLUME-I: SECTION – IV
GENERAL CONDITIONS OF
CONTRACT (GCC)

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GENERAL CONDITIONS OF CONTRACT (GCC)

Preamble

The Section-IV of the Bidding Documents is named as General Conditions of Contract (GCC) and provides all the rights and obligations of the parties under the Contract. This Section contains provisions which are to be used unchanged unless Section – V named as Special Conditions of Contract (SCC) states otherwise as any changes in GCC or any complementary information that may be needed has been shown in SCC. If there is a conflict between the provisions of Section – IV & Section – V, the provisions of Section – V shall prevail.

Suitable care has been taken to modify Standard bidding documents as per Ministry of Power's OM dated 14.08.2015 for New Initiative of Material Mobilization wherein major high value materials shall be procured centrally and these materials shall be issued by the Employer free of cost to the turnkey contractor. In case, modification at any place is left inadvertently, then provision of revised guidelines shall prevail.

A. Definitions and Interpretation

1. Definitions

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

- (a) "Arbitrator" means the person or persons appointed by agreement between the Employer and the Contractor to make a decision on or to settle any dispute or difference between the Employer and the Contractor referred to him or her by the parties pursuant to GCC Sub-Clause 39.1 (Arbitration) hereof.
- (b) "Associate" means a party who has been conjoined by the Contractor to independently execute a pre-selected part of facilities of the contract and grant him the associated contractual rights and obligations, without diluting the overall responsibility of the contractor in respect of the Facilities under the contract.
- (c) "Collaborator" or "Parent Company" means the firms/corporations who has provided technological support to the manufacturer for establishing production line for the specific Equipment.
- (d) "Commissioning" means operation of the Facilities or any part thereof, if any, as per GCC Sub-Clause 1.1(e) by the Contractor as specified in the Technical Specifications, which operation is to be carried out by the Contractor as provided in GCC Sub-Clause 20.1.3 (Commissioning), for the purpose of Trial – Operation (GCC Sub-Clause 20.1.4).
- (e) "Completion" means that the Facilities (or a specific part thereof where specific parts are specified in the SCC) have been completed operationally and structurally and put in a tight and clean condition and that all works in respect of pre-commissioning of the Facilities (or a specific part thereof where specific parts are specified in the SCC) has been completed (wherever required, as per Technical Specifications) and Commissioning followed by Trial – Operation has been completed, as provided in GCC Sub-Clause 20.1 (Completion of Facilities) hereof.
- (f) "Contract" means the Contract Agreement entered into between the Employer and the Contractor together with the Contract Documents referred to therein.
- (g) "Contract Documents" means the documents listed in Clause 1.1 of Article 1 (Contract Documents) of the Form of Contract Agreement (including any amendments thereto); Volume-I:Section-VI.
- (h) "Contract Price" means the sum specified in Clause 2.1 of Article 2 (Contract Price) of the Contract Agreement, subject to such additions or deductions therefrom, as may be made pursuant to the Contract. For the purpose of Liquidated Damages and Contract Performance Guarantee, the "Contract Price" means the sum specified in Clause 2.1 of Article 2 (Contract Price) of the Contract Agreement.
- (i) "Contractor" means the firms whose bid to perform the Contract has been accepted by the Employer and is named in the Contract Agreement, and includes the legal successors or permitted assigns of the Contractor.

- (j) "Contractor's Equipment" means all plant, facilities, equipment, machinery, tools, apparatus, appliances or things of every kind required in or for installation, completion and maintenance of Facilities that are to be provided by the Contractor, but does not include Plant and Equipment, or other things intended to form or forming part of the Facilities.
- (k) "Contractor's Representative" means any person nominated by the Contractor and approved by the Employer in the manner provided in GCC Sub-Clause 13.2 (Contractor's Representative and Construction Manager) hereof to perform the duties delegated by the Contractor.
- (l) "Day" means calendar day of the Gregorian Calendar.
- (m) "Defect Liability Period" means the period of validity of the warranties given by the Contractor commencing at Completion of the Facilities or a part thereof, if any, as per GCC Sub-Clause 1.1(e), during which the Contractor is responsible for defects with respect to the Facilities (or the relevant part thereof) as provided in GCC Clause 22 (Defect Liability) hereof.
- (n) "Effective Date" means the date of Notification of Award from which the Time for Completion shall be determined.
- (o) "Employer" means the firm/corporation/ government entity, named in the SCC, who is responsible for getting the Facilities implemented. The Employer may be Owner himself or an agency appointed by the Owner (State/Central PSU) and shall include the legal successors or permitted assigns of the Employer.
- (p) "Facilities" means the Plant and Equipment to be supplied and installed, as well as all the Installation Services to be carried out by the Contractor under the Contract.
- (q) "GCC" means the General Conditions of Contract hereof.
- (r) "Guarantee Test(s)" means the test(s) specified in the Technical Specifications to be carried out to ascertain whether the Facilities or a specified part thereof is able to attain the Functional Guarantees specified in the Technical Specifications in accordance with the provisions of GCC Sub-Clause 20.2.1 (Guarantee Test) hereof during/after successful Commissioning followed by Trial - Operation.
- (s) "Installation Services" means all those services ancillary to the supply of the Plant and Equipment for the Facilities, to be provided by the Contractor under the Contract; e.g., transportation and provision of marine or other similar insurance, inspection, expediting, site preparation works (including the provision and use of Contractor's Equipment and the supply of all construction materials required), installation, testing, pre-commissioning, commissioning, operations, maintenance, the provision of operations and maintenance manuals, training, etc.
- (t) "Month" means calendar month of the Gregorian Calendar.
- (u) "Notification of Award" means the official notice issued by the Employer notifying the Contractor that his bid has been accepted.

- (v) "Operational Acceptance" means the acceptance by the Employer of the Facilities (or any part of the Facilities where the Contract provides for acceptance of the Facilities in parts), which certifies the Contractor's fulfillment of the Contract in respect of Functional Guarantees of the Facilities (or the relevant part thereof) in accordance with the provisions of GCC Sub-Clause 20.2.2 (Operational Acceptance) hereof after successful Commissioning followed by Trial - Operation.
- (w) "Owner" means the firm/corporation/government entity, named in the SCC, who has decided to set up the Facilities and shall include the legal successors or permitted assigns of the Owner.
- (x) "Plant and Equipment" means permanent plant, equipment, machinery, apparatus, articles and things of all kinds to be provided and incorporated in the Facilities by the Contractor under the Contract (including the spare parts to be supplied by the Contractor under GCC Sub-Clause 3.3 hereof), but does not include Contractor's Equipment.
- (y) "Pre-commissioning" means the testing, checking and other requirements specified in the Technical Specifications that are to be carried out by the Contractor in preparation for Commissioning as provided in GCC Sub-Clause 20.1.2 (Pre-Commissioning) hereof.
- (z) "Project Manager" or "Engineer" or "Engineer – in Charge" means the person appointed by the Employer in the manner provided in GCC Sub-Clause 13.1 hereof to perform the duties delegated by the Employer.
- (aa) "SCC" means the Special Conditions of Contract.
- (bb) "Site" means the land and other places upon which the Facilities are to be installed, and such other land or places as may be specified in the Contract as forming part of the Site.
- (cc) "Subcontractor"/"vendor"/"sub-vendor" means firms/ corporations/government entities to whom execution of any part of the Facilities, including preparation of any design or supply of any Plant and Equipment, is sub-contracted directly or indirectly by the Contractor with the consent of the Employer in writing, and includes its legal successors or permitted assigns.
- (dd) "Taking Over" means the Employer's written acceptance of the Facilities under the Contract, after successful Trial – Operation for the specified period in accordance with the Contract, as provided in GCC Sub-Clause 20.1.5.
- (ee) "Time for Completion" means the time within which Completion of the Facilities is to be attained in accordance with the scope of work and specifications, as a whole (or of a part of the Facilities where a separate Time for Completion of such part has been prescribed in the SCC) and "Taking Over" by the Employer is to be attained.

2. Interpretation

2.1 Contract

The Contracts to be entered into with the successful Bidder shall be as defined in SCC.

2.2 Contract Documents

All documents forming part of the Contract (and all parts thereof) are intended to be correlative, complementary and mutually explanatory, subject to Article 1.2 (Order of Precedence) of the Contract Agreement. The Contract shall be read as a whole.

2.3 Language

The ruling language of the Contract and the language for communications shall be English.

2.4 Singular and Plural

The singular shall include the plural and the plural the singular, except where the context otherwise requires.

2.5 Headings

The headings and marginal notes in the General Conditions of Contract are included for ease of reference, and shall neither constitute a part of the Contract nor affect its interpretation.

2.6 Entire Agreement

Subject to GCC Sub-Clause 12.4 hereof, the Contract constitutes the entire agreement between the Employer and Contractor with respect to the subject matter of Contract and supersedes all communications, negotiations and agreements (whether written or oral) of parties with respect thereto made prior to the date of Contract.

2.7 Amendment

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

2.8 Independent Contractor

The Contractor shall be an independent contractor performing the Contract. The Contract does not create any agency, partnership, joint venture or other joint relationship between the parties hereto.

Subject to the provisions of the Contract, the Contractor shall be solely responsible for the manner in which the Contract is performed. All employees, representatives or Subcontractors engaged by the Contractor in connection with the performance of the Contract shall be under the complete control of the Contractor and shall not be deemed to be employees of the Employer, and nothing contained in the Contract or in any subcontract awarded by the Contractor shall be construed to create any contractual relationship between any such employees, representatives or Subcontractors and the Employer.

2.9 Joint Venture

If the Contractor is a joint venture of two or more firms, all such firms shall be jointly and severally bound to the Employer for the fulfillment of the provisions of the Contract and shall designate one of such firms to act as a leader with authority to bind the joint venture.

The composition or the constitution of the joint venture shall not be altered without the prior written consent of the Employer.

2.10 Non-Waiver

2.10.1 Subject to GCC Sub-Clause 2.10.2 below, no relaxation, forbearance, delay or indulgence by either party in enforcing any of the terms and conditions of the Contract or the granting of time by either party to the other shall prejudice, affect or restrict the rights of that party under the Contract, nor shall any waiver by either party of any breach of Contract operate as waiver of any subsequent or continuing breach of Contract.

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

2.11 Severability

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

2.12 Country of Origin

"Origin" means the place where the materials, equipment and other supplies for the Facilities are mined, grown, produced or manufactured, and from which the services are provided. Plant and equipment are produced when, through manufacturing, processing or substantial and major assembling of components, a commercially recognized product results that is substantially different in basic characteristics or in purpose or utility from its components.

2.13 Notices

2.13.1 Unless otherwise stated in the Contract, all notices to be given under the Contract shall be in writing, and shall be sent by personal delivery, special courier, telegraph, facsimile or Electronic Data Interchange (EDI) to the address of the relevant party set out in the Contract Agreement, with the following provisions:

- (a) Any notice sent by telegraph, facsimile or EDI shall be confirmed within two (2) days after dispatch by notice sent by special courier, except as otherwise specified in the Contract.
- (b) Any notice sent by special courier shall be deemed (in the absence of evidence of earlier receipt) to have been delivered ten (10) days after dispatch. In proving the fact of dispatch, it shall be sufficient to show that the envelope containing such notice was properly addressed, stamped and conveyed to the postal authorities or courier service for transmission by special courier. Provided further that whenever the postal authorities or courier service provide a proof of delivery, the same shall also be applicable for presenting the fact of dispatch.
- (c) Any notice delivered personally or sent by telegraph, facsimile or EDI shall be deemed to have been delivered on date of its dispatch.

(d) Either party may change its postal, facsimile or EDI address or addressee for receipt of such notices by ten (10) days' notice to the other party in writing.

2.13.2 Notices shall be deemed to include any approvals, consents, instructions, orders and certificates to be given under the Contract.

2.14 Governing Law & its Jurisdiction

The Contract shall be governed by and interpreted in accordance with laws of Union of India and the Courts of XXXX* (High Court of concerned state) shall have exclusive jurisdiction in all matters arising under this Contract.

B. Subject Matter of Contract

3. Scope of Facilities

3.1 Standards and Regulations: Following CEA regulations shall be applicable during execution of work:

- a. Construction Regulation – Central Electricity Authority (Technical Standards for construction of electrical plants and electric lines) Regulation, 2010 (as amended time to time)
- b. Safety Regulation for construction and O&M - Central Electricity Authority (Safety requirements for construction, Operation and Maintenance of electrical plants and electric lines) Regulation, 2011 (as amended time to time)
- c. Connectivity Regulation – Technical Standard for connectivity to the grid (Amendment) Regulation 2013; Technical Standards for connectivity of the Distributed Generation resources, 2013; Central Electricity Authority (Grid Standard) Regulation, 2010 (as amended time to time)
- d. Metering Regulations – Central Electricity Authority (Installation and Operation of meters) Regulations, 2006; Central Electricity Authority (Installation and Operation of meters) (Amendment) Regulations, 2010 and 2015 (as amended time to time)
- e. Central Electricity Authority (Measures relating to safety and Electric supply regulations), 2010 and amendment regulation 2015 (as amended time to time)

3.2 Unless otherwise expressly limited in the Technical Specifications, the Contractor's obligation shall include the provision of all Plant and Equipment and the performance of all Installation Services required for the design, the manufacture (including procurement, quality assurance, construction, installation, associated civil works, Pre-commissioning and delivery) of the Plant and Equipment and the installation, completion, commissioning and performance testing of the facilities in accordance with the plans, procedures, specifications, drawings, codes and any other documents as specified in the Technical specifications. Such specifications include, but are not limited to, the provision of supervision and engineering services; the supply of labour, materials, equipment, spare parts (as specified in GCC Sub-Clause 3.3 below) and accessories; Contractor's Equipment; construction utilities and supplies; temporary materials, structures and facilities; transportation (including without limitation, custom clearance, port handling, unloading and hauling to, from and at the Site); storage and training except for those supplies,

works and services that will be provided or performed by the Employer, as set forth in Appendix-6 (Scope of Works and Supply by the Employer) to the Contract Agreement.

- 3.3 The Contractor shall, unless specifically excluded in the Contract, perform all such work and/or supply all such items and materials not specifically mentioned in the Contract but that can be reasonably inferred from the Contract as being required for attaining Completion of the Facilities as if such work and/or items and materials were expressly mentioned in the Contract.
- 3.4 The Contractor shall ensure the availability of spare parts required for the operation and maintenance of the Facilities to the Employer for a minimum period of 5 years from Completion of the Facilities. The Contractor shall carry sufficient inventories to ensure an ex-stock supply of consumable spares for the plant and equipment. If so desired by the Employer, the Contractor shall submit the specifications, price and the terms and conditions relating to the supply thereof for such spares identified by the Employer with validity period of 6 months within 30 days of receipt of request from Employer for its consideration and placement of order.
- 3.5 The Contractor shall guarantee that in the event of termination of production of spare parts by the Contractor or his Sub-Contractor:
- (i) The Contractor shall send advance notification to the Employer of the pending termination, with 2 (two) years' time to permit the Employer to procure needed requirements, and
 - (ii) Following such termination, the Contractor shall furnish at no cost to the Employer the blueprints, drawings and specification of the spare parts, if requested.
- 3.6 In case the Contractor fails to supply the spares parts in accordance with the terms stipulated above, the Employer shall sanction the Contractor declaring them ineligible for a stated period of time for future projects.

4. Time for Commencement and Completion

- 4.1 The Contractor shall commence work on the Facilities from the Effective Date of Contract i.e. date of issuance of Letter of Intent (LoI) and without prejudice to GCC Sub-Clause 21.2 hereof, the Contractor shall thereafter proceed with the Facilities in accordance with the time schedule specified in the corresponding Appendix – 4 (Time Schedule) to the Contract Agreement of Volume-I : Section-VI (Sample Forms and Procedures).
- 4.2 The Contractor shall attain Completion of the Facilities (or of a part where a separate time for Completion of such part is specified in the Contract) within the time stated under Time for Completion or within such extended time to which the Contractor shall be entitled under GCC Clause 34 hereof.
- 4.3 The work under the contract shall preferably start from the "SansadAdarsh Gram" in presence of public representatives of the project. Hon'ble sitting Member of Parliament and Hon'ble sitting member of State Legislative Assembly shall be cordially invited on the occasion.

5. Contractor's Responsibilities

- 5.1 The Contractor shall design, manufacture (including associated purchases and/or subcontracting), install and complete the Facilities with due care and diligence in accordance with the Contract.

- 5.2 The Contractor confirms that it has entered into this Contract on the basis of a proper examination of the data relating to the Facilities (including any data as to boring tests) provided by the Employer, and on the basis of information that the Contractor could have obtained from a visual inspection of the Site (if access thereto was available) and of other data readily available to it relating to the Facilities as of the date twenty-eight (28) days prior to bid submission. The Contractor acknowledges that any failure to acquaint itself with all such data and information shall not relieve its responsibility for properly estimating the difficulty or cost of successfully performing the Facilities.
- 5.3 The Contractor shall acquire in its name all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the Site is located that are necessary for the performance of the Contract, including, without limitation, visas for the Contractor's and Subcontractor's personnel and entry permits for all imported Contractor's Equipment. The Contractor shall acquire all other permits, approvals and/or licenses that are not the responsibility of the Employer under GCC Sub-Clause 6.3 hereof and that are necessary for the performance of the Contract.
- 5.4 The Contractor shall comply with all laws in force in India. The laws will include all local, state, national or other laws that affect the performance of the Contract and bind upon the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any and all liabilities, damages, claims, fines, penalties and expenses of whatever nature arising or resulting from the violation of such laws by the Contractor or its personnel, including the Subcontractors and their personnel, but without prejudice to GCC Sub-Clause 6.1 hereof.
- 5.5 Any Plant, Material and Services that will be incorporated in or be required for the Facilities and other supplies shall have their origin as specified under GCC Sub-Clause 2.12 (Country of Origin).
- 5.6 The Contractor shall permit the Employer to inspect the Contractor's accounts and records relating to the performance of the Contractor.
- 5.7 First-aid: The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.
- 5.8 Cleanliness: The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area atleast once in a day. All such rubbish and scrap material shall be stacked or disposed off in a place to be identified by the Project Manager. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.
- Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Project Manager. Proper sanitary arrangement shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.
- 5.9 Fire Protection: The work procedures that are to be used during the erection shall be those, which minimize fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or inflammable materials shall be stored away from the construction and equipment and

materials storage areas in safe containers. Un-treated materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable materials before moving into the construction or storage area.

Similarly, corrugated paper fabricated cartons etc. will not be permitted in the construction area either storage or for handling of materials. All such materials used shall be of waterproof and flame resistant type. All other materials such as working drawings, plans etc., which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.

All the Contractor's supervisory personnel and sufficient number of workers shall be trained for firefighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract.

The Contractor shall provide enough fire protection equipment of the types and numbers for the warehouses, office, temporary structures, labour colony area etc. Access to such fire protection equipment shall be easy and kept open at all times.

- 5.10 Security: The Contractor shall have total responsibility for all equipment and materials in his custody/stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the project site only with the written permission of the Project Manager in the prescribed manner.
- 5.11 Contractor's Area Limits: The Project Manager will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contractor's personnel to work out of the areas marked out for him, the same shall be done only with the written permission of the Project Manager.
- 5.12 Contractor's Co-Operation with the Employer: In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Project Manager and the same shall be acceptable at all times to the Contractor. The Project Manager may impose such restrictions on the facilities provided to the Contractor such as electricity, water, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Project Manager. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems, which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and erected by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in the document and specifications.

6. Employer's Responsibilities

- 6.1 The Employer shall ensure the accuracy of all information and/or data to be supplied by the Employer as described in the corresponding Appendix - 6 (Scope of Works and Supply by the Employer) to the Contract, except when otherwise expressly stated in the Contract.

- 6.2 The Employer shall be responsible for acquiring and providing legal and physical possession of the Site and access thereto, and for providing possession of and access to all other areas reasonably required for the proper execution of the Contract, including all requisite rights of way, as specified in the corresponding Appendix – 6 (Scope of Works and Supply by the Employer) to the Contract Agreement. The Employer shall give full possession of and accord all rights of access thereto on or before the date(s) specified in that Appendix.
- 6.3 The Employer shall acquire and pay for all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the Site is located which such authorities or undertakings require the Employer to obtain them in the Employer's name, are necessary for the execution of the Contract (they include those required for the performance by both the Contractor and the Employer of their respective obligations under the Contract), including those specified in Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement.
- 6.4 If requested by the Contractor, the Employer shall use its best endeavors to assist the Contractor in obtaining in a timely and expeditious manner all permits, approvals and/or licenses necessary for the execution of the Contract from all local, state or national government authorities or public service undertakings that such authorities or undertakings require the Contractor or Subcontractors or the personnel of the Contractor or Subcontractors, as the case may be, to obtain.
- 6.5 Unless otherwise specified in the Contract or agreed upon by the Employer and the Contractor, the Employer shall provide sufficient, properly qualified operating and maintenance personnel; shall supply and make available all raw materials, utilities, lubricants, chemicals, catalysts, other materials and facilities; and shall perform all work and services of whatsoever nature, to enable the Contractor to properly carry out Commissioning, all in accordance with the provisions of Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement at or before the time specified in the program furnished by the Contractor under GCC Sub-Clause 14.2 (Program of Performance) hereof and in the manner thereupon specified or as otherwise agreed upon by the Employer and the Contractor.
- 6.6 The Employer shall be responsible for the continued operation of the Facilities after Taking Over, in accordance with GCC Sub-Clause 20.1.5.
- 6.7 All costs and expenses involved in the performance of the obligations under this GCC Clause 6 shall be the responsibility of the Employer.
- 6.8 facilities to be provided by the employer:
- a) Space: Land for Contractor's Office, Store, Workshop etc. –
- The Project Manager shall at his discretion and for the duration of execution of the Contract make available at site, land for construction of Contractor's field office, workshop, stores, magazines for explosives in isolated locations, assembling yard, etc. required for execution of the Contract. Any construction of temporary roads, offices, workshop, etc. as per plan approved by the Project Manager shall be done by the Contractor at his cost.
- b) Electricity (Construction Power supply): Where power supply is available with the Employer for construction purpose the same will be provided at the job site at one point of the distribution system on chargeable basis for consumption in works. Electricity provided for construction site

will be of 440 volts, 3 phase, 50 cycles and 230 volts, 1 phase, 50 cycles. Contractor shall provide and install all necessary switchgears, wiring fixtures, bulbs and other temporary equipment for further distribution and utilization of energy for power and lighting and shall remove the same on completion of the work. Should, however, electricity be used in the Contractor's labour/staff colony, the power so consumed shall be charged at the prevailing tariff rate of State as prevalent for that area at the time of its use; the supply may be withdrawn if the power is used for purposes other than for the work of the project.

- c) Water: Free supply of water will be made available for the construction purpose wherever water is available and the same shall be given at an agreed single point at the Site. Any further distribution will be the responsibility of the Contractor. Free drinking water, if available, will also be provided at one agreed point in the Site. Further distribution either to his labour colony or his work Site or to his office shall be the responsibility of the Contractor. If water source is not available with the employer at site for construction works, the contractor at his own cost shall arrange the water supply.

C. Payment

7. Contract Price

- 7.1 The Contract Price shall be as specified in Article 2 (Contract Price and Terms of Payment) of the Form of Contract Agreement.
- 7.2 The Contract Price shall be subject to adjustment in accordance with the provisions of Appendix 2 (Price Adjustment) to the Contract Agreement. The Contract Price shall be increased or reduced on account of variation in quantity in accordance with Clause 33 of GCC.
- 7.3 Subject to GCC Sub-Clauses 5.2 and 6.1 hereof, the Contractor shall be deemed to have satisfied itself as to the correctness and sufficiency of the Contract Price, which shall, except as otherwise provided for in the Contract, cover all its obligations under the Contract.

8. Terms of Payment

- 8.1 The Contract Price shall be paid as specified in the corresponding Appendix – 1 (Terms and Procedures of Payment) to the Contract Agreement of Volume-I: Section-VI (Sample Forms and Procedures). The procedures to be followed in making application for and processing payments shall be those outlined in the same Appendix.
- 8.1.1 The mounting accessories/structure supplied along with any material like circuit breaker, Lightning arrestor, Capacitor Bank, Control Panel, Isolator, AB Switch, CT/PT etc. as part of main equipment shall not be paid extra under Price Schedules. The equipment price in all such cases shall be inclusive of its mounting accessories/structure. For example: if Circuit Breaker has been supplied along with its mounting structure, the contractor shall not be paid separately for mounting structure/accessories associate with Circuit Breaker.
- 8.2 All payments shall be made in Indian Rupees under the Contract.
- 8.3 The Project Manager shall within twenty-one (21) days after receipt of invoices enclosing requisite documents as per payment terms release the payment through electronic mode in designated bank account of the contractor.

9. Securities

9.1 Issuance of Securities

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

9.2 Advance Payment Security

9.2.1 The Contractor shall, within twenty-eight (28) days of the notification of contract award, provide a security in an amount equal to the advance payment calculated in accordance with the corresponding Appendix - 1 (Terms and Procedures of Payment) to the Contract Agreement, and in the same currency(ies) with initial validity of up to ninety (90) days beyond the date of Completion of the Facilities in accordance with GCC Sub-Clause 20.1. The same shall be extended by the Contractor time to time till ninety (90) days beyond the actual date of Completion of the Facilities, as may be required under the Contract.

9.2.2 The security shall be in the Form of unconditional Bank Guarantee attached hereto in Volume-I: Section VI - Sample Forms and Procedures. The security shall be discharged after completion of the facilities or relevant part thereof. The advance guarantee shall be reduced on two occasions. First reduction shall be on receipt of 50% supply cost of equipment and second reduction shall be on receipt of 75% supply cost of equipment. The advance BG shall also proportionately reduced to 50% and 25% value respectively of initial advance BG.

- Procedure for submission, reduction of Advance Payment Security is detailed in Appendix-1: Terms and Procedures of payments (refer Volume-I : Section-VI (Sample Forms and Procedures)

9.3 Performance Security

9.3.1 The Contractor shall, within twenty-eight (28) days of the notification of Letter of Intent, provide a performance security for the due performance of the Contract in the amount equivalent to Ten percent (10%) of the Contract Price, with a validity upto ninety (90) days beyond the Defect Liability Period. The same shall be extended by the Contractor time to time till ninety (90) days beyond the actual Defect Liability Period, as may be required under the Contract.

Apart from the Contractor's performance security, the Contractor shall be required to arrange additional performance securities, as specified in SCC, within twenty-eight (28) days of the notification of award in favour of the Employer in the form acceptable to the Employer.

9.3.2 The performance security shall be in the Form of unconditional Bank Guarantee attached hereto in the Volume-I : Section VI - Sample Forms and Procedures.

9.3.3 Reduction in the security pro rata to the Contract Price of any part of the Facilities is not admissible. However, if the Defects Liability Period has been extended on any part of the Facilities pursuant to GCC Sub-Clause 22.8 hereof, the Contractor shall issue an additional security in an amount proportionate to the Contract Price of that part. The security shall be returned to the Contractor immediately after its expiration, provided, however, that if the Contractor pursuant to GCC Sub-Clause 22, is liable for an extended warranty obligation, the performance security shall be reduced to ten percent (10%) of the value of the component covered by the extended warranty.

9.3.4 In case of award of the contract to a Joint Venture, the Bank Guarantees for performance security and the Bank Guarantee for advance payment shall be submitted in the name of all the partner(s) of the Joint Venture

9.4 Issuing Banks

The Bank Guarantee for Advance Payment Security and Performance Security are to be provided by the Contractor, which should be issued either:

(a) by a Public Sector Bank located in India, or

(b) a scheduled Indian Bank having paid up capital (net of any accumulated losses) of Rs. 1,000 Million or above (the latest annual report of the Bank should support compliance of capital adequacy ratio requirement) as per attached list only [List is placed at Annexure-I to Section-V (SCC)], or

9.5 Indemnity

9.5.1 For the equipment/material to be provided by the Contractor as well as for owner free issued materials, it will be the responsibility of the Contractor to take delivery, unload and store the materials at Site and execute an Indemnity Bond and obtain authorization letter from Employer as per proforma enclosed at Serial No. 9 – 'Form for Indemnity Bond to be executed by the Contractor' of Volume-I : Section VI (Sample Forms and Procedures), in favour of the Employer against loss, damage and any risks involved for the full value of the materials. This Indemnity Bond shall be furnished by the Contractor before commencement of the supplies/taking delivery from owner stores and shall be valid till the scheduled date of Taking Over of the equipment by the Employer.

9.5.2 In case of divisible Contracts, where the Employer hands over his equipment to the Contractor for executing the Contract, then the Contractor shall, at the time of taking delivery of the equipment through Bill of Landing or other dispatch documents, furnish trust Receipt for Plant, Equipment and Materials and also execute an Indemnity Bond in favour of the Employer in the form acceptable to the Employer for keeping the equipment in safe custody and to utilize the same exclusively for the purpose of the said Contract. Samples of proforma for the Trust receipt and Indemnity Bond are enclosed at Serial No. 10 of Volume-I : Section VI (Sample Forms and Procedures). The Employer shall also issue a separate Authorization Letter to the Contractor to enable him to take physical delivery of plant, equipment and materials from the Employer as per proforma enclosed under Section VI (Sample Forms and Procedures).

9A Acceptance of Bank Guarantees:-

IT enabled confirmation system shall be used in addition to existing paper based confirmation system for verification of Bank Guarantee from issuing bank as under:

- i. Getting confirmation through digitally signed secured e-mails from issuing banks;
- ii. Online verification on company portal with user id and password followed by 2nd stage authentication system generated One Time Password (OTP) on portal for reconfirmation;
- iii. E-mail confirmation followed by 2nd stage authentication by system generated SMS through registered mobile and confirmation through SMS to the verifying officer.

Employer shall evolve its own procedure adopting any one or more of the above methods for ensuring genuineness of Bank Guarantees, which is compatible with the guidelines of Banks / Reserve Bank of India in addition to existing paper based confirmation system.

10. Taxes and Duties

10.1 The Contractor shall be entirely responsible for payment of all taxes, duties, license fees and other such levies legally payable/incurred until delivery of the contracted supplies to the Employer.

If it is statutory requirement to make deductions towards such taxes and duties or any other applicable taxes and duties, the same shall be made by the Employer and a certificate for the same shall be issued to the Contractor.

10.2 The Contractor shall be solely responsible for the taxes that may be levied on the Contractor's persons or on earnings of any of his employees and shall hold the Employer indemnified and harmless against any claims that may be made against the Employer. The Employer does not take any responsibility whatsoever regarding taxes under Indian Income Tax Act, for the Contractor or his personnel. If it is obligatory under the provisions of the Indian Income Tax Act, deduction of Income Tax at source shall be made by the Employer.

10.3 In respect of direct transaction between the Employer and the Contractor, the ex-works price is exclusive of all cost as well as duties and tax (viz., custom duties & levies, duties, sales tax/VAT etc.) paid or payable on components, raw materials and any other items used for their consumption incorporated or to be incorporated in the Plant & Equipment.

Sales tax/VAT, excise duty, local tax and other levies for the Equipment/items under 'direct transaction' including octroi/entry tax as applicable for destination site/state are not included in the ex-works price. These amounts will be payable (along with subsequent variation if any), by the Employer on the supplies made by the Contractor but limited to the tax liability on the transaction between the Employer and the Contractor. The requisite Sales Tax declaration forms shall be issued as under:

- a) When project implementing agency or employer is a Central Public Sector Undertaking, form shall be issued by State Distribution Company to Employer for onward issuance to contractor
- b) When State Distribution Company is Employer, the form shall be issued by them.

In respect of bought-out finished items, which shall be dispatched directly from the sub-vendor's works to the Project site (sale-in-transit), the ex-works price is inclusive of all cost as well as duties and taxes (viz., custom duties & levies, duties, sales tax/VAT etc.) paid or payable and any such taxes, duties, levies additionally payable will be to Contractor's account and no separate claim on this behalf will be entertained by the Employer. The requisite Sales Tax declaration forms shall be issued as under:

- a) When project implementing agency or employer is a Central Public Sector Undertaking, form shall be issued by State Distribution Company to Employer for onward issuance to contractor
- b) When State Distribution Company is Employer, the form shall be issued by them.

Further, the ex-works price of (i) bought-out finished Equipment/items as 'Off the Self' items or dispatched directly from the Contractor's works are exclusive of all cost as well as duties

and taxes (viz., custom duties & levies, duties, sales tax/VAT etc.) paid or payable and no separate claim on this behalf will be entertained by the Employer. Employer shall, however, issue requisite sales tax declaration form. If any tax exemptions, reductions, allowances or privileges may be available to the Contractor in the Country where the site is located, the Employer shall use its best endeavors to enable the Contractor to benefit from such tax savings to the maximum allowable extent.

For payment/reimbursement of Sales Tax, wherever applicable, in respect of dispatches made directly from Contractor's works, invoices raised by the Contractor shall be accepted as documentary evidence and for payment/reimbursement of VAT, VATABLE invoices raised by the Contractor shall be accepted as documentary evidence. Similarly, pre-numbered invoices duly signed by authorized signatory shall be considered as evidence for payment of Excise Duty.

- 10.4 Octroi/entry tax as applicable for destination site/state on all items of supply including bought-out finished items, which shall be dispatched directly from the sub-vendor's works to the Employer's site (sale-in-transit) are not included in the Contract price. The applicable octroi/entry tax in respect of all the items of supply would be reimbursed to the Contractor separately by the Employer subject to furnishing of documentary proof.
- 10.5 Employer would not bear any liability on account of Service Tax. Employer shall, however, deduct such tax at source as per the rules and issue necessary Certificate to the Contractor.
- 10.6 Sales Tax/VAT on Works Contract, Turnover Tax or any other similar taxes under the Sales Tax/VAT Act for services to be performed in India, as applicable is included in Contract Price and Employer would not bear any liability on this account. Employer shall, however, deduct such taxes at source as per the rules and issue Tax Deduction at Source (TDS) Certificate to the Contractor.
- 10.7 For the purpose of the Contract, it is agreed that the Contract Price specified in Article 2(Contract Price and Terms of Payment) of the Contract Agreement is based on the taxes, duties, levies and charges prevailing at the date seven (07) days prior to the last date of bid submission (hereinafter called "Tax" in this GCC Sub-clause 10.7). If any rates of Tax are increased or decreased, a new Tax is introduced, an existing Tax is abolished, or any change in interpretation or application of any Tax occurs in the course of the performance of the Contract, which was or will be assessed on the Contractor in connection with performance of the Contract, an equitable adjustment of the Contract price shall be made to fully take into account any such change by addition to the Contract price or deduction therefrom, as the case may be, in accordance with GCC Clause 31 (Changes in Laws and Regulations) hereof. In the event of introduction of GST in the course of performance of contract, PIA shall examine its impact on the affected transactions under the contract in totality, for equitable adjustment in the contract price, if required. The contractor shall furnish the relevant details/documents for this purpose, as may be required by PIA. However, these adjustments would be restricted to direct transactions between the Employer and the Contractor for which the taxes and duties are reimbursable by the Employer as per the Contract. These adjustments shall not be applicable on procurement of raw materials, intermediary components etc by the Contractor and also not applicable on the bought out items dispatched directly from sub-vendor's works to site.

In respect of raw materials, intermediary components etc and bought out items, neither the Employer nor the Contractor shall be entitled to any claim arising due to increase or decrease in the rate of Tax, introduction of a new Tax or abolition of an existing Tax in the course of the performance of the Contract.

D. Intellectual Property

11. Copy Right

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

The Employer shall however be free to reproduce all drawings, documents and other material furnished to the Employer for the purpose of the Contract including, if required, for operation and maintenance.

11.2 The copyright in all drawings, documents and other materials containing data and information furnished to the Contractor by the Employer herein shall remain vested in the Employer.

12. Confidential Information

12.1 The Employer and the Contractor shall keep confidential and shall not, without the written consent of the other party hereto, divulge to any third party any documents, data or other information furnished directly or indirectly by the other party hereto in connection with the Contract, whether such information has been furnished prior to, during or following termination of the Contract. Notwithstanding the above, the Contractor may furnish to its Subcontractor(s) such documents, data and other information it receives from the Employer to the extent required for the Subcontractor(s) to perform its work under the Contract, in which event the Contractor shall obtain from such Subcontractor(s) an undertaking of confidentiality similar to that imposed on the Contractor under this GCC Clause 12.

12.2 The Employer shall not use such documents, data and other information received from the Contractor for any purpose other than the operation and maintenance of the Facilities. Similarly, the Contractor shall not use such documents, data and other information received from the Employer for any purpose other than the design, procurement of Plant and Equipment, construction or such other work and services as are required for the performance of the Contract.

12.3 The obligation of a party under GCC Sub-Clauses 12.1 and 12.2 above, however, shall not apply to that information which

- (a) now or hereafter enters the public domain through no fault of that party
- (b) can be proven to have been possessed by that party at the time of disclosure and which was not previously obtained, directly or indirectly, from the other party hereto
- (c) otherwise lawfully becomes available to that party from a third party that has no obligation of confidentiality.

12.4 The above provisions of this GCC Clause 12 shall not in any way modify any undertaking of confidentiality given by either of the parties hereto prior to the date of the Contract in respect of the Facilities or any part thereof.

12.5 The provisions of this GCC Clause 12 shall survive termination, for whatever reason, of the Contract.

E. Execution of the Facilities

13. Representatives

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

13.2 Contractor's Representative & Construction Manager

13.2.1 If the Contractor's Representative is not named in the Contract, then within fourteen (14) days of the Effective Date, the Contractor shall appoint the Contractor's Representative and shall request the Employer in writing to approve the person so appointed. If the Employer makes no objection to the appointment within fourteen (14) days, the Contractor's Representative shall be deemed to have been approved. If the Employer objects to the appointment within fourteen (14) days giving the reason therefor, then the Contractor shall appoint a replacement within fourteen (14) days of such objection, and the foregoing provisions of this GCC Sub-Clause 13.2.1 shall apply thereto.

13.2.2 The Contractor's Representative shall represent and act for the Contractor at all times during the currency of the Contract and shall give to the Project Manager all the Contractor's notices, instructions, information and all other communications under the Contract. All notices, instructions, information and all other communications given by the Employer or the Project Manager to the Contractor under the Contract shall be given to the Contractor's Representative or, in its absence, its deputy, except as herein otherwise provided. The Contractor shall not revoke the appointment of the Contractor's Representative without the Employer's prior written consent, which shall not be unreasonably withheld. If the Employer consents thereto, the Contractor shall appoint some other person as the Contractor's Representative, pursuant to the procedure set out in GCC Sub-Clause 13.2.1.

13.2.3 The Contractor's Representative may, subject to the approval of the Employer (which shall not be unreasonably withheld), at any time delegate to any person any of the powers, functions and authorities vested in him or her. Any such delegation may be revoked at any time. Any such delegation or revocation shall be subject to a prior notice signed by the Contractor's Representative, and shall specify the powers, functions and authorities thereby delegated or revoked. No such delegation or revocation shall take effect unless and until a copy thereof has been delivered to the Employer and the Project Manager. Any act or exercise by any person of powers, functions and authorities so delegated to him or her in accordance with this GCC Sub-Clause 13.2.3 shall be deemed to be an act or exercise by the Contractor's Representative.

- 13.2.3.1 Notwithstanding anything stated in GCC Sub-Clause 13.1 and 13.2.1 above, for the purpose of execution of Contract, the Employer and the Contractor shall finalize and agree to a Contract Co-ordination Procedure and all the communication under the Contract shall be in accordance with such Contract Coordination Procedure.
- 13.2.4 From the commencement of installation of the Facilities at the Site until Operational Acceptance, the Contractor's Representative shall appoint a suitable person as the construction manager, (hereinafter referred to as "the Construction Manager"). The Construction Manager shall supervise all work done at the Site by the Contractor and shall be present at the Site through-out normal working hours except when on leave, sick or absent for reasons connected with the proper performance of the Contract. Whenever the Construction Manager is absent from the Site, a suitable person shall be appointed to act as his or her deputy.
- 13.2.5 The Employer may by notice to the Contractor object to any representative or person employed by the Contractor in the execution of the Contract who, in the reasonable opinion of the Employer, may behave inappropriately, may be incompetent or negligent, or may commit a serious breach of the Site regulations provided under GCC Sub-Clause 18.3. The Employer shall provide evidence of the same, whereupon the Contractor shall remove such person from the Facilities.
- 13.2.6 If any representative or person employed by the Contractor is removed in accordance with GCC Sub-Clause 13.2.5, the Contractor shall, where required, promptly appoint a replacement.

14. Work Program

14.1 Contractor's Organization

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

14.2 Program of Performance

Within twenty-eight (28) days after the date of Notification of Award, the Contractor shall prepare and submit to the Project Manager a detailed program of performance of the Contract (L2 Network) in the form of the Critical Path Method (CPM), the PERT network, or other internationally used programs and showing the sequence in which it proposes to design, manufacture, transport, assemble, install and pre-commissioning the Facilities, as well as the date by which the Contractor reasonably requires that the Employer shall have fulfilled its obligations under the Contract so as to enable the Contractor to execute the Contract in accordance with the program and to achieve Completion, Commissioning and Acceptance of the Facilities in accordance with the Contract. The program so submitted by the Contractor shall accord with the Time Schedule included in Appendix-4 (Time Schedule) to the Contract Agreement and any other dates and periods specified in the Contract. The Contractor shall update and revise the program as and when appropriate or when required by the Project Manager, but without modification in the Times for Completion under GCC

Sub-Clause 4.2 and any extension granted in accordance with GCC Clause 34, and shall submit all such revisions to the Project Manager.

In the PERT chart contractor shall highlight clearly timelines for requirement of major high value owner supplied materials.

14.3 Progress Report

The Contractor shall monitor progress of all the activities specified in the program referred to in GCC Sub-Clause 14.2 above, and supply a progress report to the Project Manager every month and as & when required.

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

14.4 Progress of Performance

If at any time the Contractor's actual progress falls behind the program referred to in GCC Sub-Clause 14.2, or it becomes apparent that it will so fall behind, the Contractor shall, at the request of the Employer or Project Manager, prepare and submit to the Project Manager a revised program, taking into account the prevailing circumstances, and shall notify the Project Manager of the steps being taken to expedite progress so as to attain Completion of the Facilities within the Time for Completion under GCC Sub-Clause 4.2, any extension thereof entitled under GCC Sub-Clause 34.1, or any extended period as may otherwise be agreed upon between the Employer and the Contractor.

14.5 Work Procedures

The Contract shall be executed in accordance with the Contract Documents and the procedures given in the section on Sample Forms and Procedures of the Contract Documents.

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

14.6 It is emphasized to conduct monthly contract review meeting with senior most officers of turnkey contractor at their headquarters or at project site. Employer shall decide venue of such monthly contract review meeting. In this meeting, three months rolling plan of mobilization of materials and manpower shall be reviewed. Progress of works achieved on ground shall also be reviewed along with all pending issues related to availability of fronts, payments, contractual issues, if any, etc. Minutes of the meeting shall be issued by Employer within a week time. Performance of contractor shall be reviewed based on commitment and actual achievement on ground. Planning, commitment, review and evaluation of performance of contractor through this meeting shall be under overall agreed project execution plan (PERT Chart).

14.7 It is also emphasized to conduct monthly contract review meeting with sub-contractor in presence of senior most officers of turnkey contractor at their

headquarters or at project site. Employer shall decide venue of such review meeting. In this meeting, three months rolling plan of mobilization of materials and manpower shall be reviewed. Progress of works achieved on ground shall also be reviewed along with all pending issues related to availability of fronts, payments, contractual issues, if any, etc.

15. Subcontracting

The Contractor may, after informing the Project Manager and getting his written approval, assign or sub-let the Supply Contract or any part thereof other than for raw material, for minor details or for any part of the plant for which makes are identified in the Contract. Suppliers of the equipment not identified in the Contract or any change in the identified suppliers shall be subjected to approval by the Project Manager. The experience list of equipment vendors under consideration by the Contractor for this Contract shall be furnished to the Project Manager for approval prior to procurement of all such items/equipment.

Field execution of the contract shall not be sub-contracted without written permission of the Employer. On case to case basis, if employer gets satisfied with, permission for sub-contracting entire or part project execution work may be permitted (level-1). However, further sub-letting of field execution works by sub-contractor (Level-2) shall not be acceptable by employer. In case of further sub-letting of contract, it would be construed as non-performance and breach of the contract. Contractual action shall then be initiated as per provisions of the contract.

Such assignment/sub-letting shall not relieve the Contractor of any obligation, duty or responsibility under the Contract.

15.1 The corresponding Appendix (List of Approved Subcontractors) to the Contract Agreement specifies major items of supply or services and a list of approved Subcontractors against each item, including vendors. Insofar as no Subcontractors are listed against any such item, the Contractor shall prepare a list of Subcontractors for such item for inclusion in such list. The Contractor may from time to time propose any addition to or deletion from any such list. The Contractor shall submit any such list or any modification thereto to the Employer for its approval in sufficient time so as not to impede the progress of work on the Facilities. Such approval by the Employer for any of the Subcontractors shall not relieve the Contractor from any of its obligations, duties or responsibilities under the Contract.

15.2 For items or parts of the Facilities not specified in the corresponding Appendix (List of Approved Subcontractors) to the Contract Agreement for Supply Contract(s), the Contractor may employ such Subcontractors as it may select, at its discretion.

16. Design and Engineering

16.1 Specifications and Drawings

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

The Contractor shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and other technical documents that it has prepared, whether such specifications, drawings and other documents have been approved by the Project Manager

or not, provided that such discrepancies, errors or omissions are not because of inaccurate information furnished in writing to the Contractor by or on behalf of the Employer.

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

16.2 Codes and Standards

Wherever references are made in the Contract to codes and standards in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards current at the date twenty-eight (28) days prior to date of bid submission shall apply unless otherwise specified. During Contract execution, any changes in such codes and standards shall be applied after approval by the Employer and shall be treated in accordance with GCC Clause 33.

16.3 Approval/Review of Technical Documents by Project Manager

- 16.3.1 The Contractor shall prepare (or cause its Subcontractors to prepare) and furnish to the Project Manager the documents listed in Appendix-7 (List of Documents for Approval or Review) to the Contract Agreement for its approval or review as specified and as in accordance with the requirements of GCC Sub-Clause 14.2 (Program of Performance).

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

GCC Sub-Clauses 16.3.2 through 16.3.7 shall apply to those documents requiring the Project Manager's approval, but not to those furnished to the Project Manager for its review only.

- 16.3.2 Within twenty one (21) days after receipt by the Project Manager of any document requiring the Project Manager's approval in accordance with GCC Sub-Clause 16.3.1, the Project Manager shall either return one copy thereof to the Contractor with its approval endorsed thereon or shall notify the Contractor in writing of its disapproval thereof and the reasons therefor and the modifications that the Project Manager proposes.

- 16.3.3 The Project Manager shall not disapprove any document, except on the grounds that the document does not comply with some specified provision of the Contract or that it is contrary to good engineering practice.

- 16.3.4 If the Project Manager disapproves the document, the Contractor shall modify the document and resubmit it for the Project Manager's approval in accordance with GCC Sub-Clause 16.3.2. If the Project Manager approves the document subject to modification(s), the Contractor shall make the required modification(s), and upon resubmission with the required modifications the document shall be deemed to have been approved.

The procedure for submission of the documents by the Contractor and their approval by the Project Manager shall be discussed and finalized with the Contractor.

- 16.3.5 If any dispute or difference occurs between the Employer and the Contractor in connection with or arising out of the disapproval by the Project Manager of any document and/or any modification(s) thereto that cannot be settled between the parties within a reasonable period, then such dispute or difference may be referred to an Arbitrator for determination in

accordance with GCC Sub-Clause 39 hereof. If such dispute or difference is referred to an Arbitrator, the Project Manager shall give instructions as to whether and if so, how, performance of the Contract is to proceed. The Contractor shall proceed with the Contract in accordance with the Project Manager's instructions, provided that if the Arbitrator upholds the Contractor's view on the dispute and if the Employer has not given notice under GCC Sub-Clause 39 hereof, then the Contractor shall be reimbursed by the Employer for any additional costs incurred by reason of such instructions and shall be relieved of such responsibility or liability in connection with the dispute and the execution of the instructions as the Arbitrator shall decide, and the Time for Completion shall be extended accordingly.

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

16.3.7 The Contractor shall not depart from any approved document unless the Contractor has first submitted to the Project Manager an amended document and obtained the Project Manager's approval thereof, pursuant to the provisions of this GCC Sub-Clause 16.3. If the Project Manager requests any change in any already approved document and/or in any document based thereon, the provisions of GCC Clause 33 shall apply to such request.

17. Plant and Equipment

17.1 Subject to GCC Sub-Clause 10.2, the Contractor shall manufacture or procure and transport all the Plant and Equipment in an expeditious and orderly manner to the Site.

17.2 Employer-Supplied Plant, Equipment, and Materials

If the corresponding Appendix – 6 (Scope of Works and Supply by the Employer) to the Contract Agreement provides that the Employer shall furnish any specific items of machinery, equipment or materials to the Contractor, the following provisions shall apply:

17.2.1 The Employer shall, at its own risk and expense, transport each item to the place on or near the Site as agreed upon by the parties and make such item available to the Contractor at the time specified in the program furnished by the Contractor, pursuant to GCC Sub-Clause 14.2, unless otherwise mutually agreed.

17.2.2 The equipment & materials to be furnished by the Employer shall be supplied to the Contractor at the depots established by the Contractor or the Employer. The Lorry Receipts for the materials will be handed over to the Contractor by the representative of the Employer as and when the same are received. The Contractor shall be responsible for taking delivery of these materials from the railways/road transporter, unloading them from the transporter, carting them to different stores built by him for the purpose, the unloading and cartage being at the cost of the Contractor. All wharfage and demurrage charges incurred due to delay in taking delivery will be to the Contractor's account, except those due to reasons beyond his control in which case the Contractor shall immediately intimate the Project Manager for settling the claims. The Contractor shall be responsible for proper handling and storage of these materials from the time of receipt upto the time of Taking Over of the Facilities by the Employer.

- 17.2.3 Yards and store provided by the Contractor for stacking and storage of materials shall be open for inspection by the Employer as and when required. The cost of handling and storage shall be to the Contractor's account.
- 17.2.4 Upon receipt of such item, the Contractor shall inspect the same visually and notify the Project Manager of any detected shortage, defect or default. For the material being arranged by the Employer and supplied to the Contractor for erection, are received short, broken or damaged, an entry shall be made in the delivery register of the railway authorities/road transporter as far as possible and a report of the same giving full details of shortage and damages along with a copy of report entered in the delivery register of the road transporter/railways shall be submitted by the Contractor to the Project Manager and Employer's consignee immediately. The Employer shall immediately remedy any shortage, defect or default, or the Contractor shall, if practicable and possible, at the request of the Employer, remedy such shortage, defect or default at the Employer's cost and expense. After inspection, such item shall fall under the care, custody and control of the Contractor. The provision of this GCC Sub-Clause 17.2.4 shall apply to any item supplied to remedy any such shortage or default or to substitute for any defective item, or shall apply to defective items that have been repaired.
- 17.2.5 The foregoing responsibilities of the Contractor and its obligations of care, custody and control shall not relieve the Employer of liability for any undetected shortage, defect or default, nor place the Contractor under any liability for any such shortage, defect or default whether under GCC Clause 22 or under any other provision of Contract.
- 17.3 Transportation
- 17.3.1 The Contractor shall at its own risk and expense transport all the Plant and Equipment (supplied by turnkey contractor or free supply by Employer) and the Contractor's Equipment to the Site by the mode of transport that the Contractor judges most suitable under all the circumstances.
- 17.3.2 Unless otherwise provided in the Contract, the Contractor shall be entitled to select any safe mode of transport operated by any person to carry the Plant and Equipment and the Contractor's Equipment.
- 17.3.3 Upon dispatch of each shipment of the Plant and Equipment and the Contractor's Equipment, the Contractor shall notify the Employer by e-mail, telex, facsimile or Electronic Data Interchange (EDI) of the description of the Plant and Equipment and of the Contractor's Equipment, the point and means of dispatch, and the estimated time and point of arrival in the country where the Site is located, if applicable, and at the Site. The Contractor shall furnish the Employer with relevant shipping documents to be agreed upon between the parties.
- 17.3.4 The Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the Plant and Equipment and the Contractor's Equipment to the Site. The Employer shall use its best endeavors in a timely and expeditious manner to assist the Contractor in obtaining such approvals, if requested by the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any claim for damage to roads, bridges or any other traffic facilities that may be caused by the transport of the Plant and Equipment and the Contractor's Equipment to the Site.
- 17.4 Delivery and Documents

17.4.1 Delivery Documents

Upon shipment, the Contractor shall notify the Employer with full details of the dispatch and shall furnish the documents as specified in the corresponding Appendix - 1 (Terms and Procedures of Payment) to the Contract Agreement

17.4.2 Packing

17.4.2.1 The Contractor shall provide such packing of the Goods as it is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit and open storage. Packing case size and weights shall take into consideration, where appropriate, the remoteness of the Goods final destination and the absence of heavy handling facilities at all points in transit.

17.4.2.2 The packing, marking and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract and, subject to any subsequent instruction ordered by the Employer consistent with the requirements of the Contract.

17.4.3 Materials Handling and Storage:

All the equipment furnished under the Contract and arriving at Site (materials supplied by contractor as well as material free issued by Employer) shall be promptly received, unloaded, transported and stored in the storage spaces by the Contractor.

Contractor shall be responsible for examining all the shipment and notify the Project Manager immediately of any damages, storage, discrepancy etc, for the purpose of Project Manager's information only. The Contractor shall submit to the Project Manager every week a report detailing all the receipts during the week. 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.

The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Project Manager.

All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Project Manager. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at Site.

All electrical panels, control gears, motors and such other devices shall be properly dried by heating before they are installed and energized. Motor bearings, slip ring, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected.

All the electrical equipment such as transformers, cables, insulators, motors, generators, etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the Contractor. Such records shall be opened for inspection by the Project Manager.

The Contractor shall ensure that all the packing materials and protection devices, used for various equipment during transit and storage, are removed before the equipment are installed.

The consumable and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.

All the materials stored in the open or dusty location must be covered with suitable weatherproof and flame proof covering material wherever applicable.

If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Project Manager will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.

The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment, which require indoor storage. Normally all the electrical equipment such as motors, control gears, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space. The Project Manager, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas, which the Contractor shall strictly comply with.

18. Installation

18.1 Setting Out/Supervision/Labor

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

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

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

18.1.3 Labor:

- (a) The Contractor shall provide and employ on the Site in the installation of the Facilities such skilled, semi-skilled and unskilled labor as is necessary for the proper and timely execution of the Contract. The Contractor is encouraged to use local labor that has the necessary skills.
- (b) Unless otherwise provided in the Contract, the Contractor at its own expense shall be responsible for the recruitment, transportation, accommodation and catering of all labor, local or expatriate, required for the execution of the Contract and for all payments in connection therewith.
- (c) The Contractor shall at all times during the progress of the Contract use its best endeavors to prevent any unlawful, riotous or disorderly conduct or behavior by or amongst its employees and the labor of its Subcontractors.
- (d) The Contractor shall, in all dealings with its labor and the labor of its Subcontractors currently employed on or connected with the Contract, pay due regard to all recognized festivals, official holidays, religious or other customs and all local laws and regulations pertaining to the employment of labor.

18.2 Contractor's Equipment

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

18.3 Site Regulations and Safety

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

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

18.3.1 Compliance with Labour Regulations

- 18.3.1.1 During continuance of the contract, the Contractor and his sub-contractors shall abide at all times by all applicable existing labour enactments and rules made thereunder, regulations notifications and byelaws of the State or Central Government or local authority and any

other labour law (including rules), regulations by laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. The employees of the Contractor and the Sub-contractor in no case shall be treated as the employees of the Employer at any point of time.

18.3.1.2 The Contractor shall keep the Project Manager indemnified in case any action is taken against the Contractor by the competent authority on account of contravention of any of the provisions of any Act or rules made thereunder, regulations or notifications including amendments.

18.3.1.3 If the Project Manager/Employer is caused to pay under any law as principal employer such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/ byelaws/Acts/ Rules/regulations including amendments, if any, on the part of the Contractor, the Project Manager shall have the right to deduct any money due to the Contractor under this contract or any other contract with the Project Manager/Employer including his amount of performance security for adjusting the aforesaid payment. The Project Manager shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Project Manager/Employer.

Notwithstanding the above, the Contractor shall furnish to the Project Manager the details/documents evidencing the Contractor's compliance to the laws applicable to establishments engaged in building and other construction works, as may be sought by the Project Manager. In particular the Contractor shall submit quarterly certificate regarding compliance in respect of provisions of Employees' Provident Fund and Misc. Provisions Act 1952 or latest to the Project Manager.

18.3.1.4 Salient features of some major laws applicable to establishments engaged in building and other construction works:

- (a) Workmen Compensation Act 1923 or latest: The Act provides for compensation in case of injury by accident arising out of and during the course of employment.
- (b) Payment of Gratuity Act 1972 or latest: Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years' service or more or on death at the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.
- (c) Employee P.F. and Miscellaneous Provision Act 1952 or latest: The Act provides for monthly contribution by the turnkey contractor plus his workers @10% or 8.33%. The benefits under the Act are:
 - (i) Pension or family pension on retirement or death, as the case may be.
 - (ii) Deposit linked insurance on death in harness of the worker.
 - (iii) Payment of P.F. accumulation on retirement/death etc.
- (d) Maternity Benefit Act 1951 or latest: The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.
- (e) Contract Labour (Regulation & Abolition) Act 1970 or latest: The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in

case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certification of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour.

- (f) Minimum Wages Act 1948 or latest: The Contractor is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provision of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments.
- (g) Payment of Wages Act 1936 or latest: It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.
- (h) Equal Remuneration Act 1979 or latest: The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.
- (i) Payment of Bonus Act 1965 or latest: The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs. 3500/- per month or less. The bonus is to be paid to employees getting Rs. 2500/- per month or above upto Rs. 3500/- per month shall be worked out by taking wages as Rs. 2500/- per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act. The above guidelines shall be liable to change with the change in act/notification by relevant statutory authority.
- (j) Industrial Dispute Act 1947 or latest: the Act lays down the machinery the procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.
- (k) Industrial Employment (Standing Orders) Act 1946 or latest: It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the employer (i.e. turnkey contractor) on matters provided in the Act and get the same certified by the designated Authority.
- (l) Trade Unions Act 1926 or latest: The Act lays down the procedure for registration of trade unions of workmen and contractors. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.
- (m) Child Labour (Prohibition & Regulation) Act 1986 or latest: The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry.

- (n) Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service Act 1979 or latest: The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home upto the establishment and back, etc.
- (o) The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 or latest and the Cess Act of 1996 or latest: All the establishments who carry on any building or other construction work and employ 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The turnkey contractor of the establishment is required to provide safety measures at the electrical construction site, substations, building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The turnkey contractor to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the government.
- (p) Factories Act 1948 or latest: The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.

18.3.2 Protection of Environment

The Contractor shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as consequence of his methods of operation.

During continuance of the Contract, the Contractor and his Sub-contractors shall abide at all times by all existing enactments on environmental protection and rules made thereunder, regulations, notifications and bye-laws of the State or Central Government, or local authorities and any other law, bye-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority.

Salient features of some of the major laws that are applicable are given below:

The Water (Prevention and Control of Pollution) Act, 1974 or latest, This provides for the prevention and control of water pollution and the maintaining and restoring of wholesomeness of water. 'Pollution' means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms.

The Air (Prevention and Control of Pollution) Act, 1981 or latest, this provides for prevention, control and abatement of air pollution. 'Air Pollution' means the presence in the atmosphere of any 'air pollutant', which means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.

The Environment (Protection) Act, 1986 or latest, this provides for the protection and improvement of environment and for matters connected therewith, and the prevention of hazards to human beings, other living creatures, plants and property. 'Environment' includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property.

The Public Liability Insurance Act, 1991 or latest, This provides for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling hazardous substances and for matters connected herewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under Environment (Protection) Act, 1986 or latest, and exceeding such quantity as may be specified by notification by the Central Government.

18.3.3 Safety Precautions

18.3.3.1 The Contractor shall observe all applicable regulations regarding safety on the Site.

Unless otherwise agreed, the Contractor shall, from the commencement of work on Site until Taking Over, provide:

- a) Fencing, lighting, guarding and watching of the Works, and
- b) Temporary roadways, footways, guards and fences which may be necessary for the accommodation and protection of Employer / his representatives and occupiers of adjacent property, the public and others.

18.3.3.2 The Contractor shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to Employer or to others, working at the Site. The Contractor shall also be responsible for provision of all safety notices and safety equipment required both by the relevant legislations and the Project Manager, as he may deem necessary.

18.3.3.3 The Contractor will notify well in advance to the Project Manager of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. The Project Manager shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contractor shall strictly adhere to and comply with such instructions. The Project Manager shall have the right at his sole discretion to inspect any such container or such construction plant/equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by the Employer and the Employer shall not entertain any claim of the Contractor towards additional safety provisions/conditions to be provided for/constructed as per the Project Manager's instructions.

Further, any such decision of the Project Manager shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by the Project Manager, the Contractor shall use alternative methods with the approval of the Project Manager without any cost implication to the Employer or extension of work schedule.

- 18.3.3.4 Where it is necessary to provide and/or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and/or storage in accordance with the rules and regulations laid down in Petroleum Act 1934 or latest, Explosives Act, 1948 or latest and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Project Manager. In case, any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.
- 18.3.3.5 All equipment used in construction and erection by Contractor shall meet Indian/International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipment shall be strictly operated and maintained by the Contractor in accordance with manufacturer's Operation Manual and safety instructions and as per Guidelines/rules of Employer in this regard.
- 18.3.3.6 Periodical examinations and all tests for all lifting/hoisting equipment & tackles shall be carried-out in accordance with the relevant provisions of Factories Act 1948 or latest or latest, Indian Electricity Act 2003 and associated Laws/Rules in force from time to time. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Project Manager or by the person authorised by him.
- 18.3.3.7 The Contractor shall be fully responsible for the safe storage of his and his Sub-Contractor's radioactive sources in accordance with BARC/DAE Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, storage and handling of such material will be taken by the Contractor.
- 18.3.3.8 The Contractor shall provide suitable safety equipment of prescribed standard to all employees and workmen according to the need, as may be directed by the Project Manager who will also have right to examine these safety equipment to determine their suitability, reliability, acceptability and adaptability.
- 18.3.3.9 Where explosives are to be used, the same shall be used under the direct control and supervision of an expert, experienced, qualified and competent person strictly in accordance with the Code of Practice/Rules framed under Indian Explosives Act pertaining to handling, storage and use of explosives.
- 18.3.3.10 The Contractor shall provide safe working conditions to all workmen and employees at the Site including safe means of access, railings, stairs, ladders, scaffoldings etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection, good and standard quality of material only shall be used by the Contractor.
- 18.3.3.11 The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other Contractors under any circumstances,

whatsoever, unless expressly permitted in writing by Employer to handle such fuses, wiring or electrical equipment

18.3.3.12 Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Employer, he shall:

- a. Satisfy the Project Manager that the appliance is in good working condition;
- b. Inform the Project Manager of the maximum current rating, voltage and phases of the appliances;
- c. Obtain permission of the Project Manager detailing the sockets to which the appliances may be connected.

18.3.3.13 The Project Manager will not grant permission to connect until he is satisfied that;

- a. The appliance is in good condition and is fitted with suitable plug;
- b. The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthed metal sheath surrounding the cores.

18.3.3.14 No electric cable in use by the Contractor/Employer will be disturbed without prior permission. No weight of any description will be imposed on any cable and no ladder or similar equipment will rest against or attached to it.

18.3.3.15 No repair work shall be carried out on any live equipment. The equipment must be declared safe by the Project Manager and a permit to work shall be issued by the Project Manager before any repair work is carried out by the Contractor. While working on electric lines/equipment, whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the Contractor to electricians/workmen/officers.

18.3.3.16 The Contractors shall employ necessary number of qualified, full time electricians/electrical supervisors to maintain his temporary electrical installation.

18.3.3.17 The Contractor employing more than 250 workmen whether temporary, casual, probationer, regular or permanent or on contract, shall employ at least one full time officer exclusively as safety officer to supervise safety aspects of the equipment and workmen, who will coordinate with the Project Safety Officer. In case of work being carried out through Sub-Contractors, the Sub-Contractor's workmen/employees will also be considered as the Contractor's employees/workmen for the above purpose.

The name and address of such Safety Officers of the Contractor will be promptly informed in writing to Project Manager with a copy to Safety Officer-In charge before he starts work or immediately after any change of the incumbent is made during currency of the Contract.

18.3.3.18 In case any accident occurs during the construction/ erection or other associated activities undertaken by the Contractor thereby causing any minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Project Manager in prescribed form and also to all the authorities envisaged under the applicable laws.

18.3.3.19 The Project Manager shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and/or property, and/or equipment. In such cases, the Contractor shall be informed in writing about the nature of hazards and possible injury/accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary, appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor.

18.3.3.20 The Contractor shall not be entitled for any damages/compensation for stoppage of work due to safety reasons as provided in GCC Sub-Clause 18.3.3.19 above and the period of such stoppage of work will not be taken as an extension of time for completion of work and will not be the ground for waiver of levy of liquidated damages.

18.3.3.21 It is mandatory for the Contractor to observe during the execution of the works, requirements of Safety Rules which would generally include but not limited to following:

Safety Rules

- a) Each employee shall be provided with initial indoctrination regarding safety by the Contractor, so as to enable him to conduct his work in a safe manner.
- b) No employee shall be given a new assignment of work unfamiliar to him without proper introduction as to the hazards incident thereto, both to himself and his fellow employees.
- c) Under no circumstances shall an employee hurry or take unnecessary chance when working under hazardous conditions.
- d) Employees must not leave naked fires unattended. Smoking shall not be permitted around fire prone areas and adequate firefighting equipment shall be provided at crucial location.
- e) Employees under the influence of any intoxicating beverage, even to the slightest degree shall not be permitted to remain at work.
- f) There shall be a suitable arrangement at every work site for rendering prompt and sufficient first aid to the injured.
- g) The staircases and passageways shall be adequately lighted.
- h) The employees when working around moving machinery, must not be permitted to wear loose garments. Safety shoes are recommended when working in shops or places where materials or tools are likely to fall. Only experienced workers shall be permitted to go behind guard rails or to clean around energized or moving equipment.
- i) The employees must use the standard protection equipment intended for each job. Each piece of equipment shall be inspected before and after it is used.

- j) Requirements of ventilation in underwater working to licensed and experienced divers, use of gum boots for working in slushy or in inundated conditions are essential requirements to be fulfilled.
- k) In case of rock excavation, blasting shall invariably be done through licensed blasters and other precautions during blasting and storage/transport of charge material shall be observed strictly.

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

18.3.3.23 If the Contractor fails in providing safe working environment as per Employer Safety Rules or continues the work even after being instructed to stop work by the Project Manager as provided in GCC Sub-Clause 18.3.3.19 above, the Contractor shall promptly pay to Employer, on demand by the Employer, compensation at the rate of Rs. 5,000/- per day of part thereof till the instructions are complied with and so certified by the Project Manager. However, in case of accident taking place causing injury to any individual, the provisions contained in GCC Sub-Clause 18.3.3.24 shall also apply in addition to compensation mentioned in this Clause.

18.3.3.24 If the Contractor does not take adequate safety precautions and/or fails to comply with the Safety Rules as prescribed by the Employer or under the applicable law for the safety of the equipment and plant or for the safety of personnel or the Contractor does not prevent hazardous conditions which cause injury to his own employees or employees of other Contractors or Employer's employees or any other person who are at Site or adjacent thereto, then the Contractor shall be responsible for payment of a sum as indicated below to be deposited with the Employer, which will be passed on by the Employer to such person or next to kith and kin of the deceased:

a.	Fatal injury or accident causing death	Rs. 1,000,000/- per person
b.	Major injuries or accident causing 25% or more permanent disablement	Rs. 100,000/- per person

Permanent disablement shall have same meaning as indicated in Workmen's Compensation Act. The amount to be deposited with Employer and passed on to the person mentioned above shall be in addition to the compensation payable under the relevant provisions of the Workmen's Compensation Act and rules framed there under or any other applicable laws as applicable from time to time. In case the Contractor does not deposit the above mentioned amount with Employer, such amount shall be recovered by Employer from any monies due or becoming due to the Contractor under the contract or any other on-going contract.

18.3.3.25 If the Contractor observes all the Safety Rules and Codes, Statutory Laws and Rules during the currency of Contract awarded by the Employer and no accident occurs then Employer may consider the performance of the Contractor and award suitable 'ACCIDENT FREE SAFETY MERITORIOUS AWARD' as per scheme as may be announced separately from time to time.

- 18.3.3.26 The Contractor shall also submit 'Safety Plan' as per proforma specified in Section – Sample Forms and Procedures of the Bidding Documents along with all the requisite documents mentioned therein and as per check-list contained therein to the Project Manager for its approval within 60 days of award of Contract.

Further, one of the conditions for release of first progressive payment / subsequent payment towards Services Contract shall be submission of 'Safety Plan' along with all requisite documents and approval of the same by the Project Manager.

18.4 Opportunities for Other Contractors

- 18.4.1 The Contractor shall, upon written request from the Employer or the Project Manager, give all reasonable opportunities for carrying out the work to any other contractors employed by the Employer on or near the Site.
- 18.4.2 If the Contractor, upon written request from the Employer or the Project Manager, makes available to other contractors any roads or ways the maintenance for which the Contractor is responsible, permits the use by such other contractors of the Contractor's Equipment, or provides any other service of whatsoever nature for such other contractors, the Employer shall fully compensate the Contractor for any loss or damage caused or occasioned by such other contractors in respect of any such use or service, and shall pay to the Contractor reasonable remuneration for the use of such equipment or the provision of such services.
- 18.4.3 The Contractor shall also so arrange to perform its work as to minimize, to the extent possible, interference with the work of other contractors. The Project Manager shall determine the resolution of any difference or conflict that may arise between the Contractor and other contractors and the workers of the Employer in regard to their work.
- 18.4.4 The Contractor shall notify the Project Manager promptly of any defects in the other contractors' work that come to its notice, and that could affect the Contractor's work. The Project Manager shall determine the corrective measures, if any, required to rectify the situation after inspection of the Facilities. Decisions made by the Project Manager shall be binding on the Contractor.

18.5 Emergency Work

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

If the Contractor is unable or unwilling to do such work immediately, the Employer may do or cause such work to be done as the Employer may determine is necessary in order to prevent damage to the Facilities. In such event the Employer shall, as soon as practicable after the occurrence of any such emergency, notify the Contractor in writing of such emergency, the work done and the reasons therefor. If the work done or caused to be done by the Employer is work that the Contractor was liable to do at its own expense under the Contract, the reasonable costs incurred by the Employer in connection therewith shall be paid by the Contractor to the Employer. In case such work is not in the scope of the Contractor, the cost of such remedial work shall be borne by the Employer.

18.6 Site Clearance

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

18.6.2 Clearance of Site after Completion: After Completion of all parts of the Facilities, the Contractor shall clear away and remove all wreckage, rubbish and debris of any kind from the Site, and shall leave the Site and Facilities clean and safe.

18.7 Watching and Lighting

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

18.8 Work at Night and on Holidays

18.8.1 Unless otherwise provided in the Contract, no work shall be carried out during the night and on public holidays of the country where the Site is located without prior written consent of the Employer, except where work is necessary or required to ensure safety of the Facilities or for the protection of life, or to prevent loss or damage to property, when the Contractor shall immediately advise the Project Manager, provided that provisions of this GCC Sub-Clause 18.8.1 shall not apply to any work which is customarily carried out by rotary or double-shifts.

18.8.2 Notwithstanding GCC Sub-Clauses 18.8.1 or 18.1.3, if and when the Contractor considers it necessary to carry out work at night or on public holidays so as to meet the Time for Completion and requests the Employer's consent thereto, the Employer shall not unreasonably withhold such consent.

19. Test and Inspection

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

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

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

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

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

- 19.5 The Project Manager may require the Contractor to carry out any test and/or inspection not required by the Contract, provided that the Contractor's reasonable costs and expenses incurred in the carrying out of such test and/or inspection shall be added to the Contract Price. Further, if such test and/or inspection impedes the progress of work on the Facilities and/or the Contractor's performance of its other obligations under the Contract, due allowance will be made in respect of the Time for Completion and the other obligations so affected.
- 19.6 If any Plant and Equipment or any part of the Facilities fails to pass any test and/or inspection, the Contractor shall either rectify or replace such Plant and Equipment or part of the Facilities and shall repeat the test and/or inspection upon giving a notice under GCC Sub-Clause 19.3.
- 19.7 If any dispute or difference of opinion shall arise between the parties in connection with or arising out of the test and/or inspection of the Plant and Equipment or part of the Facilities that cannot be settled between the parties within a reasonable period of time, it may be referred to an Arbitrator for determination in accordance with GCC Sub-Clause 39.
- 19.8 The Contractor shall afford the Employer and the Project Manager, at the Employer's expense, access at any reasonable time to any place where the Plant and Equipment are being manufactured or the Facilities are being installed, in order to inspect the progress and the manner of manufacture or installation, provided that the Project Manager shall give the Contractor a reasonable prior notice.
- 19.9 The Contractor agrees that neither the execution of a test and/or inspection of Plant and Equipment or any part of the Facilities, nor the attendance by the Employer or the Project Manager, nor the issue of any test certificate pursuant to GCC Sub-Clause 19.4, shall release the Contractor from any other responsibilities under the Contract.
- 19.10 No part of the Facilities or foundations shall be covered up on the Site without the Contractor carrying out any test and/or inspection required under the Contract. The Contractor shall give a reasonable notice to the Project Manager whenever any such part of the Facilities or foundations are ready or about to be ready for test and/or inspection; such test and/or inspection and notice thereof shall be subject to the requirements of the Contract.
- 19.11 The Contractor shall uncover any part of the Facilities or foundations, or shall make openings in or through the same as the Project Manager may from time to time require at the Site, and shall reinstate and make good such part or parts.

If any parts of the Facilities or foundations have been covered up at the Site after compliance with the requirement of GCC Sub-Clause 19.10 and are found to be executed in accordance with the Contract, the expenses of uncovering, making openings in or through, reinstating, and making good the same shall be borne by the Employer, and the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been delayed or impeded in the performance of any of its obligations under the Contract.

- 20. Completion of the Facilities and Operational Acceptance
 - 20.1 Completion of the Facilities
 - 20.1.1 Physical Completion
 - 20.1.1.1 As soon as the Facilities or any part thereof has, in the opinion of the Contractor, been completed operationally and structurally and put in a tight and clean condition as specified in the Technical Specifications, excluding minor items not materially affecting the operation or safety of the Facilities, the Contractor shall so notify the Employer in writing.
 - 20.1.2 Pre-Commissioning
 - 20.1.2.1 Within seven (7) days after receipt of the notice from the Contractor under GCC Sub-Clause 20.1.1.1, the Project Manager shall deploy the operating and maintenance personnel and other material if so specified in the corresponding Appendix – 6 (Scope of Works and Supply by the Employer) to the Contract Agreement for Pre-commissioning of the Facilities or any part thereof.
 - 20.1.2.2 As soon as reasonably practicable after the operating and maintenance personnel have been deployed by the Employer and other materials have been provided by the Employer in accordance with GCC Sub-Clause 20.1.2.1, the Contractor shall commence Pre-commissioning of the Facilities or the relevant part thereof, in presence of the Employer's representatives, as per procedures detailed in Technical Specifications in preparation for Commissioning.
 - 20.1.2.3 As soon as all works in respect of Pre-commissioning are successfully completed and, in the opinion of the Contractor, the Facilities or any part thereof is ready for Commissioning, the Contractor shall notify the Project Manager in writing.
 - 20.1.2.4 The Project Manager shall, within fourteen (14) days after receipt of the Contractor's notice under GCC Sub-Clause 20.1.2.3, notify the Contractor in writing of any defects and/or deficiencies.
 - 20.1.2.5 If the Project Manager notifies the Contractor of any defects and/or deficiencies, the Contractor shall then correct such defects and/or deficiencies, and shall repeat the procedure described in GCC Sub-Clause 20.1.2.2. If in the opinion of the Contractor, the Facilities or any part thereof is now ready for Commissioning, the Contractor shall again notify the Project Manager in writing. If further defects and/or deficiencies are not notified by the Project Manager and if the Project Manager is satisfied that the Pre-commissioning of Facilities or that part thereof have been successfully completed, the Project Manager shall, within seven (7) days after receipt of the Contractor's such notice, advise the Contractor to proceed with the Commissioning of the Facilities or part thereof.
 - 20.1.2.6 If the Project Manager fails to inform the Contractor of any defects and/or deficiencies within fourteen (14) days after receipt of the Contractor's notice under GCC Sub-Clause 20.1.2.4 or within seven (7) days after receipt of the Contractor's notice on completion of repeat procedure under GCC Sub-Clause 20.1.2.5, then the Pre-commissioning of the Facilities or that part thereof shall be considered to have been successfully completed as of the date of the Contractor's notice.
 - 20.1.2.7 As soon as possible after Pre-commissioning, the Contractor shall complete all outstanding minor items so that the Facilities are fully in accordance with the requirements of the

Contract, failing which the Employer will undertake such completion and deduct the costs thereof from any monies owing to the Contractor.

20.1.2.8 In the event that the Contractor is unable to proceed with the Pre-commissioning of the Facilities pursuant to Sub-Clause 20.1.2 for reasons attributable to the Employer either on account of non-availability of other facilities under the responsibilities of other contractor(s), or for reasons beyond the Employer's control, the following provisions shall apply:

When the Contractor is notified by the Project Manager that he will be unable to proceed with the activities and obligations pursuant to above GCC Sub-Clause 20.1.2.8, the Contractor shall be entitled to the following:

- a) the Time of Completion shall be extended for the period of suspension without imposition of liquidated damages pursuant to GCC Sub-Clause 21.2.
- b) payments due to the Contractor in accordance with the provisions specified in Appendix I (Terms and Procedures of Payment) to the Contract Agreement, which would have not been payable in normal circumstances due to non-completion of the said activities and obligations, shall be released to the Contractor against submission of a security in the form of a bank guarantee of equivalent amount acceptable to the Employer, and which shall become null and void when the Contractor will have complied with its obligations regarding these payments, subject to the provisions of GCC Sub-Clause 21.2.9 below.
- c) the expenses payable by the Contractor to the Bankers toward the extension of above security and extension of other securities under the Contract, of which validity need to be extended, shall be reimbursed to the Contractor by the Employer against documentary evidence.
- d) the additional charges toward the care of the Facilities pursuant to GCC Sub-Clause 28.1 shall be reimbursed to the Contractor by the Employer for the period between the notification mentioned above and the notification mentioned in GCC Sub-Clause 20.1.2.10 below. The provisions of GCC Sub-Clause 29.2 shall apply to the Facilities during the same period.

20.1.2.9 In the event that the period of suspension under GCC Sub-Clause 20.1.2.8 actually exceeds one hundred eighty (180) days, the Employer and the Contractor shall mutually agree to any additional compensation payable to the Contractor.

20.1.2.10 As and when, after the period of suspension under GCC Sub-Clause 20.1.2.8, the Contractor is notified by the Project Manager that the Facilities are ready for Pre-commissioning, the Contractor shall proceed without delay in performing all activities and obligations under the Contract.

20.1.3 Commissioning

20.1.3.1 Commissioning of the Facilities or any part thereof shall be commenced by the Contractor immediately after being advised by the Project Manager, pursuant to GCC Sub-Clause 20.1.2.5 or immediately after the Pre-commissioning is considered to be completed under GCC Sub-Clause 20.1.2.6.

- 20.1.3.1.1 Commissioning of the Facilities or any part thereof shall be completed by the Contractor as per procedures detailed in bid documents.

- 20.1.3.2 The Employer shall, to the extent specified in Appendix – 6 (Scope of works and supply by the Employer), deploy the operating and maintenance personnel and supply all raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other materials required for commissioning.

- 20.1.3.3 In the event that the Contractor is unable to proceed with the Commissioning of the Facilities pursuant to Sub-Clause 20.1.3 for reasons attributable to the Employer either on account of non-availability of other facilities under the responsibilities of other contractor(s), or for reasons beyond the Employer's control, the provisions of GCC Sub-Clause 20.1.2.8 to 20.1.2.9 shall apply.

- 20.1.3.4 As and when, after the period of suspension under GCC Sub-Clause 20.1.2.8, the Contractor is notified by the Project Manager that the Facilities are ready for Commissioning, the Contractor shall proceed without delay in performing all activities and obligations under the Contract.

- 20.1.4 Trial - Operation

 - 20.1.4.1 Trial – Operation of the Facilities or any part thereof shall be commenced by the Contractor immediately after the Commissioning is completed pursuant to GCC Sub-Clause 20.1.3.1.1.

 - 20.1.4.2 Trial – Operation of the Facilities or any part thereof shall be completed by the Contractor for the period specified in Technical Specification (or for a continuous period of 24 hours where such period is not specified in Technical Specification) and as per procedures detailed in Technical Specifications.

 - 20.1.4.3 At any time after the events set out in GCC Sub-Clause 20.1.4.2 have occurred, the Contractor may give a notice to the Project Manager requesting the issue of an Taking Over Certificate in the form provided in the Bidding Documents or in another form acceptable to the Employer in respect of the Facilities or the part thereof specified in such notice as of the date of such notice.

 - 20.1.4.4 The Project Manager shall within twenty-one (21) days after receipt of the Contractor's notice, issue an Taking Over Certificate.

- 20.1.5 Taking Over

 - 20.1.5.1 Upon successful Trial – Operation of the Facilities or any part thereof, pursuant to GCC Sub-Clause 20.1.4, the Project Manager shall issue to the Contractor a Taking Over Certificate as a proof of the acceptance of the Facilities or any part thereof. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of Contract after issue of such certificate.

 - 20.1.5.2 If within twenty one (21) days after receipt of the Contractor's notice, the Project Manager fails to issue the Taking Over Certificate or fails to inform the Contractor in writing of the justifiable reasons why the Project Manager has not issued the Taking Over Certificate, the Facilities or the relevant part thereof shall be deemed to have been Taken Over as at the date of the Contractor's said notice.

- 20.1.5.3 Upon Taking Over of the Facilities or any part thereof, the Employer shall be responsible for the care and custody of the Facilities or the relevant part thereof, together with the risk of loss or damage thereto, and shall thereafter take over the Facilities or the relevant part thereof.
- 20.2 Operational Acceptance
- 20.2.1 Guarantee Test
- 20.2.1.1 The Guarantee Test (and repeats thereof), if any specified in the SCC and/or the Technical Specification, shall be conducted by the Contractor after successful Trial – Operation of the Facilities or the relevant part thereof to ascertain whether the Facilities or the relevant part can attain the Functional Guarantees specified in the Contract Documents or if otherwise required as per the Technical Specifications. The Contractor's and Project Manager's advisory personnel may witness the Guarantee Test. The Contractor shall promptly provide the Employer with such information as the Employer may reasonably require in relation to the conduct and results of the Guarantee Test (and any repeats thereof).
- 20.2.1.2 If for reasons not attributable to the Contractor, the Guarantee Test of the Facilities or the relevant part thereof cannot be successfully completed within the time stipulated in the Technical Specifications the period for completing the same shall be as agreed upon by the Employer and the Contractor.
- 20.2.2 Operational Acceptance
- 20.2.2.1 Operational Acceptance shall occur in respect of the Facilities or any part thereof as mentioned below:
- (I) In case no Functional Guarantees are applicable, Operational Acceptance shall occur when the Facilities or part thereof have been successfully Commissioned and Trial – Operation for the specified period have been successfully completed
 - (II) In case Functional Guarantees are applicable, Operational Acceptance shall occur when the Functional Guarantees are met or the Contractor has paid liquidated damages specified in GCC Sub-Clause 23.3 hereof; or
- 20.2.2.2 At any time after any of the events set out in GCC Sub-Clause 20.2.2.1 have occurred, the Contractor may give a notice to the Project Manager requesting the issue of an Operational Acceptance Certificate in the form provided in the Bidding Documents or in another form acceptable to the Employer in respect of the Facilities or the part thereof specified in such notice as of the date of such notice.
- 20.2.2.3 The Project Manager shall within seven (7) days after receipt of the Contractor's notice, issue an Operational Acceptance Certificate.
- 20.2.2.4 Upon Operational Acceptance, pursuant to GCC Sub-Clause 20.2.2.2, the Project Manager shall issue to the Contractor a Operational Acceptance Certificate as a proof of the final acceptance of the Plant and Equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of Contract after issue of such certificate.

20.2.2.5 If within fourteen (14) days after receipt of the Contractor's notice, the Project Manager fails to issue the Operational Acceptance Certificate or fails to inform the Contractor in writing of the justifiable reasons why the Project Manager has not issued the Operational Acceptance Certificate, the Facilities or the relevant part thereof shall be deemed to have been accepted as at the date of the Contractor's said notice.

20.3 Partial Acceptance

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

20A. Quantity Variation

I. The quantity of all equipment/materials given in the Price Schedules of the bidding documents are provisional. The variation in quantity shall be limited to plus/minus (+/-) twenty percent (20%) for the individual items, total variations in all items under the contract shall be limited to ten percent (10%) of the contract price. For quantity variation of the individual items beyond twenty percent (20%), the matter shall be referred to the Employer for mutually agreed rates.

II. However, in case of highly quoted rate of individual item as compared to its estimated cost, efforts shall be made so that no positive deviation in quantity during execution shall be permitted to its award quantity. However, in case, deviations are found inevitable, present market rate analysis of the item shall be made.

III. The Contractor shall be responsible for supply and execution of such final quantities for completion of the project and they shall be paid for such finalized quantity within plus ten percent (+) 10% overall deviation limit.

20B. Electrical Inspector inspection:

After successful completion of the work permission from State Electrical Inspectorate is required. Necessary fee etc. shall be paid by the Employer. However if Contractor pays such fee it shall be reimbursed on actual basis on documentary evidence.

Defects / in-complete works notified by Electrical Inspectorate shall be completed by the agency at no extra cost implication to Employer.

F. Guarantees and Liabilities

21. Completion Time Guarantee

21.1 The Contractor guarantees that it shall attain Completion of the Facilities (or a part for which a separate time for completion is specified in the SCC) within the Time for Completion specified in the SCC pursuant to GCC Sub-Clause 4.2, or within such extended time to which the Contractor shall be entitled under GCC Clause 34 hereof.

21.2 If the Contractor fails to comply with the Time for Completion in accordance with Clause GCC 21 for the whole of the facilities, (or a part for which a separate time for completion is agreed) then the Contractor shall pay to the Employer a sum equivalent to half percent

(0.5%) of the Contract Price for the whole of the facilities, (or a part for which a separate time for completion is agreed) as liquidated damages for such default and not as a penalty, without prejudice to the Employer's other remedies under the Contract, for each week or part thereof which shall elapse between the relevant Time for Completion and the date stated in Taking Over Certificate of the whole of the Works (or a part for which a separate time for completion is agreed) subject to the limit of five percent (5%) of Contract Price for the whole of the facilities, (or a part for which a separate time for completion is agreed). The Employer may, without prejudice to any other method of recovery, deduct the amount of such damages from any monies due or to become due to the Contractor. The payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the Works, or from any other of his obligations and liabilities under the Contract.

21.3 No bonus will be given for earlier Completion of the Facilities or part thereof.

21A. Pre-dispatch Inspection:

Pre-dispatch inspection shall be performed on various materials at manufacturer's work place for which contractor shall be required to raise requisition giving at least 10-day time. Depending on requirement, inspection shall be witnessed by representatives of Employer, TPIA and/or REC/PFC/MoP.

The contractor shall ensure receipt of material at site within 21 days from date of receipt of dispatch instructions. In case materials are not received within 21 days from date of issue of dispatch instruction, the dispatch instruction shall stand cancelled. All expenditure incurred by Employer in performance of dispatch instruction shall be recovered from turnkey contractor.

The turnkey contractor shall ensure that pre-dispatch inspection for materials are intimated only when the material is completely ready for inspection. On due date of inspection, if it is found that materials are not ready in required quantities or the inspection could not be carried out due to non-availability of requisite calibrated certificate of instruments with manufacturer, closing of works on scheduled date of inspection, non-availability of sufficient testing/material handling staff at manufacturer works etc, all expenditures incurred on deployment of various inspecting officials along with a fine of Rs 50,000/- shall be recovered from the bills of the agency and re-inspection shall be carried out on expense of contractor. 2nd such situation at same manufacturer/supplier shall result in rejection of name of manufacturer from list of approved vendors/sub-vendors. In case sub-standard materials (old component, re-cycled materials, re-used core material, re-used transformer coil material etc) offered for inspection and are noticed during the inspection, materials shall be rejected and approval of sub-vendor shall also be cancelled for all DDUGJY/IPDS projects.

22. Defect Liability

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

22.1.1 Volume of concreting: If it was observed by employer, quality monitoring agencies and/or REC/MoP that volume and quality of concreting used in foundation of support, equipment foundation, gantry structure foundation, stay set etc. are not as per requirement specified in the scope of work/technical

specifications, the contractor has to dismantle the supports, foundation and redo the concreting of all the supports in that particular section of line/redo all the foundations in that particular substation at his own cost. To ensure this, the employer reserves the right to withhold the payment of contractor for such defective works till such time the contractor conforms to scope of works, technical specification and tender drawings.

22.1.2 Galvanization of metallic structure: All Metallic structures& fabricated items excluding metallic supports (Steel tubular poles/H-Beam) must be galvanized. In case any metallic item found rusted during execution of works, the contractor has to replace the item used at all places. To ensure this, the employer reserves the right to withhold the payment of contractor for such works till such time the contractor conforms to scope of works, technical specification and tender drawings.

22.1.3 Painting of metallic supports (Steel tubular poles/H-Beam): Painting of metallic supports in overhead lines, distribution transformer substation and Power substation shall be ensured as per specifications. In case metallic supports found rusted during execution of works, the contractor has to remove inferior painting, clean the surface and re-paint it as per given specifications. To ensure this, the employer reserves the right to withhold the payment of contractor for such works till such time the contractor conforms to scope of works, technical specification and tender drawings.

22.2 The Defect Liability Period shall be Twelve (12) months from the date of Taking Over /Completion of Facilities (or any part thereof).

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

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

22.3 The Contractor's obligations under this GCC Clause 22 shall not apply to

- (a) any materials that are supplied by the Employer under GCC Sub-Clause 17.2, are normally consumed in operation, or have a normal life shorter than the Defect Liability Period stated herein
- (b) any designs, specifications or other data designed, supplied or specified by or on behalf of the Employer or any matters for which the Contractor has disclaimed responsibility herein

- (c) any other materials supplied or any other work executed by or on behalf of the Employer, except for the work executed by the Employer under GCC Sub-Clause 22.7.
- 22.4 The Employer shall give the Contractor a notice stating the nature of any such defect together with all available evidence thereof, promptly following the discovery thereof. The Employer shall afford all reasonable opportunity for the Contractor to inspect any such defect.
- 22.5 The Employer shall afford the Contractor all necessary access to the Facilities and the Site to enable the Contractor to perform its obligations under this GCC Clause 22. The Contractor may, with the consent of the Employer, remove from the Site any Plant and Equipment or any part of the Facilities that are defective if the nature of the defect, and/or any damage to the Facilities caused by the defect, is such that repairs cannot be expeditiously carried out at the Site.
- 22.6 If the repair, replacement or making good is of such a character that it may affect the efficiency of the Facilities or any part thereof, the Employer may give to the Contractor a notice requiring that tests of the defective part of the Facilities shall be made by the Contractor immediately upon completion of such remedial work, whereupon the Contractor shall carry out such tests.
- If such part fails the tests, the Contractor shall carry out further repair, replacement or making good (as the case may be) until that part of the Facilities passes such tests.
- 22.7 If the Contractor fails to commence the work necessary to remedy such defect or any damage to the Facilities caused by such defect within a reasonable time (which shall in no event be considered to be less than fifteen (15) days), the Employer may, following notice to the Contractor, proceed to do such work, and the reasonable costs incurred by the Employer in connection therewith shall be paid to the Employer by the Contractor or may be deducted by the Employer from any monies due the Contractor or claimed under the Performance Security.
- 22.8 If the Facilities or any part thereof cannot be used by reason of such defect and/or making good of such defect, the Defect Liability Period of the Facilities or such part, as the case may be, shall be extended by a period equal to the period during which the Facilities or such part cannot be used by the Employer because of any of the aforesaid reasons.
- Upon correction of the defects in the Facilities or any part thereof by repair/replacement, such repair/replacement shall have the Defect Liability Period extended by a period mentioned in GCC Sub-Clause 22.2 from the time of such replacement/repair of the facilities or any part thereof.
- 22.8.1 At the end of the Defect Liability Period, the Contractor's Liability ceases except for latent defects. The Contractor's liability for latent defects warranty shall be limited to period of ten (10) years from the end of Defect Liability Period. For the purpose of this clause, the latent defects shall be the defects inherently lying within the material or arising out of design deficiency, which do not manifest themselves during the Defect Liability Period defined in this GCC Clause 22, but later.
- 22.9 Except as provided in GCC Clauses 22 and 29, the Contractor shall be under no liability whatsoever and howsoever arising, and whether under the Contract or at law, in respect of

defects in the Facilities or any part thereof, the Plant and Equipment, design or engineering or work executed that appear after Defect Liability Period except for the liability towards obligations that may survive in terms of the Contract after Defect Liability Period, except where such defects are the result of the gross negligence, fraud, criminal or willful action of the Contractor.

23. Functional Guarantees

23.1 The Contractor guarantees that the Facilities and all parts thereof shall attain the Functional Guarantees specified in the Technical Specifications, subject to and upon the conditions therein specified.

23.2 If, for reasons attributable to the Contractor, the minimum level of the Functional Guarantees specified in the Technical Specifications are not met either in whole or in part, the Contractor shall at its cost and expense make such changes, modifications and/or additions to the Plant or any part thereof as may be necessary to meet at least the minimum level of such Guarantees. The Contractor shall notify the Employer upon completion of the necessary changes, modifications and / or additions, and shall request the Employer to repeat the Guarantee Test until the minimum level of the Guarantees has been met. If the Contractor eventually fails to meet the minimum level of Functional Guarantees, the Employer may consider termination of the Contract pursuant to GCC Sub-Clause 36.2.2 and recover the payments already made to the Contractor.

23.3 If, for reasons attributable to the Contractor, the Functional Guarantees specified in the Technical Specifications are not attained either in whole or in part, but the minimum level of the Functional Guarantees specified in the Technical Specifications is met, the Contractor shall, at the Contractor's option, either

- (a) make such changes, modifications and/or additions to the Facilities or any part thereof that are necessary to attain the Functional Guarantees at its cost and expense within a mutually agreed time and shall request the Employer to repeat the Guarantee Test, or
- (b) pay liquidated damages to the Employer in respect of the failure to meet the Functional Guarantees in accordance with the provisions in the SCC.

23.4 In case the Employer exercises its option to accept the equipment after levy of liquidated damages, the payment of liquidated damages under GCC Sub-Clause 23.3, upto the limitation of liability specified in the SCC, shall completely satisfy the Contractor's guarantees under GCC Sub-Clause 23.3, and the Contractor shall have no further liability whatsoever to the Employer in respect thereof. Upon the payment of such liquidated damages by the Contractor, the Project Manager shall issue the Operational Acceptance Certificate for the Facilities or any part thereof in respect of which the liquidated damages have been so paid.

24. Equipment Performance Guarantees

24.1 The Contractor guarantees that the Equipment, named in the SCC, shall attain the rating and performance requirements specified in Appendix – 8 (Guarantees, Liquidated Damages for Non – Performance) to the Contract Agreement, subject to and upon the conditions therein specified.

- 24.2 If the guarantees specified in Appendix – 8 (Guarantees, Liquidated Damages for Non – Performance) to the Contract Agreement are not established, then the Employer shall reject the equipment.
- 24.3 In case the Employer rejects the equipment, the Contractor shall at its cost and expense make such changes, modifications and/or additions to the equipment or any part thereof as may be necessary to meet the specified guarantees. The Contractor shall notify the Employer upon completion of the necessary changes, modifications and/or additions, and shall request the Employer to repeat the Test until the level of the specified guarantee has been met.
- 24.4 Whenever the Employer exercises its option to accept the equipment after levy of liquidated damages, the payment of liquidated damages under GCC Sub-Clause 24.2, upto the limitation of liability specified in the SCC, shall completely satisfy the Contractor's guarantees under GCC Sub-Clause 24.2, and the Contractor shall have no further liability whatsoever to the Employer in respect thereof.
25. Patent Indemnity
- 25.1 The Contractor shall, subject to the Employer's compliance with GCC Sub-Clause 25.2, indemnify and hold harmless the Employer and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Employer may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract by reason of: (a) the installation of the Facilities by the Contractor or the use of the Facilities in the country where the Site is located; and (b) the sale of the products produced by the Facilities in any country.
- Such indemnity shall not cover any use of the Facilities or any part thereof other than for the purpose indicated by or to be reasonably inferred from the Contract, any infringement resulting from the use of the Facilities or any part thereof, or any products produced thereby in association or combination with any other equipment, plant or materials not supplied by the Contractor, pursuant to the Contract Agreement.
- 25.2 If any proceedings are brought or any claim is made against the Employer arising out of the matters referred to in GCC Sub-Clause 25.1, the Employer shall promptly give the Contractor a notice thereof, and the Contractor may at its own expense and in the Employer's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim. If the Contractor fails to notify the Employer within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the twenty-eight (28) day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim.
- The Employer shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.
- 25.3 The Employer shall indemnify and hold harmless the Contractor and its employees, officers and Subcontractors from and against any and all suits, actions or administrative proceedings,

claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Contractor may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract arising out of or in connection with any design, data, drawing, specification, or other documents or materials provided or designed by or on behalf of the Employer.

26. Limitation of Liability

26.1 Except in cases of gross negligence or willful misconduct,

(a) the Contractor and the Employer shall not be liable to the other party for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the Contractor to pay liquidated damages to the Employer and

(b) the aggregate liability of the Contractor to the Employer, whether under the Contract, in tort or otherwise, shall not exceed the total Contract Price, provided that this limitation shall not apply to the cost of repairing or replacing defective equipment, or to any obligation of the Contractor to indemnify the Employer with respect to patent infringement.

26.2 All payments to subcontractor shall be made by contractor. Contractor shall indemnify Employer from any legal issues related to delay in payment or not making any payment to sub-vendor/sub-contractor.

G. Risk Distribution

27. Transfer of Ownership

27.1 Imported finished items are not covered under the contract. Only indigenous finished items are covered under the contract.

27.2 Ownership of the Plant and Equipment (including spare parts) procured in India, shall be transferred to the Employer upon loading on to the mode of transport to be used to carry the Plant and Equipment from the works to the site and upon endorsement of the dispatch documents in favour of the Employer.

27.3 Ownership of the Contractor's Equipment used by the Contractor and its Subcontractors in connection with the Contract shall remain with the Contractor or its Subcontractors.

27.4 Ownership of any Plant and Equipment in excess of the requirements for the Facilities shall revert to the Contractor upon Completion of the Facilities or at such earlier time when the Employer and the Contractor agree that the Plant and Equipment in question are no longer required for the Facilities provided quantity of any Plant and Equipment specifically stipulated in the Contract shall be the property of the Employer whether or not incorporated in the Facilities.

27.5 Notwithstanding the transfer of ownership of the Plant and Equipment, the responsibility for care and custody thereof together with the risk of loss or damage thereto shall remain with

the Contractor pursuant to GCC Clause 28 (Care of Facilities) hereof until Completion of the Facilities and Taking Over pursuant to GCC Clause 20 or the part thereof, if any, as per GCC Sub-Clause 1.1(e) in which such Plant and Equipment are incorporated.

28. Care of Facilities
- 28.1 The Contractor shall be responsible for the care and custody of the Facilities or any part thereof until the date of Taking Over Certificate pursuant to GCC Clause 20 or, where the Contract provides for Completion of the Facilities in parts, until the date of Completion of the relevant part, and shall make good at its own cost any loss or damage that may occur to the Facilities or the relevant part thereof from any cause whatsoever during such period. The Contractor shall also be responsible for any loss or damage to the Facilities caused by the Contractor or its Subcontractors in the course of any work carried out, pursuant to GCC Clause 22. Notwithstanding the foregoing, the Contractor shall not be liable for any loss or damage to the Facilities or that part thereof caused by any use or occupation by the Employer or any third party (other than a Subcontractor) authorized by the Employer of any part of the Facilities.
29. Loss of or Damage to Property; Accident or Injury to Workers; Indemnification
- 29.1 The Contractor shall indemnify and hold harmless the Employer and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, in respect of the death or injury of any person or loss of or damage to any property (other than the Facilities whether accepted or not), arising in connection with the supply and installation of the Facilities and by reason of the negligence of the Contractor or its Subcontractors, or their employees, officers or agents, except any injury, death or property damage caused by the negligence of the Employer, its contractors, employees, officers or agents.
- 29.2 If any proceedings are brought or any claim is made against the Employer that might subject the Contractor to liability under GCC Sub-Clause 29.1, the Employer shall promptly give the Contractor a notice thereof and the Contractor may at its own expense and in the Employer's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim.
- If the Contractor fails to notify the Employer within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the twenty-eight (28) day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim.
- The Employer shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.
- 29.3 Notwithstanding anything in this Contract to the contrary, it is agreed that neither the Contractor nor the Employer shall be liable to the other party for loss of production, loss of profit, loss of use or any other indirect or consequential damages.
30. Insurance

30.1 To the extent specified in the corresponding Appendix-3 (Insurance Requirements) to the Contract Agreement, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified in the said Appendix. The identity of the insurers and the form of the policies shall be subject to the approval of the Employer, who should not unreasonably withhold such approval.

(a) Marine Cargo Policy/Transit Insurance Policy:

(I)(i) Marine Cargo policy for imported equipment

Since imported finished materials are not permitted under the contract, this policy shall not be applicable,

(I)(ii) Transit Insurance Policy for indigenous equipment

Transit Insurance Policy shall be taken wherein only inland transit is involved for the movement of Plant and Equipment supplied from within India. The policy shall cover movement of Plant and Equipment from the manufacturer's works to the project's warehouse at final destination site. Inland Transit Clause(ITC) 'A' along with war & Strike Riots & Civil Commotion (SRCC) extension cover shall be taken. The policy shall cover movement of Plant and Equipment from the manufacturer's works to the project's warehouse at final destination site. The policy shall cover all risk for loss or damage that may occur during transit of Plant and Equipment from the Contractor/sub-Contractor's works or stores until arrival at project's warehouse/ store at final destination. Institute Cargo Clause (ICC) 'A' along with war & Strike Riots & Civil Commotion (SRCC) cover shall be taken.

(II) If during the execution of Contract, the Employer requests the Contractor to take any other add-on cover(s)/ supplementary cover(s) in aforesaid insurance, in such a case, the Contractor shall promptly take such add-on cover(s)/ supplementary cover(s) and the charges towards such premium for such add-on cover(s)/ supplementary cover(s) shall be reimbursed to the Contractor on submission documentary evidence of payment to the Insurance company. Therefore, charges towards premium for such add-on cover(s)/ supplementary cover(s) are not included in the Contract Price.

(III) The Contractor shall take the policy in the joint names of Employer and the Contractor. The policy shall indicate the Employer as the beneficiary. However, if the Contractor is having an open policy for its line of business, it should obtain an endorsement of the open cover policy from the insurance company indicating that the dispatches against this Contract are duly covered under its open policy and include the name of the Employer as jointly Insured in the endorsements to the open policy.

(b) Erection All Risk Policy/Contractor All Risk Policy:

(I) The policy should cover all physical loss or damage to the facility at site during storage, erection and commissioning covering all the perils as

provided in the policy as a basic cover and the add on covers as mentioned at Sl. No. (III) below.

- (II) The Contractor shall take the policy in the joint name of Employer and the Contractor. All these policies shall indicate Employer as the beneficiary. The policy shall be kept valid till the date of the Operational Acceptance of the project and the period of the coverage shall be determined with the approval of the Employer.

If the work is completed earlier than the period of policy considered, the Contractor shall obtain the refund as per provisions of the policy and pass on the benefit to Employer. In case no refund is payable by the insurance company then the certificate to that effect shall be submitted to Employer at the completion of the project.

- (III) The following add-on covers shall also be taken by the Contractor:

- i) Earthquake
- ii) Terrorism
- iii) Escalation cost (approximately @10% of sum insured on annual basis)
- iv) Extended Maintenance cover for Defect Liability Period
- v) Design Defect
- vi) Other add-on covers viz., 50-50 clause, 72 hours clause, loss minimization clause, waiver of subrogation clause (for projects of more than 100 crores, cover for offsite storage/fabrication (over 100 crores).

- (IV) Third Party Liability cover with cross Liability within Geographical limits of India as on ADD-on cover to the basic EAR cover:

The third party liability add-on cover shall cover bodily injury or death suffered by third parties (including the Employer's personnel) and loss of or damage to property (including the Employer's property and any parts of the Facilities which have been accepted by the Employer) occurring in connection with supply and installation of the Facilities.

- (V) As per para 30.8 below, the cost of insurance premium is to be reimbursed to the Contractor for Employer Supplied Materials (OSM) for which the insurer is to be finalized by the Contractor as detailed therein. Alternatively, the Contractor may take a single policy covering the entire cost of the project including the cost of OSM. For this purpose, the Contractor shall submit documentary evidence for the premium paid for the entire project to the Employer and Employer shall reimburse to the Contractor the proportion of premium equal to value of OSM to total sum insured.

- (VI) If during the execution of Contract, the Employer requests the Contractor to take any other add-on cover(s)/ supplementary cover(s) in aforesaid insurance, in such a case, the Contractor shall promptly take such add-on cover(s)/ supplementary cover(s) and the charges towards such premium

for such add-on cover(s)/ supplementary cover(s) shall be reimbursed to the Contractor on submission documentary evidence of payment to the Insurance company. Therefore, charges towards premium for such add-on cover(s)/ supplementary cover(s) are not included in the Contract Price.

(c) Automobile Liability Insurance

The Contractor shall ensure that all the vehicles deployed by the Contractor or its Subcontractors (whether or not owned by them) in connection with the supply and installation of the Facilities in the project are duly insured as per RTA act. Further the Contractor or its Subcontractors may also take comprehensive policy (own damage plus third party liability) of each individual vehicles deployed in the project on their own discretion in their own name to protect their own interest.

(d) Workmen Compensation Policy:

(I) Workmen Compensation Policy shall be taken by the Contractor in accordance with the statutory requirement applicable in India. The Contractor shall ensure that all the workmen employed by the Contractor or its Subcontractors for the project are adequately covered under the policy.

(II) The policy may either be project specific covering all men of the Contractor and its Subcontractors. The policy shall be kept valid till the date of Operational Acceptance of the project.

Alternatively, if the Contractor has an existing 'Workmen Compensation Policy' for all its employees including that of the Subcontractor(s), the Contractor must include the interest of the Employer for this specific Project in its existing 'Workmen Compensation Policy'.

(III) Without relieving the Contractor of its obligations and responsibilities under this Contract, before commencing work the Contractor shall insure against liability for death of or injury to persons employed by the Contractor including liability by statute and at common law. The insurance cover shall be maintained until all work including remedial work is completed including the Defect Liability Period. The insurance shall be extended to indemnify the Principal for the Principal's statutory liability to persons employed by the Contractor.

The Contractor shall also ensure that each of its Subcontractors shall effect and maintain insurance on the same basis as the 'Workmen Compensation Policy' effected by the Contractor.

(e) Contractor's Plant and Machinery (CPM) Insurance

The Employer (including without limitation any consultant, servant, agent or employee of the Employer) shall not in any circumstances be liable to the Contractor for any loss of or damage to any of the Contractor's Equipment or for any losses, liabilities, costs, claims, actions or demands which the Contractor may incur or which may be made against it as a result of or in connection with any such loss or damage.

- 30.2 The Employer shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 30.1, except for the Third Party Liability, Workmen Compensation Policy Insurances, and the Contractor's Subcontractors shall be named as co-insureds under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 30.1 except for the Cargo Insurance During Transport, Workmen Compensation Policy Insurances. All insurer's rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies.
- 30.3 The Contractor shall, in accordance with the provisions of the corresponding Appendix – 3 (Insurance Requirements) to the Contract Agreement, deliver to the Employer certificates of insurance (or copies of the insurance policies) as evidence that the required policies are in full force and effect. The certificates shall provide that no less than twenty-one (21) days' notice shall be given to the Employer by insurers prior to cancellation or material modification of a policy.
- 30.4 The Contractor shall ensure that, where applicable, its Subcontractor(s) shall take out and maintain in effect adequate insurance policies for their personnel and vehicles and for work executed by them under the Contract, unless such Subcontractors are covered by the policies taken out by the Contractor.
- 30.5 The Employer shall at its expense take out and maintain in effect during the performance of the Contract those insurances specified in the corresponding Appendix – 3 (Insurance Requirements) to the Contract Agreement, in the sums and with the deductibles and other conditions specified in the said Appendix. The Contractor and the Contractor's Subcontractors shall be named as co-insureds under all such policies. All insurers' rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies. The Employer shall deliver to the Contractor satisfactory evidence that the required insurances are in full force and effect. The policies shall provide that not less than twenty-one (21) days' notice shall be given to the Contractor by all insurers prior to any cancellation or material modification of the policies. If so requested by the Contractor, the Employer shall provide copies of the policies taken out by the Employer under this GCC Sub-Clause 30.5.
- 30.6 If the Contractor fails to take out and/or maintain in effect the insurances referred to in GCC Sub-Clause 30.1, the Employer may take out and maintain in effect any such insurances and may from time to time deduct from any amount due the Contractor under the Contract any premium that the Employer shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Contractor. If the Employer fails to take out and/or maintain in effect the insurances referred to in GCC 30.5, the Contractor may take out and maintain in effect any such insurances and may from time to time deduct from any amount due the Employer under the Contract any premium that the Contractor shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Employer.
- 30.7 Unless otherwise provided in the Contract, the Contractor shall prepare and conduct all and any claims made under the policies effected by it pursuant to this GCC Clause 30, and the monies payable by any insurers under all the insurance except Third Party Liability Insurance and Workmen Compensation Policy, shall be paid to the joint account of the Employer and the Contractor as mutually agreed and such amounts paid shall be apportioned between the Employer and the Contractor in accordance with the respective responsibilities under the Contract. The Employer shall give to the Contractor all such reasonable assistance as may be required by the Contractor. With respect to insurance claims in which the Employer's interest is involved, the Contractor shall not give any release or make any compromise with the

insurer without the prior written consent of the Employer. With respect to insurance claims in which the Contractor's interest is involved, the Employer shall not give any release or make any compromise with the insurer without the prior written consent of the Contractor.

30.8 Further all equipment and materials being supplied by Employer for the erection (as per Technical Specification) shall be kept insured by the Contractor against any loss, damage, pilferage, theft, fire, etc. from the point of unloading up to the time of taking over by Employer including handling, transportation, storage, erection, testing and commissioning etc. The premium paid to the Insurance company by the Contractor for such insurance shall be reimbursed by Employer to the Contractor. The Contractor shall obtain competitive quotation for such insurance and shall take prior approval from Employer before taking the insurance. The insurable value of the equipment being supplied by Employer shall be intimated to the Contractor for arranging the insurance.

30.9 It will be the responsibility of the Contractor to lodge, pursue and settle all claims with the insurance company in case of any damage, loss, theft, pilferage or fire during execution of Contract and Employer shall be kept informed about it. The Contractor shall replace the lost/damaged materials promptly irrespective of the settlement of the claims by the underwriters and ensure that the work progress is as per agreed schedules. The losses, if any, in such replacement will have to be borne by the Contractor.

31. Change in Laws and Regulations

31.1 If, after the date seven (07) days prior to the date of Bid Opening, any law, regulation, ordinance, order or by-law having the force of law is enacted, promulgated, abrogated or changed in India (which shall be deemed to include any change in interpretation or application by the competent authorities) that subsequently affects the costs and expenses of the Contractor and/or the Time for Completion, the Contract Price shall be correspondingly increased or decreased, and/or the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been affected in the performance of any of its obligations under the Contract. However, these adjustments would be restricted to direct transactions between the Employer and the Contractor and not on procurement of raw materials, intermediary components etc. by the Contractor for which the Employer shall be the sole judge. Notwithstanding the foregoing, such additional or reduced costs shall not be separately paid or credited if the same has already been accounted for in the price adjustment provisions where applicable, in accordance with the Appendix-2 to the Contract Agreement.

32. Force Majeure

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

- (a) war, hostilities or warlike operations (whether war be declared or not), invasion, act of foreign enemy and civil war,
- (b) rebellion, revolution, insurrection, mutiny, usurpation of government, conspiracy, riot and civil commotion,
- (c) earthquake, landslide, volcanic activity, flood or cyclone, or other inclement weather condition, nuclear and pressure waves or other natural or physical disaster,

- 32.2 Neither party shall be considered to be in default or in breach of his obligations under the Contract to the extent that performance of such obligation is prevented by any circumstances of Force majeure, which arises after date of Notification of Award.
- 32.3 If either party is prevented, hindered or delayed from or in performing any of its obligations under the Contract by an event of Force Majeure, then it shall notify the other in writing of the occurrence of such event and the circumstances thereof within fourteen (14) days after the occurrence of such event.
- 32.4 The party who has given such notice shall be excused from the performance or punctual performance of its obligations under the Contract for so long as the relevant event of Force Majeure continues and to the extent that such party's performance is prevented, hindered or delayed. The Time for Completion shall be extended in accordance with GCC Clause 34.

H. Change in Contract Elements

33. Change in the Facilities

33.1 Introducing a Change

33.1.1 Subject to GCC Sub-Clause 33.2.5, the Employer shall have the right to propose, and subsequently require, that the Project Manager order the Contractor from time to time during the performance of the Contract to make any change, modification, addition or deletion to, in or from the Facilities (hereinafter called "Change"), provided that such Change falls within the general scope of the Facilities and does not constitute unrelated work and that it is technically practicable, taking into account both the state of advancement of the Facilities and the technical compatibility of the Change envisaged with the nature of the Facilities as specified in the Contract.

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

33.1.3 Changes made necessary because of any default of the Contractor in the performance of its obligations under the Contract shall be not be deemed to be a Change, and such change shall not result in any adjustment of the Contract Price or the Time for Completion.

33.1.4 The procedure on how to proceed with and execute Changes is specified in GCC Sub-Clauses 33.2 and 33.3.

33.2 Changes Originating from Employer

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

33.2.2 The Contract Price for (i) the items for which quantities have been indicated as lumpsum or lot or set and/or (ii) where the quantities are to be estimated by the Contractor shall remain constant unless there is change made in the Scope of Work by Employer. The quantities and

unit prices (i) subsequently arrived while approving the Bill of Quantities (BOQ)/Billing breakup of lumpsum quantities/lot/Set and/or (ii) estimated by the Contractor shall be for on account payment purpose only. In case additional quantities, over and above the quantities in BOQ/billing breakup and /or estimated by the Contractor, are required for successful completion of the scope of work as per Technical Specification, the Contractor shall execute additional quantities of these items for which no additional payment shall be made over and above the lumpsum Contract Price. In case quantities of these items supplied at site are in excess of that required for successful completion of scope of work, such additional quantities shall be the property of the Contractor and they shall be allowed to take back the same from the site for which no deduction from the lumpsum Contract Price shall be made. Further, in case actual requirement of quantities for successful completion of scope of work is less than the quantities identified in the approved BOQ /billing breakup and/or estimated by the Contractor, the lumpsum contract price shall remain unchanged and no deduction shall be made from the lumpsum price due to such reduction of quantities.

It shall be the responsibility of the Contractor to pay all statutory taxes, duties and levies to the concerned authorities for such surplus material which would otherwise have been, lawfully payable in case of non-deemed export contracts. The Contractor shall submit an indemnity bond to keep Employer harmless from any liability, before release of such material to the Contractor by Employer.

Set/Lot/Lumpsum shall be governed as per the requirement of the corresponding item description read in conjunction with relevant provisions of Technical Specifications and the Billing breakup referred to above shall be issued by the Employer based on Contractor's request, if and as may be required during the currency of the Contract.

- 33.2.3 If before or during the preparation of the Change Proposal it becomes apparent that the aggregate effect of compliance therewith and with all other Change Orders that have already become binding upon the Contractor under this GCC Clause 33 would be to increase or decrease the Contract Price as originally set forth in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement by more than the percentage specified in SCC, the Employer and the Contractor shall mutually agree on specific rates for valuation of the Change beyond the specified percentage.

For the said purpose, the Contract Price means the Contract Price of the Facilities notwithstanding the Construction of the Contract.

- 33.2.4 If rates and prices of any change are not available in the Contract, the parties thereto shall agree on specific rates for the valuation of the change and all matters therein related to the change. Based on the same, the Employer shall, if it intends to proceed with the Change, issue the Contractor with a Change Order.

- 33.2.5 The Employer shall issue the Contractor with a Change Order pursuant to GCC Sub-Clause 33.2 by way of amendment to the Contract or in any other manner deemed appropriate. Even if the Employer and the Contractor cannot reach agreement on the price for the Change, an equitable adjustment to the Time for Completion, or any other matters related to the Change Proposal, the Employer may nevertheless instruct the Contractor to proceed with the Change by issue of a "Pending Agreement Change Order" ("Pending Agreement Amendment").

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

If the parties cannot reach agreement within sixty (60) days from the date of issue of the Pending Agreement Change Order, then the matter may be referred to the Arbitrator in accordance with the provisions of GCC Clause 38 & 39.

33.3 Changes Originating from Contractor

33.3.1 If the Contractor proposes a Change pursuant to GCC Sub-Clause 33.1.2, the Contractor shall submit to the Project Manager a written "Request for Change Proposal", giving reasons for the proposed Change and which shall include the following:

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

Upon receipt of the Request for Change Proposal, the parties shall follow the procedures outlined in GCC Sub-Clauses 33.2.1 and 33.2.5. However, should the Employer choose not to proceed, the Contractor shall not be entitled to recover the costs of preparing the Request for Change Proposal.

33A. Surplus Materials

- a. On completion of the works all such materials supplied by contractor for erection that remain unutilized, if any, shall be taken back by Contractor after detailed materials and payment reconciliations.
- b. The Contractor, within two (2) months from the taking over of the equipment/materials under the package, shall submit payment and materials account for the reconciliations, failing which necessary recoveries will be made from the outstanding bills of the Contractor for the cost of the materials left unaccounted as decided by the Project Manager.

34. Extension of Time for Completion

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

- (a) any Change in the Facilities as provided in GCC Clause 33
- (b) any occurrence of Force Majeure as provided in GCC Clause 32
- (c) any suspension order given by the Employer under GCC Clause 35 hereof or reduction in the rate of progress pursuant to GCC Sub-Clause 35.2 or
- (d) any changes in laws and regulations as provided in GCC Clause 31 or

(e) any other matter specifically mentioned in the Contract

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

34.2 Except where otherwise specifically provided in the Contract, the Contractor shall submit to the Project Manager a notice of a claim for an extension of the Time for Completion, together with particulars of the event or circumstance justifying such extension as soon as reasonably practicable after the commencement of such event or circumstance. As soon as reasonably practicable after receipt of such notice and supporting particulars of the claim, the Employer and the Contractor shall agree upon the period of such extension. In the event that the Contractor does not accept the Employer's estimate of a fair and reasonable time extension, the Contractor shall be entitled to refer the matter to Arbitration, pursuant to GCC Sub-Clause 39.

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

35. Suspension

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

If, by virtue of a suspension order given by the Project Manager, other than by reason of the Contractor's default or breach of the Contract, the Contractor's performance of any of its obligations is suspended for an aggregate period of more than ninety (90) days, then at any time thereafter and provided that at that time such performance is still suspended, the Contractor may give a notice to the Project Manager requiring that the Employer shall, within twenty-eight (28) days of receipt of the notice, order the resumption of such performance or request and subsequently order a change in accordance with GCC Clause 33, excluding the performance of the suspended obligations from the Contract.

If the Employer fails to do so within such period, the Contractor may, by a further notice to the Project Manager, elect to treat the suspension, where it affects a part only of the Facilities, as a deletion of such part in accordance with GCC Clause 33 or, where it affects the whole of the Facilities, as termination of the Contract under GCC Sub-Clause 36.1.

35.2 If the Contractor's performance of its obligations is suspended or the rate of progress is reduced pursuant to this GCC Clause 35, then the Time for Completion shall be extended in accordance with GCC Sub-Clause 34.1, and any and all additional costs or expenses incurred by the Contractor as a result of such suspension or reduction shall be paid by the Employer to the Contractor in addition to the Contract Price, except in the case of suspension order or reduction in the rate of progress by reason of the Contractor's default or breach of the Contract.

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

36. Termination

36.1 Termination for Employer's Convenience

36.1.1 The Employer may at any time terminate the Contract for any reason by giving the Contractor a notice of termination that refers to this GCC Sub-Clause 36.1.

36.1.2 Upon receipt of the notice of termination under GCC Sub-Clause 36.1.1, the Contractor shall either immediately or upon the date specified in the notice of termination

- (a) cease all further work, except for such work as the Employer may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition
- (b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) (ii) below
- (c) remove all Contractor's Equipment from the Site, repatriate the Contractor's and its Subcontractors' personnel from the Site, remove from the Site any wreckage, rubbish and debris of any kind, and leave the whole of the Site in a clean and safe condition
- (d) In addition, the Contractor, subject to the payment specified in GCC Sub-Clause 36.1.3, shall
 - (i) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination
 - (ii) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant and Equipment as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors
 - (iii) deliver to the Employer all non-proprietary drawings, specifications and other documents prepared by the Contractor or its Subcontractors as at the date of termination in connection with the Facilities.

36.1.3 In the event of termination of the Contract under GCC Sub-Clause 36.1.1, the Employer shall pay to the Contractor the following amounts:

- (a) the Contract Price, properly attributable to the parts of the Facilities executed by the Contractor as of the date of termination
- (b) the costs reasonably incurred by the Contractor in the removal of the Contractor's Equipment from the Site and in the repatriation of the Contractor's and its Subcontractors' personnel
- (c) any amounts to be paid by the Contractor to its Subcontractors in connection with the termination of any subcontracts, including any cancellation charges
- (d) costs incurred by the Contractor in protecting the Facilities and leaving the Site in a clean and safe condition pursuant to paragraph (a) of GCC Sub-Clause 36.1.2

- (e) the cost of satisfying all other obligations, commitments and claims that the Contractor may in good faith have undertaken with third parties in connection with the Contract and that are not covered by paragraphs (a) through (d) above.

36.2 Termination for Contractor's Default

36.2.1 The Employer, without prejudice to any other rights or remedies it may possess, may terminate the Contract forthwith in the following circumstances by giving a notice of termination and its reasons therefor to the Contractor, referring to this GCC Sub-Clause 36.2:

- (a) if the Contractor becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, if the Contractor is a corporation, a resolution is passed or order is made for its winding up (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), a receiver is appointed over any part of its undertaking or assets, or if the Contractor takes or suffers any other analogous action in consequence of debt
- (b) if the Contractor assigns or transfers the Contract or any right or interest therein in violation of the provision of GCC Clause 37.
- (c) if the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.
- (d) If the contractor fails to achieve mutually agreed deadline (as set in mutually agreed Project Execution Plan/PERT chart) for consecutive 3 months, Employer shall issue contract termination notice giving suitable time to contractors which may be up to time agreed between employer and contractor. In case, contractor does not improve its performance as per contract termination notice, which shall be within overall plan under mutually agreed project execution plan, employer will terminate the contract and encash performance securities.

For the purpose of this Sub-Clause:

"corrupt practice" is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;

"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;

"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;

"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;

"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 Employer's 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 Employer's inspection and audit rights.

In persuasions of its policy, the Employer will sanction a firm or individual, including declaring ineligible, either indefinitely or for a stated period of time, to be awarded a contract 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 contract.

36.2.2 If the Contractor

- (a) has abandoned or repudiated the Contract
- (b) has without valid reason failed to commence work on the Facilities promptly or has suspended (other than pursuant to GCC Sub-Clause 35.2) the progress of Contract performance for more than twenty-eight (28) days after receiving a written instruction from the Employer to proceed
- (c) persistently fails to execute the Contract in accordance with the Contract or persistently neglects to carry out its obligations under the Contract without just cause
- (d) refuses or is unable to provide sufficient materials, services or labor to execute and complete the Facilities in the manner specified in the program furnished under GCC Sub-Clause 14.2 at rates of progress that give reasonable assurance to the Employer that the Contractor can attain Completion of the Facilities by the Time for Completion as extended,

then the Employer may, without prejudice to any other rights it may possess under the Contract, give a notice to the Contractor stating the nature of the default and requiring the Contractor to remedy the same. If the Contractor fails to remedy or to take steps to remedy the same within fourteen (14) days of its receipt of such notice, then the Employer may terminate the Contract forthwith by giving a notice of termination to the Contractor that refers to this GCC Sub-Clause 36.2.

36.2.3 Upon receipt of the notice of termination under GCC Sub-Clauses 36.2.1 or 36.2.2, the Contractor shall, either immediately or upon such date as is specified in the notice of termination,

- (a) cease all further work, except for such work as the Employer may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition
- (b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) below

- (c) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination
- (d) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant and Equipment as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors
- (e) deliver to the Employer all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as of the date of termination in connection with the Facilities.

36.2.4 The Employer may enter upon the Site, expel the Contractor, and complete the Facilities itself or by employing any third party. The Employer may, to the exclusion of any right of the Contractor over the same, take over and use with the payment of a fair rental rate to the Contractor, with all the maintenance costs to the account of the Employer and with an indemnification by the Employer for all liability including damage or injury to persons arising out of the Employer's use of such equipment, any Contractor's Equipment owned by the Contractor and on the Site in connection with the Facilities for such reasonable period as the Employer considers expedient for the supply and installation of the Facilities.

Upon completion of the Facilities or at such earlier date as the Employer thinks appropriate, the Employer shall give notice to the Contractor that such Contractor's Equipment will be returned to the Contractor at or near the Site and shall return such Contractor's Equipment to the Contractor in accordance with such notice. The Contractor shall thereafter without delay and at its cost remove or arrange removal of the same from the Site.

36.2.5 Subject to GCC Sub-Clause 36.2.6, the Contractor shall be entitled to be paid the Contract Price attributable to the Facilities executed as of the date of termination, the value of any unused or partially used Plant and Equipment on the Site, and the costs, if any, incurred in protecting the Facilities and in leaving the Site in a clean and safe condition pursuant to paragraph (a) of GCC Sub-Clause 36.2.3. Any sums due to the Employer from the Contractor accruing prior to the date of termination shall be deducted from the amount to be paid to the Contractor under this Contract.

36.2.6 If the Employer completes the Facilities, the cost of completing the Facilities by the Employer shall be determined.

If the sum that the Contractor is entitled to be paid, pursuant to GCC Sub-Clause 36.2.5, plus the reasonable costs incurred by the Employer in completing the Facilities, exceeds the Contract Price or the entire Facilities if entire Facilities have been completed or the price for part of the Facilities if part of the Facilities have been completed, the Contractor shall be liable for such excess.

If such excess is greater than the sums due the Contractor under GCC Sub-Clause 36.2.5, the Contractor shall pay the balance to the Employer, and if such excess is less than the sums due the Contractor under GCC Sub-Clause 36.2.5, the Employer shall pay the balance to the Contractor. For facilitating such payment the Employer shall encash the Bank Guarantees of the Contractor available with the Employer and retain such other payments due to the Contractor under the Contract in question or any other Contract that the Employer may have with the Contractor.

The Employer and the Contractor shall agree, in writing, on the computation described above and the manner in which any sums shall be paid.

36.3 In this GCC Clause 36, the expression "Facilities executed" shall include all work executed, Installation Services provided, and all Plant and Equipment acquired (or subject to a legally binding obligation to purchase) by the Contractor and used or intended to be used for the purpose of the Facilities, up to and including the date of termination.

36.4 In this GCC Clause 36, in calculating any monies due from the Employer to the Contractor, account shall be taken of any sum previously paid by the Employer to the Contractor under the Contract, including any advance payment paid pursuant to the corresponding Appendix (Terms and Procedures of Payment) to the Contract Agreement.

37. Assignment

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

I. Resolution of Disputes

38. Settlement of Disputes

38.1 If any dispute of any kind whatsoever shall arise between the Employer and the Contractor in connection with or arising out of the Contract, including without prejudice to the generality of the foregoing, any question regarding its existence, validity or termination, or the execution of the Facilities, whether during the progress of the Facilities or after their completion and whether before or after the termination, abandonment or breach of the Contract, the parties shall seek to resolve any such dispute or difference, to the extent possible, amicably by mutual consultation.

38.2 If the parties fail to resolve such a dispute or difference by mutual consultation at the execution site level, then the dispute shall be referred by the Contractor to the Project Manager, who, within a period of thirty (30) days after being requested by Contractor to do so, shall give written notice of his decision.

38.2.1 The decision/instruction of the Project Manager shall be deemed to have been accepted by the Contractor unless notified by the Contractor of his intention to refer the matter for Arbitration within thirty (30) days of such decision/instruction.

38.2.2 In the event the Project Manager fails to notify his decision as aforesaid within thirty (30) days, the Contractor, if he intends to go for Arbitration, shall notify his intention to the Project Manager within 30 days of expiry of the first mentioned period of thirty days failing which it shall be deemed that there are no dispute or difference between the Employer and the Contractor.

38.3 In case of dispute or difference between the Employer and the Contractor, if the Employer intends to go for Arbitration, he shall notify such intention to the Contractor.

39. Arbitration

39.1 All disputes or differences in respect of which the decision, if any, of the Project Manager and/or the Head of the Implementing Authority has not become final or binding as aforesaid shall be settled by arbitration in the manner provided herein below:

39.2 The arbitration shall be conducted by three arbitrators, one each to be nominated by the Contractor and the Employer and the third to be appointed by both the arbitrators in accordance with the Indian Arbitration Act. If either of the parties fails to appoint its arbitrator within sixty (60) days after receipt of a notice from the other party invoking the Arbitration clause, the arbitrator appointed by the party invoking the arbitration clause shall become the sole arbitrator to conduct the arbitration.

39.3 The language of the arbitration proceedings and that of the documents and communications between the parties shall be English. The arbitration shall be conducted in accordance with the provisions of the Indian Arbitration and Conciliation Act, 1996 or any statutory modification thereof. The venue of arbitration shall be xxxxx (headquarter of Employer).

39.4 The decision of the majority of the arbitrators shall be final and binding upon the parties. In the event of any of the aforesaid arbitrators dying, neglecting, resigning or being unable to act for any reason, it will be lawful for the party concerned to nominate another arbitrator in place of the outgoing arbitrator.

39.5 During settlement of disputes and arbitration proceedings, both parties shall be obliged to carry out their respective obligations under the Contract.

40. Up-front intimation of approved manufacturers and criterion for Fresh Vendor approval:

Employer shall up-front intimate list containing name of already approved vendors/manufacturers of various sub-transmission and distribution materials. Employer shall upload the list on their web portal. The turnkey contractor shall choose one or more than one vendors from the pre-approved lists depending upon capacity and capability of vendors to supply the materials for DDUGJY & IPDS works. No separate approval for vendor shall be required from Employer.

Also, normal procedure being followed for empanelment of new vendors shall be uploaded and up-front intimated to all turnkey contractors. In case turnkey contractor desires to add new vendor, up-front intimation shall be available on criterion and procedure for selection of vendors.

41. Up-front intimation of Guaranteed Technical Particulars:

Technical Specifications are enclosed with the bid documents. Employer shall up-front intimate acceptable Guaranteed Technical Particulars of various materials through their web portal.

The turnkey contractor will examine these documents and supply only those materials which meets the above acceptable criterion. In case there are Employer's approved vendor(s) (one or more) through which turnkey contractor wish to procure the materials and are complying with the acceptable GTP parameters of Employer as available on their web portal, there would not be any formality needed like approval of sub-vendor or approval of GTP again.

In event of change in name of vendor or change in GTP parameter, separate approval of Employer shall be sought by successful turnkey contractor.

42. Turnkey contractor's Store at Project site:

"Project wise separate Site Stores shall be maintained and manned by turnkey contractor. Same store shall not be used for more than one projects even if neighboring districts' projects are awarded to the same agency. The turnkey contractor shall deploy his own manpower in stores for round the clock security and for its day to day operation through trained Store-ki-per.

Since materials received in this stores are owned by Employer (including owner's free issued material) and are pre-dispatch inspected by Employer's representative, materials in a lot shall not be issued to the sub-contractor for physical execution by turnkey contractor. Instead, day to day requirements shall be issued to the working teams of sub-vendors by authorized store-ki-per. In exceptional cases, on prior written permission of Employer, materials for a week time may be issued to working team of sub-vendor. Daily accounting of materials receipt, materials issues, materials in custody of sub-vendors are to be maintained by turnkey contractor. Handing of Stores shall, in no circumstances, be off loaded.

In no case, inter-project transfer of materials shall be permitted.

43. Handing over of assets:

On completion of erection and testing of a section of line, DTR substation, power substation, contracting agency shall submit digital photographs in soft copies of each and every support structures along-with submission of completion report in support of their claim for energisation and handing over of assets. Project Manager within a week time, shall review the photographs for acceptance of quality of works and shall immediately deploy officials for joint measurement and inspection of executed works for energisation. In parallel, a requisition to State Electrical Inspectorate shall also be submitted by Project Manager. Fee/Charges for inspection by electrical inspector shall be paid by Project Manager.

While offering section of work / substation for commissioning and handing over, turnkey contractor shall provide pre-commissioning test reports and detail checklist (format provided along with quality guidelines at Volume-II : Section-I).

44. Supply of Materials in lots:

Item wise mobilization of materials shall be planned in 6 lots. Employer shall arrange pre-dispatch inspections for 6 lots at his own expenditure. Any additional resource mobilization for inspection of materials by employer beyond 6 lots shall be chargeable at actual. However, in case of approved quantity variation, employer may consider to increase the number of Lots.

45. Contract Closing:

On completion of handing over formality and successfully completion of defect liability / guarantee period, the contract shall be closed on completion of following formality:

- I. Material reconciliation of owner free issued materials as well as material supplied by turnkey contractor,

- II. Payment reconciliations, submission and verifications that reconciliation of payment toward statutory provisions like CST/VAT/Entry Tax/Excise Duty, any other dues etc. Reconciliation statement shall be verified and vetted by chartered accountant.
 - III. Approval for extension of Completion period, with or without compensation, as required.
 - IV. Certification from agency regarding payment of dues to its
 - i. Sub-vendors
 - ii. Workers/ contract laborers,
 - iii. Payment of statutory dues toward Provident Funds, wages etc as required.
 - V. Certification of Project Manager & agency to the effect that erection, testing and commissioning of the equipment have been completed as per specifications laid down in the contract and defects noted at the time of commissioning and notified to the agency have been liquidated to the satisfaction of Employer.
 - VI. Removal of construction meant for site stores, hutment, labour colony etc. in the premises of EMPLOYER.
 - VII. Certificate from Project Manager in charge regarding final amendment of drawings and detailed of such amendments,
 - VIII. Drawing receipt certificate by the Project Manager,
 - IX. Receipt of compliance report on Quality Assurance Mechanism along with photograph, Assurance documents by Project Manager
 - X. Shortfall in equipment / Line performance Certificate issued by Project Manager,
 - XI. No demand certificate issued by contractor,
 - XII. Certificate about completion of Defect Liability Period of the package by Project Manager,
 - XIII. Certificate regarding return of Performance Security / Indemnity Bond by Project Manager/Employer.
46. Banning of business dealings
- 46.1. Employer shall ban business dealings with contractor on following grounds for the period as decided by Project Manager:-
 - a. If the contractor fails to submit Performance Security after issuance of Letter of Intent (LoI) within 28 days.
 - b. If the Contractor fails to accept the award of contract or has abandoned or repudiated the Contract.
 - c. If the Contractor is found to be non-performing in execution of contract by the Employer.

- d. If a disaster / major failure / accident / collapse of a structure / system is caused during erection or during defect liability period due to negligence of contractor or design deficiency or poor quality of execution.
- e. Misbehavior or physical manhandling by the Contractor or his representative or any person acting on his behalf with any official of the Company dealing with the concerned contract is established.
- f. If the Director / Owner of the Contractor, proprietor or partner of the Contractor, is convicted by a court of law for offences involving corrupt and fraudulent practices including moral turpitude in relation to its business dealings with the government or State Public Sector Undertakings or Central Public Sector Undertakings or Employer or Employer's group companies, during the last five years.
- g. If the proprietors of the Contractor have been guilty of malpractices such as bribery, corruption, fraud, substitution of the tenders, interpolations, etc.
- h. If the Contractor continuously refuses to return / refund the dues of Employer or Employer's group companies, without showing adequate reason and this is not due to any reasonable dispute which would attract proceedings in arbitration or court of Law;
- i. If the Contractor employs a public servant dismissed / removed or employs a person convicted for an offence involving corruption or abetment of such offences;
- j. If business dealings with the Contractor have been banned by the Ministry of Power or Government of India and the ban is still in force,
- k. If it is established that Contractor has resorted to corrupt, fraudulent practices including misrepresentation of facts;
- l. If the Contractor uses intimidation/threatening or brings undue outside pressure on the Project Manager or his authorised representatives or its officials in acceptance / performance of the job under the contract.
- m. If the Contractor indulges in repeated and / or deliberate use of delay tactics in complying with contractual stipulations;
- n. If the Contractor is found to be involved in cartel formation during bidding.
- o. On wilful indulgence by the Contractor in supplying sub-standard material with respect to Technical Specifications under the Contract irrespective of whether pre-dispatch inspection was carried out by Employer or not;
- p. If the Contractor is declared bankrupt or insolvent or its financial position has become unsound, and in the case of a limited company, it is wound up or liquidated.
- q. Established litigant nature of the Contractor to derive undue benefit;
- r. Continued poor performance of the Contractor;
- s. If the Contractor violates the provisions of the Integrity Pact provided in the Contract.
- t. If the Contractor commits fraud as defined under the Fraud Prevention Policy of Employer.

- u. If the Contractor has assigned or transferred the contract or engaged subcontractor(s) without the prior approval of the Competent Authority in violation of the provisions of the contract.
- v. If the Contractor misuses the premises or facilities of the Employer, forcefully occupies, tampers or damages the Employer's properties including land, water resources, forests / trees, etc.
- w. If the security consideration, including questions of loyalty of the Contractor to the state, so warrants;

----- End -----

VOLUME-I: SECTION – V
SPECIAL CONDITIONS OF
CONTRACT (SCC)

SPECIAL CONDITIONS OF CONTRACT (SCC)

The following bid specific data for the Plant and Equipment to be procured shall amend and/or supplement the provisions in the General Conditions of Contract (GCC)

Sl. No.	GCC Clause Ref. No.	Amendment/Supplement to GCC									
1.	GCC 1.1(o)	<p>Supplementing Sub-Clause GCC 1.1(o)</p> <p>The Employer is: Name & Postal Address of the Employer with Contact Number, Fax, Email etc.</p> <p>For the purpose of execution of the contract, the contractual activities shall be performed by the Employer "for and on behalf of the Owner" except in cases where the Owner itself is statutorily required to do so.</p>									
2.	GCC 1.1(w)	<p>Supplementing Sub-Clause GCC 1.1(w)</p> <p>The Owner is: Government of XXXX(State Name)</p>									
3.	GCC 1.1 (ee)	<p>Supplementing Sub-Clause GCC 1.1(ee)</p> <p>Time for Completion:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Sl. No.</th> <th style="text-align: center;">Activities</th> <th style="text-align: center;">Duration in Months from the effective date of Contract</th> </tr> </thead> <tbody> <tr> <td></td> <td>Taking Over by the Employer upon successful Completion of:</td> <td></td> </tr> <tr> <td style="text-align: center;">1.</td> <td>Package-XXX for Electrification works of XXXX(Project/District Name) in XXXX(State Name) under DDUGJY/IPDS [Spec. No.:.....].</td> <td style="text-align: center;">24 (Months)</td> </tr> </tbody> </table>	Sl. No.	Activities	Duration in Months from the effective date of Contract		Taking Over by the Employer upon successful Completion of:		1.	Package-XXX for Electrification works of XXXX(Project/District Name) in XXXX(State Name) under DDUGJY/IPDS [Spec. No.:.....].	24 (Months)
Sl. No.	Activities	Duration in Months from the effective date of Contract									
	Taking Over by the Employer upon successful Completion of:										
1.	Package-XXX for Electrification works of XXXX(Project/District Name) in XXXX(State Name) under DDUGJY/IPDS [Spec. No.:.....].	24 (Months)									
4.	GCC 2.1	<p>GCC 2.1.1 The Contracts to be entered into with the successful Bidder shall be as under :</p> <ul style="list-style-type: none"> - First Contract: For Ex-Works supply of all equipment and materials (Ex-Works Supply Contract) - Second Contract: For providing all erection services including inland transportation for delivery at site, insurance, unloading, storage, handling at site, installation, Testing and Commissioning including performance testing in respect of all the equipment supplied under the "First Contract", and any other services specified in the Contract Documents (Services Contract). <p>GCC 2.1.2 The award of two separate Contracts shall not in any way dilute the responsibility of the Contractor for the successful completion of the facilities as per Specification and a breach in one Contract shall automatically be construed as a breach of the other Contract(s) which will confer a right on the Employer to terminate the other Contract(s) also at the risk and the cost of the Contractor.</p> <p>GCC 2.1.3 The Contract will be signed in two originals and the Contractor shall be provided with one signed original and the second will be retained by the Employer.</p> <p>GCC 2.1.4 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.</p>									

Sl. No.	GCC Clause Ref. No.	Amendment/Supplement to GCC
		GCC 2.1.5 Subsequent to signing of the Contract, the Contractor at his own cost shall provide the Employer with at least Two (2) true copies of Contract Agreement within fifteen (15) days after signing of the Contract.
5.	GCC 8.3	Addition of following new Sub-Clause after GCC 8.2: All the payments upto 60% (or 85% for special category states) of project cost of infrastructure to the Contractor shall be made by XXXX (Name of Employer) strictly out of the funds received from REC/PFC on behalf of the Owner, 30% (10% for special category states) of infrastructure cost shall be arranged by owner from REC loan/loan from other FIs/own resources and 10% (5% for special category states) of infrastructure cost shall be arrange by utility from own resources.
6.	GCC 9.3.1	Supplementing Sub-Clause GCC 9.3.1 In addition to the above, the Contractor shall arrange to provide additional Performance Security(ies), if applicable, as per Clause no. 4 of Joint Deed of Undertaking mentioned at Sl. No. 19 of Volume-I : Section-VI (Sample Forms and Procedures). The said security(ies) shall be required to be extended time to time till ninety (90) days beyond the actual Defect Liability Period, as may be required under the Contract. The Performance Security(ies) to be furnished by the Contractor under the Contract shall be in favour of the Employer. The Owner shall also be entitled to enforce these performance security(ies).
7.	GCC 10.3	Supplementing Sub-Clause GCC 10.3 The requisite Sales Tax declaration forms shall be issued as under: a) When project implementing agency or Employer is a Central Public Sector Undertaking, form shall be issued by State Distribution Company to Employer for onward issuance to contractor b) When State Distribution Company is Employer, the form shall be issued by them.
8.	GCC 10.6	Supplementing the Clause GCC 10.6 In case Employer is Central Public Sector Undertaking, the recovery of TDS under CST/VAT/WCT/Income Tax Act and any other acts as per Govt. regulation related to this work shall be done by XXXXX (Name of Employer) on behalf of XXXXX(DISCOM Name)/State Govt.. TDS so deducted by XXXXX (Employer Name) on behalf of the XXXX (Name of DISCOM)/State Govt. shall be deposited with the relevant tax authorities and TDS certificates shall be issued on behalf of XXXXX (DISCOM Name)/State Govt. using PAN, TIN, TAN of XXXXX(DISCOM Name). Relevant challans and copies of the TDS certificates shall be forwarded to XXXXX(DISCOM Name) for filling necessary returns. In case, wherever E-filling system is applicable, the relevant information would be given to the Owner for issuing TDS certificate, filling returns, etc.
9.	GCC 11	At all places in the clause, replace the word "Employer" with "Employer/Owner/State Distribution Utility in case employer is a Central Public Undertaking.
10.	GCC 22.4, 22.5, 22.6 & 22.7	At all places in the clause, replace the word "Employer" with "Employer/Owner/State Distribution Utility in case employer is a Central Public Undertaking'.
11.	GCC 24.1	-
12.	GCC 24.2 (b) & GCC 24.3	Supplementing Clause GCC 24.2 (b)

Sl. No.	GCC Clause Ref. No.	Amendment/Supplement to GCC
		<p>LD for Non-Performance of the Equipment</p> <p>The guaranteed loss at rated voltage for each equipment shall be corrected in accordance with IS2026, Part-I for the purpose of comparison of guaranteed losses with measured losses for levy of liquidated damages. However, the equipment (i.e. Power Transformer/Station Transformer) under no circumstances shall be accepted if the measured losses are more than +15 percent of the guaranteed losses at rated voltage, specified in Appendix – 8 (Guarantees, Liquidated Damages for Non – Performance) to the Contract Agreement.</p> <p>In case of Distribution Transformer, the equipment under no circumstances shall be accepted if the total losses exceed the max. limit specified in Technical Specifications.</p> <p>Differential Price Factors for Liquidated Damages</p>
13.	GCC 33.2.3	<p>Supplementing Sub-Clause GCC 33.2.3</p> <p>Percentage for the Change Proposal under this Clause shall be limited to Ten (10) percent.</p>
14.	Annexure-I to SCC	Enclosed herewith
15.	Others	<p>Rating of Transformers - Standard Ratings of Distribution & Power Transformers as per IS are covered in bid documents. Transformer ratings must be confirming to IS specifications. Non Standard ratings shall not be permitted.</p> <p>The Distribution Transformers shall be BIS certified in line with Electrical Transformers (Quality Control) order, 2015 (along with its latest amendments) issued by Department of Heavy Industries, Ministry of Heavy Industries & Public Enterprise, Govt of India.</p>

----- End of Section-V (SCC) -----

LIST OF ELIGIBLE SCHEDULED COMMERCIAL PRIVATE INDIAN BANKS

Sl. No.	Name of Banks
1	HDFC Bank Ltd.
2	Axis Bank Ltd.
3	Kotak Mahindra Bank Ltd.
4	Federal Bank Ltd.
5	Indusind Bank Ltd.
6	Development Credit Bank Ltd.
7	ING Vysya Bank Ltd.
8	Karnataka Bank Ltd.
9	Karur Vysya Bank Ltd.
10	Ratnakar Bank Ltd.
11	South Indian Bank Ltd.
12	Yes Bank Ltd.
13	ICICI Bank
14	IDFC Bank

VOLUME-I: SECTION – VI

SAMPLE FORMS AND PROCEDURES
(FORMS)

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SAMPLE FORMS AND PROCEDURES (FORMS)

Preamble

This Section (Section –VI) of the Bidding Documents [named as Sample Forms and Procedures (FORMS)] provides proforma to be used by the bidders at the time of their bid preparation and by the Contractor subsequent to the award of Contract.

The Bidder shall complete, sign and submit with its bid the relevant FORMS to be used un-amended, in accordance with the requirements included in the Bidding Documents.

The Bidder shall provide the Bid Security, either in the form included hereafter or in another form acceptable to the Employer, pursuant to the provisions in the instructions to Bidders.

The Form of Contract Agreement shall be used un-amended, except for the need to complete Article 1.1 (Contract Documents), as appropriate and as may be required to suit the specific requirement of the Contract. The form shall also include the Appendices listed, as required, which should be completed according to the instructions for their completion provided at the beginning of each Appendix. The Price Schedule deemed to form part of the contract shall be modified according to any corrections or modifications to the accepted bid resulting from price corrections, pursuant to the provisions of the Instructions to Bidders.

The Performance Security(ies) and Bank Guarantee for Advance Payment forms should not be completed by the bidders at the time of their bid preparation. Only the successful Bidder will be required to provide the Performance Security(ies) and Bank Guarantee for Advance Payment, according to one of the forms indicated herein or in another form acceptable to the Employer and pursuant to the provisions of the General and Special Conditions of Contract, respectively.

Depending on specific facts and circumstances related to the Bid, other specific agreement, if any, and the contract, the text of the Forms herein may need to be modified to some extent. The Employer reserves the right to make such modifications in conformity with such specific facts and circumstances and rectify and consequent discrepancies, if any. However, modifications, if any, to the text of the Forms that may be required in the opinion of the Bidder/Contractor shall be effected only if the same is approved by the Employer. The Employer's decision in this regard shall be final and binding.

1. BID FORMS AND PRICE SCHEDULES

1.1 Bid Form

Please see Volume – III.

1.2 Price Schedule

Please see Volume - III

2. BID SECURITY FORM

(To be stamped in accordance with Stamp Act, the Non-Judicial Stamp Paper should be in the name of the issuing Bank)

Bank Guarantee No.:

Date:

To: (insert Name and Address of Employer)

WHEREAS M/s. (insert name of Bidder)..... having its Registered/Head Office at (insert address of the Bidder) (hereinafter called "the Bidder") has submitted its Bid for the performance of the Contract for.....(insert name of the Package).....under.....(insert Specification No)..... (hereinafter called "the Bid")

KNOW ALL PERSONS by these present that WE (insert name & address of the issuing bank) having its Registered/Head Office at(insert address of registered office of the bank)..... (hereinafter called "the Bank"), are bound unto(insert name of Employer)..... (hereinafter called "the Employer") in the sum of(insert amount of Bid Security in figures & words)..... for which payment well and truly to be made to the said Employer, the Bank binds itself, its successors and assigns by these presents.

Sealed with the Common Seal of the said Bank this day of 20....

THE CONDITIONS of this obligation are:

- (1) If the Bidder withdraws its bid during the period of bid validity specified by the Bidder in the Bid Form; or
- (2) In case the Bidder does not withdraw the deviations proposed by him, if any, at the cost of withdrawal stated by him in the bid and/or accept the withdrawals/rectifications pursuant to the declaration/confirmation made by him in Attachment – Declaration of the Bid; or
- (3) If the Bidder does not accept the corrections to arithmetical errors identified during preliminary evaluation of his bid pursuant to ITB Clause 27.2; or
- (4) If, as per the requirement of Qualification Requirements the Bidder is required to submit a Deed of Joint Undertaking and he fails to submit the same, duly attested by Notary Public of the place(s) of the respective executant(s) or registered with the Indian Embassy/High Commission in that Country, within ten days from the date of intimation of post – bid discussion; or
- (5) in the case of a successful Bidder, if the Bidder fails within the specified time limit
 - (i) to sign the Contract Agreement, in accordance with ITB Clause 33, or
 - (ii) to furnish the required performance security, in accordance with ITB Clause 34.or
- (6) In any other case specifically provided for in ITB.

WE undertake to pay to the Employer up to the above amount upon receipt of its first written demand, without the Employer having to substantiate its demand, provided that in its demand the Employer will note that the amount claimed by it is due to it, owing to the occurrence of any of the above-named CONDITIONS or their combination, and specifying the occurred condition or conditions.

This guarantee will remain in full force up to and including (insert date, which shall be the date 30 days after the period of bid validity)....., and any demand in respect thereof must reach the Bank not later than the above date.

For and on behalf of the Bank

[Signature of the authorised signatory(ies)]

Signature_____

Name_____

Designation_____

POA Number_____

Contact Number(s): Tel._____ Mobile_____

Fax Number_____

email _____

Common Seal of the Bank_____

Witness:

Signature_____

Name_____

Address_____

Contact Number(s): Tel._____ Mobile_____

email _____

Note:

1. In case the bid is submitted by a Joint Venture, the bid security shall be in the name of the Joint Venture and not in the name of the Lead Partner or any other Partner(s) of the Joint Venture.
2. The Bank Guarantee should be in accordance with the proforma as provided. However, in case the issuing bank insists for additional paragraph for limitation of liability, the following may be added at the end of the proforma of the Bank Guarantee [i.e., end paragraph of the Bank Guarantee preceding the signature(s) of the issuing authority(ies) of the Bank Guarantee]:

Quote

“Notwithstanding anything contained herein:

1. Our liability under this Bank Guarantee shall not exceed _____ (value in figures)_____ [_____ (value in words)_____].
2. This Bank Guarantee shall be valid upto _____ (validity date)_____.

3. We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only & only if we receive a written claim or demand on or before _____ (validity date) _____."

Unquote

3a. FORM OF NOTIFICATION BY THE EMPLOYER TO THE BANK
(Applicable for Forfeiture of Bank Guarantee)

To: (insert Name and Address of the issuing Bank)

Ref.: Forfeiture of Bid Security Amount against Bank Guarantee No. dated for
....., issued by you on behalf of M/s.(insert name of the Bidder)

Dear Sirs,

Please refer to the subject Bank Guarantee executed by you in our favour for as Bid Security for
the bid submitted by M/s.(insert name of the Bidder) against (insert name of the Package)
..... ; Specification No.

As per the terms of the said guarantee, the bank has guaranteed and undertaken to pay immediately on demand
by the Employer the amount of without any reservation, protest, demur and recourse. Further, any
demand made by the Employer shall be conclusive and binding on the Bank irrespective of any dispute or
difference raised by the Bidder.

In terms of the said guarantee, we hereby submit our claim/demand through this letter for remittance of Bid
Security amount to (insert name of the Employer) owing to the occurrence of the condition referred to
at Sl. No. The Bank is requested to remit the full guaranteed sum towards proceeds of
the bid security in the form of Demand Draft in favour of '.... (insert name of the Employer)', payable at
....(insert place of the Employer)....'.

Thanking you,

For.....(Name of the Employer)

(AUTHORISED SIGNATORY)

Copy to:

....(Registered Office of the Bank)....

3b. FORM OF NOTIFICATION BY THE EMPLOYER TO THE BANK

(Applicable for conditional claim pending extension of Bank Guarantee by the Bidder)

To: (insert Name and Address of the issuing Bank)

Ref.: Conditional Claim against Bank Guarantee No. dated for valid up to
..... issued by you on behalf of M/s.(insert name of the Bidder)

Dear Sirs,

Please refer to the subject Bank Guarantee executed by you in our favour on behalf of M/s.(insert name of the Bidder), who have submitted this Bank Guarantee to us towards Bid Security against (insert name of the Package) ; Specification No.

We, (insert name of the Employer) do hereby request you to lodge our claim/demand against the subject Bank Guarantee for full guaranteed sum. Kindly note that this claim/demand against the subject Bank Guarantee is without any further notice in case the amendment to Bank Guarantee No. dated extending its validity upto is not got arranged by(insert name of the Bidder) in our favour and are not received by us upto In such an event you are requested to remit the full guaranteed amount in terms of the subject guarantee in its letter and spirit and proceeds of this Bank Guarantee shall be forwarded to us in form of demand draft in favour of '.... (insert name of the Employer), payable at(insert place of the Employer)....'.

This is without prejudice to our right under this guarantee and under the law.

Thanking you,

For.....(Name of the Employer)

(AUTHORISED SIGNATORY)

Copy to:

(insert Name and Address of the Bidder)

- You are requested to do the needful so that the amendment to the subject Bank Guarantee extending the validity up to is received by us by

4. FORM OF 'NOTIFICATION OF AWARD OF CONTRACT'

4a. FORM OF 'NOTIFICATION OF AWARD OF CONTRACT' FOR SUPPLY OF PLANT AND EQUIPMENT

Ref. No. :

Date :

.....(insert Contractor's Name & Address).....

.....

.....

.....

[in case of Joint Venture, the aforesaid details shall be of the Lead Partner and the following shall also be included:

(Lead Partner of the Joint Venture of M/s. and M/s.)]

Attn : Mr.....

Sub. : Notification of Award for Ex-works Supply Contract for (insert name of the Package)
Specification No.: Domestic Competitive Bidding. (Project Funding: Domestic).

Dear Sir,

1.0 REFERENCE

This has reference to the following:

1.1 Our Invitation for Bids (IFB) dated

1.2 Bidding documents for the subject package issued to you vide our letter Ref. No. dated, comprising the following:

- a) Conditions of Contract Volume-I
(Document Code No.)
- b) Technical Specifications, Drawings Volume-II
(Document Code No.)
- c) Bid Form, Price Schedules Volume-III
& Technical Data Sheets
(Document Code No.)

1.2.1 Amendment/Errata No. to Bidding Documents issued to you vide our letter no. dated
(Applicable only if any Errata/Amendment to the Bidding Documents has been issued subsequently)

1.2.2 Clarifications to the Bidding Documents, pursuant to pre-bid conference held on, issued to you vide our letters no. dated (Use as applicable)

(Applicable only if any clarification to the Bidding Documents has been issued subsequently)
(INCLUDE AS FURTHER SUB-PARAGRAPHS ANY OTHER CORRESPONDENCE MADE TO THE BIDDER AFTER ISSUANCE OF BIDDING DOCUMENTS UP TO BID OPENING)

1.3 First envelope of your Bid submitted/the Bid submitted by the Joint Venture (JV) of M/s. (Lead Partner) and M/s. (Other Partner) for the subject package under Proposal reference no. dated was opened on (Use as applicable)

- 1.4 Intimation for Opening of Price Schedule issued to you vide our letter no. dated
- 1.5 Your Bid/the Bid by the Joint Venture (JV) of M/s. (Lead Partner) and M/s. (Other Partner) under proposal reference no. dated was opened on.....(Use as applicable)
- 1.6 Post bid discussions we had with you on various dates from to resulting into the Minutes of Meeting/ Record Notes of Post Bid Discussions enclosed as APPENDIX (NOA)-1with this Notification of Award.

2.0 AWARD OF CONTRACT AND ITS SCOPE

- 2.1 We confirm having accepted your Bid/Bid of the Joint Venture (JV) of M/s. (Lead Partner) and M/s. (Other Partner) (Use as applicable) (referred to at para 1.3 & 1.5 above) read in conjunction with all the specifications, terms & conditions of the Bidding Documents (referred to at para 1.2, 1.2.1 & 1.2.2 [modify as applicable] above) and specific confirmations recorded in the Record Notes of Post Bid Discussions (referred to at para 1.6 above), and award on you/the JV(use as applicable) the 'Ex-works Supply Contract' (also referred to as the 'First Contract') covering inter-alia Ex-works supply of all equipment and materials including Type Testing to be conducted, required for the complete execution of the (insert name of Package alongwith name of the Project), as detailed in the documents referred hereinabove. The scope of work inter-alia includes the following:

..... (Indicate brief Scope of Work)

The scope of work under this Notification of Award (NOA) shall also include all such items which are not specifically mentioned in the Bidding Documents and/or your bid but are necessary for the successful completion of your scope under the Contract for the construction of (insert name of Package alongwith name of the Project), unless otherwise specifically excluded in the Bidding Documents or in this NOA.

- 2.1.1 You, the Lead Partner of the JV, along with M/s., the Other Partner of JV, shall be liable jointly and severally for the execution of the Contract in accordance with terms and conditions of the Contract. As per the Power of Attorney furnished in your favour by the Joint Venture, as enclosed with Bid Proposal of the JV, you shall act as the Partner In-charge (Lead Partner) of the above Joint Venture for execution of the Contract. (This provision shall be included only in case the Bidder is a Joint Venture)

- 2.2 The notification for award of Contract for performance of all other activities, as set forth in the Bidding Documents, viz.
..... (Indicate brief scope of work of the Second Contract)
has been issued on you vide our NOA no. dated (hereinafter called the "Second Contract" or "Services Contract").

Notwithstanding the award of work under two separate Contracts in the aforesaid manner, you/the JV (use as applicable) shall be overall responsible to ensure the execution of both the Contracts to achieve successful completion and taking over of the works under the package by the Employer as per the requirements stipulated in the Bidding Documents. It is expressly understood and agreed by you/the JV (use as applicable) that any default or breach under the 'Second Contract' shall automatically be deemed as a default or breach of this 'First Contract' also and vice-versa, and any such default or breach or occurrence giving us a right to terminate the 'Second Contract', either in full or in part, and/or recover damages there under, shall give us an absolute right to terminate this Contract, at your/JV's (use as applicable) risk, cost and responsibility, either in full or in part and/or recover damages under this 'First Contract' as well. However, such default or breach or occurrence in the 'Second Contract', shall not automatically relieve you/the JV (use as applicable) of any of your/JV's (use as

applicable) obligations under this 'First Contract'. It is also expressly understood and agreed by you/the JV (use as applicable) that the equipment/materials supplied by you/the JV (use as applicable) under this 'First Contract', when erected, installed & commissioned by you under the 'Second Contract' shall give satisfactory performance in accordance with the provisions of the Contract.

3.0 CONTRACT PRICE

3.1 The total Contract Price for the entire scope of work under this Contract shall be (Specify the currency and the amount in figures & words) as per the following break-up:

Sl. No.	Price Component	Amount
1.	Ex-Works Price component	
2.	Type Test Charges	Not Applicable
Total for Ex-works Supply Contract		

3.2 Notwithstanding the break-up of the Contract Price, the Contract shall, at all times, be construed as a single source responsibility Contract and any breach in any part of the Contract shall be treated as a breach of the entire Contract.

4.0 You/The JV (use as applicable) are/is required to furnish at the earliest a Performance Security(ies), as per the Bidding Documents, for an amount of (Specify the value) i.e. equal to 10% (Ten percent) of the Contract Price, and valid upto and including and any other securities as per the Bidding Documents.
(In case any other performance security is required to be furnished, the same is to be mentioned here)

5.0 For release of advance payment (admissible as per the Bidding Documents) equal to% of the Ex-works Price component of the Contract Price, you are, inter-alia, required to furnish a Bank Guarantee for the equivalent advance amount. The validity of the Advance Bank Guarantee shall be up to and including Further, please note that furnishing of all the Contract Performance Securities under the 'First Contract' and 'Second Contract' shall be one of the conditions precedent to release of advance under this Contract.

6.0 All the bank guarantees shall be furnished from an eligible bank as described in the Bidding Documents.

7.0 The schedule for Taking Over/Completion of Facilities by the Employer upon successful completion of the (insert name of Package alongwith name of the Project) shall be ... (indicate the completion schedule) months from the date of issue of this Notification of Award for all contractual purposes.

8.0 This Notification of Award constitutes formation of the Contract and comes into force with effect from the date of issuance of this Notification of Award.

9.0 You shall enter into a Contract Agreement with us within twenty-eight (28) days from the date of this Notification of Award.

10.0 This Notification of Award is being issued to you in duplicate. We request you to return its duplicate copy duly signed and stamped on each page including the enclosed Appendix as a token of your acknowledgement.

Please take the necessary action to commence the work and confirm action.

Yours faithfully,

For and on behalf of

.....(Name of the Employer).....
(Authorised Signatory)

Enclosures:

APPENDIX (NOA) – 1 - Record Notes of Post - Bid Discussions held on various dates from
to

4b. FORM OF 'NOTIFICATION OF AWARD OF CONTRACT' FOR INSTALLATION OF PLANT AND EQUIPMENT

Ref. No. :

Date :

.....(insert Contractor's Name & Address).....
.....
.....
.....

[in case of Joint Venture, the aforesaid details shall be of the Lead Partner and the following shall also be included:

(Lead Partner of the Joint Venture of M/s. and M/s.)]

Attn : Mr.....

Sub. : Notification of Award for Services Contract for (insert name of the Package) Specification No.: Domestic Competitive Bidding. (Project Funding: Domestic).

Dear Sir,

1.0 REFERENCE

This has reference to the following:

1.1 Our Invitation for Bids (IFB) dated

1.2 Bidding documents for the subject package issued to you vide our letter Ref. No. dated, comprising the following:

a) Conditions of Contract Volume-I
(Document Code No.)

b) Technical Specifications Volume-II
(Document Code No.)

c) Bid Form, Price Schedules Volume-III
& Technical Data Sheets
(Document Code No.)

1.2.1 Amendment/Errata No. to Bidding Documents issued to you vide our letter no. dated
(Applicable only if any Errata/Amendment to the Bidding Documents has been issued subsequently)

1.2.2 Clarifications to the Bidding Documents, pursuant to pre-bid conference held on, issued to you vide our letters no. dated (Use as applicable)
(Applicable only if any clarification to the Bidding Documents has been issued subsequently)

(INCLUDE AS FURTHER SUB-PARAGRAPHS ANY OTHER CORRESPONDENCE MADE TO THE BIDDER AFTER ISSUANCE OF BIDDING DOCUMENTS UP TO BID OPENING)

- 1.3 First envelope of your Bid submitted/the Bid submitted by the Joint Venture (JV) of M/s. (Lead Partner) and M/s. (Other Partner) for the subject package under Proposal reference no. dated was opened on (Use as applicable)
- 1.4 Intimation for Opening of Price Schedule issued to you vide our letter no. dated
- 1.5 Your Bid/the Bid by the Joint Venture (JV) of M/s. (Lead Partner) and M/s. (Other Partner) under proposal reference no. dated was opened on.....(Use as applicable)
- 1.6 Post bid discussions we had with you on various dates from to resulting into the Minutes of Meeting/ Record Notes of Post Bid Discussions enclosed as APPENDIX (NOA)-1with this Notification of Award.

2.0 AWARD OF CONTRACT AND ITS SCOPE

- 2.1 We confirm having accepted your Bid/Bid of the Joint Venture (JV) of M/s. (Lead Partner) and M/s. (Other Partner) (Use as applicable) (referred to at para 1.3 & 1.5 above) read in conjunction with all the specifications, terms & conditions of the Bidding Documents (referred to at para 1.2, 1.2.1 & 1.2.2 [modify as applicable] above) and specific confirmations recorded in the Record Notes of Post Bid Discussions (referred to at para 1.6 above), and award on you/the JV(use as applicable) the 'Services Contract' (also referred to as the 'Second Contract') for performance of all other activities, as set forth in the documents, viz. (Indicate brief scope of work) for the (insert name of Package alongwith name of the Project)....

The scope of work under this Notification of Award (NOA) shall also include all such items which are not specifically mentioned in the Bidding Documents and/or your bid but are necessary for the successful completion of your scope under the Contract for the construction of (insert name of Package alongwith name of the Project), unless otherwise specifically excluded in the Bidding Documents or in this NOA.

- 2.1.1 You, the Lead Partner of the JV, along with M/s., the Other Partner of JV, shall be liable jointly and severally for the execution of the Contract in accordance with terms and conditions of the Contract. As per the Power of Attorney furnished in your favour by the Joint Venture, as enclosed with Bid Proposal of the JV, you shall act as the Partner In-charge (Lead Partner) of the above Joint Venture for execution of the Contract. (This provision shall be included only in case the Bidder is a Joint Venture)
- 2.2 The notification for award of Contract for Ex-works Supply of all equipment and materials including Type Testing to be conducted, as set forth in the documents, viz.

..... (Indicate brief scope of work of the First Contract)

has been issued on you vide our NOA no. dated (hereinafter called the "Ex-works Supply Contract" or "First Contract").

Notwithstanding the award of work under two separate Contracts in the aforesaid manner, you/the JV (use as applicable) shall be overall responsible to ensure the execution of both the Contracts to achieve successful completion and taking over of the works under the package by the Employer as per the requirements stipulated in the Bidding Documents. It is expressly understood and agreed by you/the JV(use as applicable) that any default or breach under the 'First Contract' shall automatically be deemed

as a default or breach of this 'Second Contract' also and vice-versa, and any such default or breach or occurrence giving us a right to terminate the 'First Contract', either in full or in part, and/or recover damages there under, shall give us an absolute right to terminate this Contract, at your/JV's (use as applicable) risk, cost and responsibility, either in full or in part and/or recover damages under this 'Second Contract' as well. However, such default or breach or occurrence in the 'First Contract', shall not automatically relieve you/the JV(use as applicable) of any of your obligations under this 'Second Contract'. It is also expressly understood and agreed by you/the JV(use as applicable) that the equipment/materials supplied by you/the JV(use as applicable) under the 'First Contract', when erected, installed & commissioned by you/the JV(use as applicable) under this 'Second Contract' shall give satisfactory performance in accordance with the provisions of the Contract.

3.0 CONTRACT PRICE

3.1 The total Contract Price for the entire scope of work under this Contract shall be (Specify the currency and the amount in figures & words) as per the following break-up:

Sl. No.	Price Component	Amount
1.	Local Transportation, Insurance and other Incidental Services (including port clearance etc)	
2.	Installation Services	
3.	Training Charges	Not Applicable
Total for Services Contract		

3.2 Notwithstanding the break-up of the Contract Price, the Contract shall, at all times, be construed as a single source responsibility Contract and any breach in any part of the Contract shall be treated as a breach of the entire Contract.

4.0 You/the JV(use as applicable)are/is required to furnish at the earliest a Performance Security(ies), as per the Bidding Documents, for an amount of (Specify the value) i.e. equal to 10% (Ten percent) of the Contract Price, and valid upto and including and any other securities as per the Bidding Documents.

(In case any other performance security is required to be furnished, the same is to be mentioned here)

5.0 All the bank guarantees shall be furnished from an eligible bank as described in the Bidding Documents.

6.0 The schedule for Taking Over/Completion of Facilities by the Employer upon successful completion of the (insert name of Package alongwith name of the Project) shall be ... (indicate the completion schedule) months from the date of issue of this Notification of Award for all contractual purposes.

7.0 This Notification of Award constitutes formation of the Contract and comes into force with effect from the date of issuance of this Notification of Award.

8.0 You shall enter into a Contract Agreement with us within twenty-eight (28) days from the date of this Notification of Award.

9.0 This Notification of Award is being issued to you in duplicate. We request you to return its duplicate copy duly signed and stamped on each page including the enclosed Appendix as a token of your acknowledgement.

Please take the necessary action to commence the work and confirm action.

Yours faithfully,

For and on behalf of

.....(Name of the Employer).....

(Authorised Signatory)

Enclosures:

APPENDIX (NOA) – 1 - Record Notes of Post - Bid Discussions held on various dates from
to

Note:

(1) Instructions indicated in italics in this notification of award are to be taken care of by the issuing authority.
The Forms may be modified appropriately to suit the specific requirement of the Contract.

5. FORM OF CONTRACT AGREEMENT

[Alternative – a]

SUPPLY CONTRACT AGREEMENT BETWEEN (Name of Employer) AND M/s.
(Name of Contractor)/JOINT VENTURE (JV) OF M/s. (Name of Lead Partner).... (THE LEAD
PARTNER OF THE JV) AND M/s.(Name of Other Partner)..... (THE PARTNER OF THE JV) [Use as applicable]

THIS CONTRACT AGREEMENT No. (also referred to as 'Ex-Works Supply Contract/the First
Contract') is made on the day of 20.....

BETWEEN

(1) (Name of Employer)..... a company incorporated under the laws of Companies Act
1956/2013 (with amendment from time to time) and having its Registered Office at(registered address of
the Employer) and its Corporate Office at(address of the Employer)..... (hereinafter
called "the Employer" and also referred to as ".....(insert abbreviated name of the Employer)")

and

(2) M/s (Name of Contractor), a company incorporated under the laws of Companies Act
1956/2013 (with amendment from time to time) and having its Principal place of business at(Address of
Contractor) and Registered Office at(Registered address of Contractor)
(hereinafter called "the Contractor" and also referred to as ".....(insert abbreviated name of the Contractor)
.....")

or

Joint Venture (JV) of M/s (Name of Lead Partner) (the Lead Partner of JV), a company
incorporated under the laws of Companies Act 1956 and having its Principal place of business at
.....(Address of Lead Partner) and Registered Office at(Registered address of
Lead Partner) and M/s (Name of Other Partner) (the Partner of JV), a
company incorporated under the laws of Companies Act 1956/2013 (with amendment from time to time) and
having its Principal place of business at(Address of Other Partner) and Registered
Office at(Registered address of Other Partner) (hereinafter called "the Contractor" and
also referred to as "Joint Venture"/the 'JV'")
(Applicable only in case of Joint Venture)

WHEREAS the Employer desires to engage the Contractor for the supply of all equipment and materials including
taxes and duties as applicable, Type Testing to be conducted inter-alia including (Indicate
brief scope of work) for the complete execution of the (insert name of Package
alongwith name of the Project)..... as detailed in the Contract Document ("the Facilities"), and the Contractor
has agreed to such engagement upon and subject to the terms and conditions hereinafter appearing.

NOW IT IS HEREBY AGREED as follows:

Article 1. Contract Documents

1.1 Contract Documents (Reference GCC Clause 2.2)

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

VOLUME – A

1. This Contract Agreement and the Appendices thereto.
2. Invitation for bids (Reference No..... dated.....)
3. Pre-bid clarification (Reference No..... dated.....)
4. Letter of Intent (Reference No..... dated.....)
5. Mutually agreed contract execution plan/PERT chart (Reference No..... dated.....)
6. Contract Performance Securities (Reference No..... dated.....)
7. Letter of Award (Reference No..... dated.....)

VOLUME – B

3. "Bidding Documents" comprising of the following:

The Bidding Document is a compilation of the following and shall include amendments.... to, if any, thereto:

- a. VOLUME – I: Condition of contract (Document Code No.:):
 - Section I: Invitation for Bid (Section - IFB)
 - Section II: Instructions to Bidders (Section – ITB)
 - Section III: Bid Data sheets (BDS)
 - Section IV: General Conditions of Contract (GCC)
 - Section V: Special Conditions of Contract (SCC)
 - Section VI: Sample Forms and Procedures (FP)
 1. Bid Form & Price Schedule
 - 1.1 Bid Form
 - 1.2 Price Schedule
 2. Bid Security Form
 3. Form of Notification by the Employer to the Bank
 - 3.a Applicable for forfeiture of Bank Guarantee
 - 3.b Applicable for conditional claim pending extension of Bank Guarantee by the bidder.
 4. Form of 'Notification of Award of Contract'
 - 4(a) Form of 'Notification of Award of Contract' for Supply of Plant and equipment
 - 4(b) Form of 'Notification of Award of Contract' for Installation of Plant and equipment
 5. Form of Contract Agreement
 - Alternative A
 - Alternative B
 - 5.1 Appendix-1: Terms and Procedures of Payment: Grid/Power Substation, and 11KV, Distribution Transformer, LT and Service connection
 - 5.2 Appendix-2: Price Adjustment
 - 5.3 Appendix-3: Insurance Requirements
 - 5.4 Appendix-4: Time Schedule
 - 5.5 Appendix-5: List of Approved Subcontractors
 - 5.6 Appendix-6: Scope of Works and Supply by the Employer
 - 5.7 Appendix-7: List of Document for Approval or Review
 - 5.8 Appendix-8: Guarantees, Liquidated Damages for Non-Performance
 6. Performance Security Form
 7. Bank Guarantee Form for Advance Payment
 8. Form of Taking over Certificate

9. Form of Indemnity Bond to be executed by the Contractor for the Equipment handed over in one lot by Employer for performance of its contract
10. Form of Indemnity Bond to be executed by the Contractor for the Equipment handed over in installments by Employer For performance of its contract
11. Form of Authorisation Letter
12. Form of Trust Receipt for Plant, Equipment and Materials received
13. Form of Extension of Bank Guarantee
14. Form of Power of Attorney for Joint Venture
15. Form of Undertaking by the Joint Venture Partners
16. Format for Evidence of Access to or Availability of Credit/ Facilities
17. Form of Operational Acceptance
18. Form of Safety Plan to be submitted by the Contractor within sixty days of award of contract
19. Form of joint deed of undertaking by the Sub-contractor along with the bidder /contractor
20. Form of Certificate of Financial Parameters for QR

Section VII: Scope of works,

- b. VOLUME-II: Bid –Proposal Sheets(Document Code No.:):
 - Section I: Project Management System (PMS), Quality Assurance & Evaluation Mechanism, Documentation & PMA
 - Section II: Bid Forms
 - Section III: Price Schedules
- c. Volume-III: Technical Specifications, Drawings (Document Code No.:):
 - Section I: Technical Specifications
 - Section II: Tender Drawings
 - Section III: Technical Specifications for IPDS

VOLUME – C

4. Bid Submitted by the Contractor.

(Only relevant extracts are attached herewith for easy reference. Should the circumstances warrant, the original Bid along with the enclosures thereof, shall be referred to.).

1.2 Order of Precedence (Reference GCC Clause 2)

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

1.3 Definitions (Reference GCC Clause 1/SCC Clause 1)

- 1.3.1 Capitalized words and phrases used herein shall have the same meanings as are ascribed to them in the General Conditions of Contract/Special Conditions of Contract.

Article 2. Contract Price and Terms of Payment

2.1 Contract Price (Reference GCC Clause 7)

The Employer hereby agrees to pay to the Contractor the Contract Price in consideration of the performance by the Contractor of its obligations hereunder. The Contract Price shall be the aggregate of (amount in words) (.....(amount in figures)), or such other sums as may be determined in accordance with the terms and conditions of the Contract. The break-up of the Contract price is as under:

Sl. No.	Price Component	Amount
1.	Ex-Works Price Component	
2.	Type Test Charges	Not Applicable
Total for Ex-Works Supply Contract		

The detailed break-up of Contract Price is given in the relevant Appendices hereto.

2.2 Terms of Payment (Reference GCC Clause 8)

The terms and procedures of payment according to which the Employer will reimburse the Contractor are given in Appendix 1 (Terms and Procedures of Payment) hereto.

Article 3. Effective Date for Determining Time for Completion

3.1 Effective Date (Reference GCC Clause 1)

The Time of Completion of Facilities shall be determined from the date of the Notification of Award i.e., from

Article 4. Appendices

The Appendices listed in the List of Appendices, as mentioned below, shall be deemed to form an integral part of this Contract Agreement.

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

List of Appendices

Appendix 1	Terms and Procedures of Payment
Appendix 2	Price Adjustment
Appendix 3	Insurance Requirements
Appendix 4	Time Schedule
Appendix 5	List of Approved Subcontractors
Appendix 6	Scope of Works and Supply by the Employer
Appendix 7	List of Document for Approval or Review
Appendix 8	Guarantees, Liquidated Damages for Non-Performance

Article 5.

The Contract Agreement No. has also been made on the day of 20...., between the Employer and the Contractor for the Services Contract (hereinafter referred to as the "Second Contract") for the subject package which includes performance of all the services interalia including (Indicate brief scope of work) for the complete execution of the (insert name of Package alongwith name of the Project).....

Notwithstanding the award of contract under two separate contracts in the aforesaid manner, the Contractor shall be overall responsible to ensure the execution of both the contracts to achieve successful completion and taking over of the facilities by the Employer as per the requirements stipulated in the Contract. It is expressly understood and agreed by the Contractor that any default or breach under the 'Second Contract' shall automatically be deemed as a default or breach of this 'First Contract' also and vice-versa and any such breach or occurrence or default giving the Employer a right to terminate the 'Second Contract' either in full or in part, and/or recover damages there under that Contract, shall give the Employer an absolute right to terminate this Contract at the Contractor's risk, cost and responsibility, either in full or in part and /or recover damages under this 'First Contract' as well. However, such breach or default or occurrence in the 'Second Contract' shall not automatically relieve the Contractor of any of its responsibility/ obligations under this 'First Contract'. It is also expressly understood and agreed by the Contractor that the equipment /materials supplied by the Contractor under this 'First Contract' when installed and commissioned by the Contractor under the 'Second Contract' shall give satisfactory performance in accordance with the provisions of the Contract.

IN WITNESS WHEREOF the Employer and the Contractor have caused this Agreement to be duly executed by their duly authorized representatives the day and year first above written.

Signed by for and
on behalf of the Employer

.....
Signature

.....
Title
in the presence of

Signed by for and
on behalf of the Contractor

.....
Signature

.....
Title
in the presence of

5. FORM OF CONTRACT AGREEMENT

[Alternative – b]

SERVICES CONTRACT AGREEMENT BETWEEN (Name of Employer) AND M/s. (Name of Contractor)/JOINT VENTURE (JV) OF M/s. (Name of Lead Partner).... (THE LEAD PARTNER OF THE JV) AND M/s.(Name of Other Partner)..... (THE PARTNER OF THE JV) [Use as applicable]

THIS CONTRACT AGREEMENT No. (also referred to as 'Services Contract/the Second Contract') is made on the day of 20.....

BETWEEN

(1) (Name of Employer)..... a company incorporated under the laws of Companies Act 1956/2013 (with amendment from time to time) and having its Registered Office at(registered address of the Employer) and its Corporate Office at(address of the Employer)..... (hereinafter called "the Employer" and also referred to as ".....(insert abbreviated name of the Employer)")

and

(2) M/s (Name of Contractor), a company incorporated under the laws of Companies Act 1956/2013 (with amendment from time to time) and having its Principal place of business at(Address of Contractor) and Registered Office at(Registered address of Contractor) (hereinafter called "the Contractor" and also referred to as ".....(insert abbreviated name of the Contractor)")

or

Joint Venture (JV) of M/s (Name of Lead Partner) (the Lead Partner of JV), a company incorporated under the laws of Companies Act 1956 and having its Principal place of business at(Address of Lead Partner) and Registered Office at(Registered address of Lead Partner) and M/s (Name of Other Partner) (the Partner of JV), a company incorporated under the laws of Companies Act 1956/2013 (with amendment from time to time) and having its Principal place of business at(Address of Other Partner) and Registered Office at(Registered address of Other Partner) (hereinafter called "the Contractor" and also referred to as "Joint Venture"/the 'JV'")
(Applicable only in case of Joint Venture)

WHEREAS the Employer desires to engage the Contractor for providing all the services inter-alia including (Indicate brief scope of work) for the complete execution of the (insert name of Package alongwith name of the Project)..... as detailed in the Contract Document ("the Facilities"), and the Contractor has agreed to such engagement upon and subject to the terms and conditions hereinafter appearing.

NOW IT IS HEREBY AGREED as follows:

Article 1. Contract Documents

1.1 Contract Documents (Reference GCC Clause 2.2)

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

VOLUME – A

1. This Contract Agreement and the Appendices thereto.
2. Invitation for bids (Reference No..... dated.....)
3. Pre-bid clarification (Reference No..... dated.....)
4. Letter of Intent (Reference No..... dated.....)
5. Mutually agreed contract execution plan/PERT chart (Reference No..... dated.....)
6. Contract Performance Securities (Reference No..... dated.....)
7. Letter of Award (Reference No..... dated.....)

VOLUME – B

3. "Bidding Documents" comprising of the following:

The Bidding Document is a compilation of the following and shall include amendments.... to, if any, thereto:

- a. VOLUME – I: Condition of contract (Document Code No.:):
 - Section I: Invitation for Bid (Section - IFB)
 - Section II: Instructions to Bidders (Section – ITB)
 - Section III: Bid Data sheets (BDS)
 - Section IV: General Conditions of Contract (GCC)
 - Section V: Special Conditions of Contract (SCC)
 - Section VI: Sample Forms and Procedures (FP)
 1. Bid Form & Price Schedule
 - 1.1 Bid Form
 - 1.2 Price Schedule
 2. Bid Security Form
 3. Form of Notification by the Employer to the Bank
 - 3.a Applicable for forfeiture of Bank Guarantee
 - 3.b Applicable for conditional claim pending extension of Bank Guarantee by the bidder.
 4. Form of 'Notification of Award of Contract'
 - 4(a) Form of 'Notification of Award of Contract' for Supply of Plant and equipment
 - 4(b) Form of 'Notification of Award of Contract' for Installation of Plant and equipment
 5. Form of Contract Agreement
 - Alternative A
 - Alternative B
 - 5.1 Appendix-1: Terms and Procedures of Payment: Grid/Power Substation, and 11KV, Distribution Transformer, LT and Service connection
 - 5.2 Appendix-2: Price Adjustment
 - 5.3 Appendix-3: Insurance Requirements
 - 5.4 Appendix-4: Time Schedule
 - 5.5 Appendix-5: List of Approved Subcontractors
 - 5.6 Appendix-6: Scope of Works and Supply by the Employer
 - 5.7 Appendix-7: List of Document for Approval or Review
 - 5.8 Appendix-8: Guarantees, Liquidated Damages for Non-Performance
 6. Performance Security Form
 7. Bank Guarantee Form for Advance Payment
 8. Form of Taking over Certificate

9. Form of Indemnity Bond to be executed by the Contractor for the Equipment handed over in one lot by Employer for performance of its contract
10. Form of Indemnity Bond to be executed by the Contractor for the Equipment handed over in installments by Employer For performance of its contract
11. Form of Authorisation Letter
12. Form of Trust Receipt for Plant, Equipment and Materials received
13. Form of Extension of Bank Guarantee
14. Form of Power of Attorney for Joint Venture
15. Form of Undertaking by the Joint Venture Partners
16. Format for Evidence of Access to or Availability of Credit/ Facilities
17. Form of Operational Acceptance
18. Form of Safety Plan to be submitted by the Contractor within sixty days of award of contract
19. Form of joint deed of undertaking by the Sub-contractor along with the bidder /contractor
20. Form of Certificate of Financial Parameters for QR

Section VII: Scope of works

- d. VOLUME-II: Bid –Proposal Sheets (Document Code No.:):
 - Section I: Project Management System (PMS), Quality Assurance & Evaluation Mechanism, Documentation & PMA
 - Section II: Bid Forms
 - Section III: Price Schedules
- e. Volume-III: Technical Specifications, Drawings (Document Code No.:):
 - Section I: Technical Specifications
 - Section II: Tender Drawings
 - Section III: Technical Specifications for IPDS

VOLUME – C

4. Bid Submitted by the Contractor.

(Only relevant extracts are attached herewith for easy reference. Should the circumstances warrant, the original Bid along with the enclosures thereof, shall be referred to.).

1.2 Order of Precedence (Reference GCC Clause 2)

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

1.3 Definitions (Reference GCC Clause 1/SCC Clause 1)

- 1.3.1 Capitalized words and phrases used herein shall have the same meanings as are ascribed to them in the General Conditions of Contract/Special Conditions of Contract.

Article 2. Contract Price and Terms of Payment

2.1 Contract Price (Reference GCC Clause 7)

The Employer hereby agrees to pay to the Contractor the Contract Price in consideration of the performance by the Contractor of its obligations hereunder. The Contract Price shall be the aggregate of (amount in words) (.....(amount in figures)), or such other sums as may be determined in accordance with the terms and conditions of the Contract. The break-up of the Contract price is as under:

Sl. No.	Price Component	Amount
1.	Local Transportation, Insurance and other Incidental Services	
2.	Installation Services	
3.	Training Charges (if required)	Not Applicable
Total for Services Contract		

The detailed break-up of Contract Price is given in the relevant Appendices hereto.

2.2 Terms of Payment (Reference GCC Clause 8)

The terms and procedures of payment according to which the Employer will reimburse the Contractor are given in Appendix 1 (Terms and Procedures of Payment) hereto.

Article 3. Effective Date for Determining Time for Completion

3.1 Effective Date (Reference GCC Clause 1)

The Time of Completion of Facilities shall be determined from the date of the Notification of Award i.e., from

Article 4. Appendices

The Appendices listed in the List of Appendices, as mentioned below, shall be deemed to form an integral part of this Contract Agreement.

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

List of Appendices

Appendix 1	Terms and Procedures of Payment
Appendix 2	Price Adjustment
Appendix 3	Insurance Requirements
Appendix 4	Time Schedule
Appendix 5	List of Approved Subcontractors
Appendix 6	Scope of Works and Supply by the Employer
Appendix 7	List of Document for Approval or Review
Appendix 8	Guarantees, Liquidated Damages for Non-Performance

Article 5.

The Contract Agreement No. has also been made on the day of 20...., between the Employer and the Contractor for the Ex-Works Supply Contract (hereinafter referred to as the "First Contract") for the subject package which includes Ex-works supply of all equipment and

materials including Type Testing to be conducted interalia including (Indicate brief scope of work) for the complete execution of the (insert name of Package alongwith name of the Project).....

Notwithstanding the award of contract under two separate contracts in the aforesaid manner, the Contractor shall be overall responsible to ensure the execution of both the contracts to achieve successful completion and taking over of the facilities by the Employer as per the requirements stipulated in the Contract. It is expressly understood and agreed by the Contractor that any default or breach under the 'First Contract' shall automatically be deemed as a default or breach of this 'Second Contract' also and vice-versa and any such breach or occurrence or default giving the Employer a right to terminate the 'First Contract' either in full or in part, and/or recover damages there under that Contract, shall give the Employer an absolute right to terminate this Contract at the Contractor's risk, cost and responsibility, either in full or in part and /or recover damages under this 'Second Contract' as well. However, such breach or default or occurrence in the 'First Contract' shall not automatically relieve the Contractor of any of its responsibility/ obligations under this 'Second Contract'. It is also expressly understood and agreed by the Contractor that the equipment /materials supplied by the Contractor under the 'First Contract' when installed and commissioned by the Contractor under this 'Second Contract' shall give satisfactory performance in accordance with the provisions of the Contract.

IN WITNESS WHEREOF the Employer and the Contractor have caused this Agreement to be duly executed by their duly authorized representatives the day and year first above written.

Signed by for and
on behalf of the Employer

Signed by for and
on behalf of the Contractor

.....
Signature

.....
Signature

.....
Title

.....
Title

in the presence of

in the presence of

(Separate Contract Agreements shall be executed by the Employer and the Contractor in accordance with the Construction of the Contract stipulated at BDS Clause [ITB 30.4]. The forms of Contract under both Alternative i.e., a & b shall be used).

Appendix-1: TERMS AND PROCEDURES OF PAYMENT

- I. "Billable Items" are worked out and attached to Price Schedule. Items otherwise required for completion of work but not listed in the Price Schedule shall also be in the scope of the contractor. The costs of such "Non- billable Items" may be included in the quoted price of "Billable Items" by the bidder in the Price Schedule. The payment shall be made on billable item wise basis only as indicated in Price Schedule.
 - II. The payment to the Contractor under the contract will be made by the Employer in line with Clause 8, Section GCC, Vol.-I and as per the guidelines and conditions specified hereunder.
 - III. All progressive payments shall be released on validity of Contract Performance Security and securities against Initial Advance.
 - IV. The interest rate on advance payment shall be SBI's Base rate on the date of disbursement of advance payment. The interest accrued on interest bearing advance shall be adjusted first before releasing any payment. The interest rate shall be calculated on the daily progressive balances outstanding as on the date of recovery/adjustment i.e. on daily rest basis.
 - V. Upon award of the contract, contractor shall be free to take on the work at all the fronts or at specified fronts as advised by Project Manager.
 - VI. Unmeasured ad-hoc payment: The employer, at his discretion in exigencies, to ensure liquidity of funds with the contractor may accept un-measured ad-hoc bill of the contractor. In this method, following methodology shall be adopted:
 - a. Submission of certificate on measurement book by Project Manager that materials under consideration have been erected, tested and commissioned as per technical specification, scope of work & approved drawings.
 - b. Quantum and completion of works is certified by Project Manager jointly with contractor and eligible amount of such works are computed as per approved payment terms.
 - c. 50% of such eligible amount shall be released to the contractor immediately within a week. The amount of un-measured bill should not be more than average of previous two measured bill.
 - d. Next bill of the work shall invariably be a measured bill in which, various quantities of unmeasured bill shall be verified and measured jointly by Project Manager and contractor.
- A. Supply, Erection, Testing and Commissioning of works under DDUGJY/IPDS:
1. Advance payment (Optional):
 - i. For Ex-works Supply contract, initial interest bearing adjustable Mobilization Advance of 15% of ex-works contract cost excluding taxes and duties shall be released for all the materials in two tranches of 7.5% each, First installment of 7.5% of ex-works price component shall be released on presentation of the following:
 - a. Unconditional acceptance of the Letter of Award and signing of contract agreement by the Contractor.

- b. Contractor's detailed invoice.
- c. Submission and acceptance of unconditional & irrevocable part Bank Guarantees (as many number as proposed recovery installments and should be of 110% amount of each installment) in favor of employer with total amounting to 110% of total advance amount as per proforma attached with Section-VI of Vol.-I (Conditions of Contract). The said Bank Guarantees shall be initially valid upto end of ninety (90) days after the scheduled month of supply of materials and shall be extended from time to time till ninety (90) days beyond revised scheduled month of supply of materials, as may be required under the Contract.
- d. An unconditional & irrevocable Bank Guarantee for ten percent (10%) of the total Contract price towards Contract Performance Guarantee (CPG) in accordance with the provisions of Clause 34.1, Section ITB and as per proforma attached with Section-VI of Vol.-I (Conditions of Contract). The said bank guarantee shall be initially valid up to ninety (90) days after expiry of the Warranty Period and shall be extended from time to time till ninety (90) days beyond successful completion of warranty period, as may be required under the Contract.
- e. Detailed PERT Network/Bar chart and its approval by the Employer.

The bidder must utilize first advance installment of 7.5% of ex-works supply component before requesting for second advance installment. Second installment of 7.5% shall be released on presentation of contractor's invoice and satisfactory utilization certificate supported with documentary evidences of first advance installment.

- ii. For Services Contract, initial interest bearing adjustable Mobilization Advance of 10% of erection contract price excluding taxes and duties shall be released for all the works in two tranches of 5% each. First installment of 5% of total erection price shall be released on presentation of the following:
 - a. Submission of detailed invoice for advance payment.
 - b. Establishment of Contractor's site offices and certification by Engineer that satisfactory mobilization for erection exists.
 - c. Submission and acceptance of unconditional & irrevocable part Bank Guarantees (as many number as proposed recovery installments and should be of 110% amount of each installment) in favor of employer with total amounting to 110% of total advance amount as per proforma attached with Section-VI of Vol.-I (Conditions of Contract). The said Bank Guarantees shall be initially valid up to end of ninety (90) days after the scheduled month of erection of materials and shall be extended from time to time till ninety (90) days beyond revised scheduled month of erection of materials, as may be required under the Contract.
 - d. Submission of an unconditional & irrevocable Bank Guarantee in favor of Employer for **ten percent (10%)** of the total Contract price towards Contract Performance Guarantee (CPG) in accordance with Clause 34.1 of Section-ITB, Vol.-I and as per proforma attached with Section-VI of Volume-I (Conditions of Contract). The said Bank Guarantee shall be initially valid up to 90 (ninety) days after the expiry of warranty period and shall be extended from time to time till ninety (90) days beyond successful completion of warranty period, as may be required under the Contract.

The bidder must utilize first advance installment of 5% of total erection price before requesting for second advance installment. Second installment of 5% shall be released on presentation of contractor's invoice and satisfactory utilization certificate of first advance installment.

2. Progressive payments (Supply):

2.1. First Installment(60%) : Sixty percent (60%) payments against various items of price schedule 1 including 100% Excise Duty, Taxes etc shall be paid on receipt and acceptance of Materialson submission of documents indicated herein under:

- a. Unconditional acceptance of the Letter of Award and signing of contract agreement by the Contractor.
- b. An unconditional & irrevocable Bank Guarantee for ten percent (10%) of the total Contract price towards Contract Performance Guarantee (CPG) in accordance with the provisions of Clause 34.1, Section ITB and as per proforma attached with Section-VI of Vol.-I (Conditions of Contract). The said bank guarantee shall be initially valid upto ninety (90) days after expiry of the Warranty Period and shall be extended from time to time till ninety (90) days beyond successful completion of warranty period, as may be required under the Contract.
- c. Detailed Project Execution Plan/PERT chart and its approval by the Employer.
- d. Evidence of dispatch (R/R or receipted L/R)
- e. Contractor's detailed invoice & packing list identifying contents of each shipment.
- f. Invoice certifying payments of ED, Taxes for the direct transaction between Employer and Contractor,
- g. Copy of Certificate to the effect of payments of State/ Central taxes, duties, levies etc have been made against supply of materials through sub-vendors under the contract.
- h. Certified copy of Insurance policy/Insurance Certificate.
- i. Manufacturer's/Contractor's guarantee certificate of Quality.
- j. Material Dispatch Clearance Certificate (MDCC) / Dispatch Instructions (DI) for dispatch of materials from the manufacturer's works. MDCC/DI shall be issued by authorized officer of Employer
- k. Manufacturer's copy of challan
- l. submission of the certificate by the Employer's representative that the item(s) have been received,
- m. Submission of certificate by Project Manager that materials have been supplied as per technical specification, scope of work & approved drawings enclosing certified copy of inspection reports and dispatch clearances.
 - a. 60% of proportionate Mobilization Advance against Supply shall be adjusted while making payments of this installment. In case of delay of project, the entire

mobilization advance shall get recovered from the contractor as per supply and erection contracts' works completion schedule respectively.

2.2. Second Installment (30%): Thirty percent (30%) payments against various items of price schedule 1 shall be paid on following conditions:

- a. Unconditional acceptance of the Letter of Award and signing of contract agreement by the Contractor.
- b. An unconditional & irrevocable Bank Guarantee for ten percent (10%) of the total Contract price towards Contract Performance Guarantee (CPG) in accordance with the provisions of Clause 34.1, Section ITB and as per proforma attached with Section-VI of Vol.-I (Conditions of Contract). The said bank guarantee shall be initially valid upto ninety (90) days after expiry of the Warranty Period and shall be extended from time to time till ninety (90) days beyond successful completion of warranty period, as may be required under the Contract.
- c. Detailed Project Execution Plan/PERT chart and its approval by the Employer.
- d. Evidence of dispatch (R/R or receipted L/R)
- e. Contractor's detailed invoice & packing list identifying contents of each shipment.
- f. Invoice certifying payments of ED, Taxes for the direct transaction between Employer and Contractor,
- g. Copy of Certificate to the effect of payments of State/ Central taxes, duties, levies etc have been made against supply of materials through sub-vendors under the contract.
- h. Certified copy of Insurance policy/Insurance Certificate.
- i. Manufacturer's/Contractor's guarantee certificate of Quality.
- j. Material Dispatch Clearance Certificate (MDCC) / Dispatch Instructions (DI) for dispatch of materials from the manufacturer's works. MDCC/DI shall be issued by authorized officer of Employer
- k. Manufacturer's copy of challan
- l. submission of the certificate on measurement book by the Project Manager that the item(s) have been received,
- m. Submission of certificate on measurement book by Project Manager that materials under consideration have been erected, tested and commissioned as per technical specification, scope of work & approved drawings.
- n. Test check certification on Measurement Book be recorded by officers in hierarchy with the claim as per policy.
While releasing 2nd installment of 30% supply payment following adjustment shall be made:
 - a. Balance initial mobilization advance shall be adjusted. Also, up-to-date accrued interest shall also be recovered.
 - b. In case of delay of project, the entire mobilization advance shall get recovered at this stage.

2.3. Third and Final Installment (10%):

- a. The balance ten percent (10%) of payment against Supply contracts excluding Excise Duty, Taxes etc shall be reimbursable on successful supply, erection, testing and commissioning of the works in the project and issuance of Taking over Certificate by the Employer.
- b. 'Commissioning' for the purpose of payments shall mean satisfactory completion of all supplies, erection, commissioning checks and successful completion of all site tests and continuous energisation of the equipment/ materials at rated voltage as per the Contract and to the satisfaction/approval of the Employer.
- c. On submission of the certificate by the Project Manager that the item(s) have been received, erected, tested and commissioned.
- d. On certification by Project Manager for validity of an unconditional & irrevocable Bank Guarantee for ten percent (10%) of the total Contract price towards Contract Performance Guarantee (CPG) in accordance with the provisions of Clause 34.1, Section ITB and as per proforma attached with Section-VI of Vol.-I (Conditions of Contract). The said bank guarantee shall be initially valid upto ninety (90) days after expiry of the Warranty Period and shall be extended from time to time till ninety (90) days beyond successful completion of warranty period, as may be required under the Contract.
- e. In case, for any reason not attributable to the contractor, the commissioning and charging of equipment/materials is delayed beyond 120 days of successful completion of final checking and testing of works, the balance 10% payment shall be released against an unconditional & irrevocable bank guarantee of equivalent amount initially valid till 6 months from the readiness of works for commissioning and charging at rated voltage, to be extended till 90 days beyond actual commissioning & taking over.

3. Progressive payments (Erection):

- 3.1. First Installment (90%) : Ninety percent (90%) payments against Erection contracts shall be paid on erection, testing and commissioning of works and on submission of documents of all villages indicated herein under:
 - a. Unconditional acceptance of the Letter of Award and signing of contract agreement by the Contractor.
 - b. Detailed Project Execution Plan/PERT chart and its approval by the Employer.
 - c. An unconditional & irrevocable Bank Guarantee for ten percent (10%) of the total Erection Contract price towards Contract Performance Guarantee (CPG) in accordance with the provisions of Clause 34.1, Section ITB and as per proforma attached with Section-VI of Vol.-I (Conditions of Contract). The said bank guarantee shall be initially valid upto ninety (90) days after expiry of the Warranty Period and shall be extended from time to time till ninety (90) days beyond successful completion of warranty period, as may be required under the Contract.
 - d. Certified copy of Insurance policy/Insurance Certificate.
 - e. Material reconciliation statement consisting of the materials utilized for erection, testing & commissioning vis-à-vis erection activity of the lot of villages.

- o. Submission of certificate on measurement book by Project Manager that materials under consideration have been erected, tested and commissioned as per technical specification, scope of work & approved drawings.
- p. Test check certification on Measurement Book be recorded by officers in hierarchy with the claim as per policy.

While releasing 1st installment of 90% erection payment following adjustment shall be made:

- b. 100% Mobilization Advance against Erection shall be fully adjusted while making payments of first installment. Also, up-to-date accrued interest shall also be recovered.
- c. In case of delay of project, the entire mobilization advance shall get recovered from the contractor as per supply and erection contracts' works completion schedule respectively.

3.2. Second and Final Installment (10%):

- a. The balance ten percent (10%) of payment against Erection contract shall be released on successful commissioning of the works in the project and issuance of Taking over Certificate of the project.
- b. 'Commissioning' for the purpose of payments shall mean satisfactory completion of all supplies, erection, commissioning checks and successful completion of all site tests and continuous energisation of the equipment/ materials at rated voltage as per the Contract and to the satisfaction/approval of the Employer.
- c. On submission of the certificate by the Project Manager that the equipment/materials have been erected, tested and commissioned.
- d. On certification by Project Manager for validity of an unconditional & irrevocable Bank Guarantee for ten percent (10%) of the total Contract price towards Contract Performance Guarantee (CPG) in accordance with the provisions of Clause 34.1, Section ITB and as per proforma attached with Section-VI of Vol.-I (Conditions of Contract). The said bank guarantee shall be initially valid upto ninety (90) days after expiry of the Warranty Period and shall be extended from time to time till ninety (90) days beyond successful completion of warranty period, as may be required under the Contract.
- e. On certification of Project Manager for reconciliation of materials and payments.
- f. On certification of Project Manager that assets under the project are created and are taken over by Employer.
- g. However, in case, for any reason solely attributable to the Owner/Employer, the commissioning of equipment/materials is delayed beyond 120 days of successful completion of final checking and testing of line for the purpose of commissioning as defined in bid documents, the balance 10% payment shall be released against an unconditional & irrevocable bank guarantee of equivalent amount initially valid till 6 months from the readiness of transmission lines/ distribution transformer/ service connections for commissioning and charging at rated voltage, to be extended till 90 days beyond actual commissioning & taking over.

Appendix-2 : PRICE ADJUSTMENT

The prices for execution of the entire works covered under the scope of this work shall be quoted by the Bidder in the manner specified, in the BPS. The Ex-works price component, less advance will be subject to price adjustment, only for equipment/materials/items of work specifically stated under clause 1.0 below, (for which the bidder shall quote a base price), based on separate formulae as per price adjustment provisions given herein.

Prices for Ex-works price component for all other equipment/items except specified at Clause 1.0 below, Charges for Erection, Inland Freight & Insurance etc shall be FIRM and no price adjustment shall be applicable for these components for the entire duration of the Contract.

No price adjustment shall be applicable on the portion of the Contract Price payable to the Contractor as advance payment.

1.0 Materials and Labour portion:

1.0.1 For ACSR Conductor

The price adjustment on the Ex-works price component, less advance, of Conductor shall be as follows:

$$dECc = ECc [0.80 \times \{(A_1 - A_0) / A_0\} + 0.05 \times \{(L_1 - L_0) / L_0\}]$$

Where,

dECc = Price adjustment amount payable on Ex-works price of Conductor, shipment-wise (if it works out negative, that would mean the amount to be recovered by the employer from the contractor).

ECc = Ex-works price for Conductor, shipment wise, less advance (Quoted Price)

A = Published price indices for EC grade aluminum ingots as published by IEEMA

L = All India consumer price index for industrial workers as published by Labour Bureau, Shimla (Govt. of India)

Fixed portion of the ex-works price component shall be 0.15. This shall not be subject to any adjustment.

In the above price adjustment formulae:

Subscript '0' refers to indices as on 30 days prior to date of bid opening (referred to as base date indices),

Subscript '1' refers to indices as on 60 days prior to date of shipment.

1.0.2 For Station/ Power Transformer (Copper Wound)

The price adjustment on the Ex-works price component, less advance, of Transformers shall be as follows:

1.0.2.1 For power transformer (Copper wound)

$$dP = P_0 \times [0.15 + 0.23 \times (C_1/C_0) + 0.26 \times (ES_1/ES_0) + 0.08 \times (IS_1/IS_0) + 0.05 \times (IM_1/IM_0) + 0.11 \times (TB_1/TB_0) + 0.12 \times (L_1/L_0)] - P_0$$

Where,

- dP = Price adjustment amount shipment-wise,
- P0 = Ex-works price component of Transformer (Quoted Price),
- C, ES, IS, IM, TB & L are the price indices for material and labour as below,
- C = Price of copper wire bars, in Rupees per MT, as published by IEEMA,
- ES = Price of Electrical steel sheets, C&F price of M4 grade Electrical Steel Sheets in Rupees per MT, as published by IEEMA,
- IS (Iron & Steel) = Wholesale Price Index Number for 'Iron & Steel' (Base 2004-05 = 100), as published by IEEMA,
- IM (Insulating Materials) = Price of Insulating Materials, as published by IEEMA,
- TB = Price of Transformer Oil Base Stock (TOBS) in Rs./KL, as published by IEEMA,
- L = All India Average Consumer Price Index Number, for Industrial Workers (base 2001=100) as published / declared by Labour Bureau, Shimla, GOI and circulated by IEEMA.

In the above price adjustment formulae:

Subscript '0' refers to indices as on 30 days prior to date of bid opening (referred to as base date indices),

Subscript '1' refers to indices as on 60 days prior to date of shipment.

1.0.3 Station / Distribution Transformer (Aluminium Wound)

The price adjustment on the Ex-works price component, less advance, of Transformers shall be as follows:

1.0.3.1 For station/distribution transformer(Aluminium wound) (of rating up to 160 kVA and voltage up to 33 kV)

$$dP = P_0 \times [0.13 + 0.27 \times (A_1/A_0) + 0.31 \times (ES_1/ES_0) + 0.09 \times (IS_1/IS_0) + 0.02 \times (IM_1/IM_0) + 0.06 \times (TB_1/TB_0) + 0.12 \times (L_1/L_0)] - P_0$$

Where,

- dP = Price adjustment amount shipment-wise,
- P0 = Ex-works price component of Transformer (Quoted Price),
- C, ES, IS, IM, TB & L are the price indices for material and labour as below,
- A = Published price indices for EC grade aluminum ingots as published by IEEMA

ES	=	Price of Electrical steel sheets, C&F price of M4 grade Electrical Steel Sheets in Rupees per MT, as published by IEEMA,
IS (Iron & Steel)	=	Wholesale Price Index Number for 'Iron & Steel' (Base 2004-05 = 100), as published by IEEMA,
IM (Insulating Materials)	=	Price of Insulating Materials, as published by IEEMA,
TB	=	Price of Transformer Oil Base Stock (TOBS) in Rs./KL, as published by IEEMA,
L	=	All India Average Consumer Price Index Number, for Industrial Workers (base 2001=100) as published / declared by Labour Bureau, Shimla, GOI and circulated by IEEMA.

In the above price adjustment formulae:

Subscript '0' refers to indices as on 30 days prior to date of bid opening (referred to as base date indices),

Subscript '1' refers to indices as on 60 days prior to date of shipment.

1.0.4 Cables

The price adjustment on the Ex-works price component, less advance, of Cables shall be as follows:

$$dP = P_0 \times \{0.85 + 0.15 \times (A_1/A_0)\} - P_0 + (M_1 - M_0),$$

Where,

dP	=	Price Adjustment amount per kilometer of cable,
P0	=	Ex-works price per kilometer of cable (Quoted Price)
A	=	Price Index for PVC / XLPE as published by IEEMA,
M1-M0	=	Change in metal component of the ex-works price of particular type and size of cable,
M	=	(Weight in MT of metal per kilometer of cable) x (published price index of metals per MT as published by IEEMA)

The bidder has to specify in his bid the metal component per km for each type and size of cable.

In the above price adjustment formulae:

Subscript '0' refers to indices as on 30 days prior to date of bid opening (referred to as base date indices),

Subscript '1' refers to indices as on 60 days prior to date of shipment.

1.0.5 Steel Structure

Steel structure (excluding nuts, bolts) used in fabrication work at various places in Sub-Transmission and Distribution network (such as lattice structure used in ST&D network/line, switchyard etc.), which are billable items in the Bill of quantity (BOQ) shall be covered under this head. The price adjustment formula for such structural steel items shall be as mentioned hereinafter.

The price component of the structural steel for any shipment/ dispatch comprises of a fixed portion (designated as 'F' and the value of which is specified hereunder) and a variable portion linked with the indices for respective materials and labour (description and co-efficient as enumerated below).

The amount of price adjustment towards variable portion payable/recoverable on each shipment/dispatch shall be computed as under:

$$EC = EC1 - ECo$$

EC1 will be computed as follows in any of appropriate manner as applicable (a or b or c):

a) For structure using both heavy and lighter angles:

$$EC1 = ECo * [F + 0.18 * (HA1/HA0) + 0.40 * (LA1/LA0) + 0.16 * (Zn1/Zn0) + 0.11 * (L1/L0)]$$

b) For structure using only heavy angles:

$$EC1 = ECo * [F + 0.58 * (HA1/HA0) + 0.16 * (Zn1/Zn0) + 0.11 * (L1/L0)]$$

c) For structure using only lighter angles:

$$EC1 = ECo * [F + 0.58 * (LA1/LA0) + 0.16 * (Zn1/Zn0) + 0.11 * (L1/L0)]$$

Where

EC = Adjustment to Ex-Works price component payable to contractor for each shipment/dispatch

EC1 = Adjusted amount of Ex-works price component of Contract payable to Contractor for each shipment / dispatch.

ECo = Ex-works price for the respective item of the Contract, Shipment/dispatch wise (quoted price).

F = Fixed portion of the ex-works/FOB component of the Contract Price (F) shall be 0.15.

HA = Price of Heavy angle steel, as published by IEEMA

LA = Price of Lighter angle steel, as published by IEEMA

Zn = Price of electrolytic high grade zinc, as published by IEEMA

L = All India average Consumer Price Index Number for Industrial Workers (base 2001=100) as published/declared by Labour Bureau, Shimla, Government of India and circulated by IEEMA.

For the indices, subscript 'o' refers to indices as on 30 days prior to date set for opening of bids. Subscript '1' refers to indices as of

- (a) two months/sixty (60) days prior to the date of shipment/dispatch for labour, and
- (b) at the expiry of two third (2/3) period from the date of Notification of Award to the date of shipment/dispatch, for material.

For the purpose of this clause the date of shipment/ dispatch shall mean the Schedule date of shipment/dispatch or actual date of shipment/dispatch, whichever is earlier. The schedule date of shipment/dispatch shall be as identified in line with provisions of Time Schedule in the Contract Agreement.

In case of shipments/ dispatches which are delayed beyond the schedule date of shipment/dispatch for reasons attributable to the Contractor, the price adjustment provision shall not be applicable for the period of time between the schedule date of shipment/dispatch and the actual date of shipment/dispatch.

Note: As per IEEMA Circular No. IEEMA(PVC)/TLT/(R)/02/2007-

- 1) Heavy Steel Angles of size 150mm*150mm*12mm as per IS-2062 has been categorized as Heavy Angles (HA).
- 2) Re-rolled steel angles of size 50mm*50mm*4 mm Lighter has been categorized as Lighter Angles (LA).
- 3) Input costs for all heavy angles of size above 110m*110mm are deemed to be related to the price under Sr No.1.
- 4) Input costs for all lighter angles of size below & including 110m*110mm are deemed to be related to the price under Sr No.2.

1.0.6 66/11 KV & 33/11 KV Switchgear (indoor/outdoor) including 66/33/11 KV Circuit Breakers, RMU, Sectionalizer and Isolators:

The Contract Price shall be subject to price adjustment during performance of the Contract to reflect changes in the cost of labour and material components in accordance with the provisions described below.

The Ex-Works price of 66/11 KV & 33/11 KV Switchgear (Indoor/Outdoor), Circuit Breakers, RMU, Sectionalizer and Isolators excluding Mandatory Spares and Type Tests Charges (if any) will be subject to Price adjustment. The price adjustment formula for the components of the Contract Price, as mentioned above shall be as stipulated hereinafter.

The price component of the equipment for any shipment/ dispatch comprises of a fixed portion (designated as 'F' and the value of which is specified hereunder) and a variable portion linked with the indices for various materials and labour (description and co-efficient as enumerated below).

The amount of price adjustment towards variable portion payable/recoverable on each shipment/dispatch shall be computed as under:

$$EC = EC_1 - EC_0$$

EC₁ will be computed as follows:

$$EC_1 = EC_0 * [F + 0.17 * (IS_1/IS_0) + 0.18 * (C_1/C_0) + 0.10 * (AL_1/AL_0) + 0.13 * (ER_1/ER_0) + 0.17 * (L_1/L_0)]$$

Where

EC = Adjustment to Ex-Works price component payable to contractor for each shipment/dispatch
EC₁ = Adjusted amount of Ex-works price component of Contract payable to Contractor for each shipment / dispatch.

EC₀ = Ex-works price for the respective equipment of the Contract, shipment/dispatch wise.

F = Fixed portion of the ex-works/FOB component of the Contract Price (F) shall be 0.25.

IS = Wholesale Price Index Number for 'Iron & Steel' (Base 2004-05=100), as published by IEEMA

C = Price of copper wire bars, as published by IEEMA

AL = Price of EC grade Aluminium rods, as published by IEEMA

ER = Price of Insulating Materials (epoxy resin), as published by IEEMA

L = All India average Consumer Price Index Number for Industrial Workers (base 2001=100) as published/declared by Labour Bureau, Shimla, Government of India and circulated by IEEMA.

For the indices, subscript 'o' refers to indices as on 30 days prior to date set for opening of bids.

Subscript '1' refers to indices as of:

three months/ninety (90) days prior to the date of shipment/dispatch for labour, and

at the expiry of two third (2/3) period from the date of Notification of Award to the date of

shipment/dispatch, for material.

For the purpose of this clause the date of shipment/dispatch shall mean the Schedule date of shipment/dispatch or actual date of shipment/dispatch, whichever is earlier. The schedule date of shipment/dispatch shall be as identified in line with provisions of Time Schedule in the Contract Agreement.

In case of shipments/dispatches which are delayed beyond the schedule date of shipment/dispatch for reasons attributable to the Contractor, the price adjustment provision shall not be applicable for the period of time between the schedule date of shipment/dispatch and the actual date of shipment/dispatch.

- 1.0.7 The price adjustment amount towards price components of aforesaid materials i.e. conductor, transformers, cable, Steel structure and 66/11 KV & 33/11 KV Switchgear shall be subject to a ceiling of twenty percent (20%) of Ex-works price component of the corresponding Contract Price.
- 1.0.8 For the purpose of price adjustment for Ex-works price component, the date of shipment for goods shall mean the scheduled date of shipment or actual date of shipment, whichever is earlier. Scheduled date of shipment will be ex-works date of dispatch, governed by the approved Bar Chart.
- 1.0.9 No price increase shall be allowed beyond the original delivery dates unless specifically stated in the Time Extension letter, if any, issued by the Employer. The Employer will, however, be entitled to any decrease in the Contract price which may be caused due to lower price adjustment amount in case of delivery beyond the original delivery dates. Therefore, in case of delivery of goods beyond the original delivery dates, the liability of the Employer shall be limited to the lower of the price adjustment amount which may be worked out either on scheduled date or actual date of dispatch of goods.
- 1.0.10 In case of non-publication of applicable indices on a particular date, which happens to be the applicable date for price adjustment purposes, the published indices prevailing immediately prior to the particular date shall be applicable.
- 1.0.11 If the price adjustment amount works out to be positive, the same is payable to the Contractor by the Employer and if it works out to be negative, the same is to be recovered by the Employer from the Contractor without any ceiling.
- 1.0.12 The Contractor shall promptly submit the price adjustment invoices for the supplies made and works executed at site, positively within three (3) months from the date of shipment/work done whether it is positive or negative.
- 1.0.13 Bids shall conform to the price adjustment provisions detailed above. Bids specifying prices for items on variable basis run the risk of rejection. A bid submitted on a fixed price basis will not be rejected but the price adjustment will be treated as zero.

Appendix-3 : INSURANCE REQUIREMENTS

A) Insurances to be taken out by the Contractor

In accordance with the provisions of GCC Clause 30, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified. The identity of the insurers and the form of the policies shall be subject to the approval of the Employer, such approval not to be unreasonably withheld. The inability of the insurers to provide insurance cover in the sums and with the deductibles and other conditions as set forth below, shall not absolve the Contractor of his risks and liabilities under the provisions of GCC Clause 30. However, in such a case the Contractor shall be required to furnish to the Employer documentary evidence from the insurer in support of the insurer's inability as aforesaid.

(a) Marine Cargo Policy/Transit Insurance Policy:

(I) Transit Insurance Policy for indigenous equipment

Similarly, Transit Insurance Policy shall be taken wherein only inland transit is involved for the movement of Plant and Equipment supplied from within India. The policy shall cover movement of Plant and Equipment from the manufacturer's works to the project's warehouse at final destination site. Inland Transit Clause(ITC) 'A' along with war & Strike Riots & Civil Commotion (SRCC) extension cover shall be taken.

Amount	Deductible Limits	Parties insured	From	To
120% of Ex-work Price of all the Plant and Equipment to be supplied from within India plus Excise Duty and Sales Tax/ VAT etc., if additionally payable.	Nil	Contractor & Employer	Mfrs ware-house	Project's ware-house store at final destination

(II) If during the execution of Contract, the Employer requests the Contractor to take any other add-on cover(s)/ supplementary cover(s) in aforesaid insurance, in such a case, the Contractor shall promptly take such add-on cover(s)/ supplementary cover(s) and the charges towards such premium for such add-on cover(s)/ supplementary cover(s) shall be reimbursed to the Contractor on submission documentary evidence of payment to the Insurance company. Therefore, charges towards premium for such add-on cover(s)/ supplementary cover(s) are not included in the Contract Price.

(III) The Contractor shall take the policy in the joint names of Employer and the Contractor. The policy shall indicate the Employer as the beneficiary. However, if the Contractor is having an open policy for its line of business, it should obtain an endorsement of the open cover policy from the insurance company indicating that the dispatches against this Contract are duly covered under its open policy and include the name of the Employer as jointly Insured in the endorsements to the open policy.

(b) Erection All Risk Policy/Contractor All Risk Policy:

(I) The policy should cover all physical loss or damage to the facility at site during storage, erection and commissioning covering all the perils as provided in the policy as a basic cover and the add on covers as mentioned at Sl. No. (III) below.

Amount	Deductible limits	Parties insured	From	To

105% of Ex-work Price of all the Plant and Equipment to be supplied from within India plus Excise Duty and Sales Tax/ VAT etc., if additionally payable. and 100% of erection price component	Nil	Contractor & Employer	Receipt at site of first lot of the Plant and Equipment	Up to Operational Acceptance
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(II) The Contractor shall take the policy in the joint name of Employer and the Contractor. All these policies shall indicate Employer as the beneficiary. The policy shall be kept valid till the date of the Operational Acceptance of the project and the period of the coverage shall be determined with the approval of the Employer.

If the work is completed earlier than the period of policy considered, the Contractor shall obtain the refund as per provisions of the policy and pass on the benefit to Employer. In case no refund is payable by the insurance company then the certificate to that effect shall be submitted to Employer at the completion of the project.

(III) The following add-on covers shall also be taken by the Contractor:

- i) Earthquake
- ii) Terrorism
- iii) Escalation cost (approximately @10% of sum insured on annual basis)
- iv) Extended Maintenance cover for Defect Liability Period
- v) Design Defect
- vi) Other add-on covers viz., 50-50 clause, 72 hours clause, loss minimization clause, waiver of subrogation clause (for projects of more than Rs.100 crores, cover for offsite storage/fabrication (over Rs.100 crores).

(IV) Third Party Liability cover with cross Liability within Geographical limits of India as on ADD-on cover to the basic EAR cover:

The third party liability add-on cover shall cover bodily injury or death suffered by third parties (including the Employer's personnel) and loss of or damage to property (including the Employer's property and any parts of the Facilities which have been accepted by the Employer) occurring in connection with supply and installation of the Facilities.

Amount	Deductible limits	Parties insured	From	To
<ul style="list-style-type: none"> • For projects upto Rs. 100 crores, the third party liability limit shall be 10% of the project value for single occurrence/ multiple occurrences in aggregate during the entire policy period. • For projects from Rs. 100 crores to Rs. 500 crores, the third party liability limit shall be Rs. 10 crores for single occurrence/multiple occurrences in aggregate during entire policy period. For projects of more than Rs.500 crores, the 	Nil	Contractor/ Sub-contractor	Receipt at site	Upto Defect Liability Period.

third party liability limit shall be Rs. 25 crores for single occurrence/ multiple occurrences in aggregate during entire policy period.				
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- (V) As per GCC Clause 30.8, the cost of insurance premium is to be reimbursed to the Contractor for Owner Supplied Materials (OSM) for which the insurer is to be finalized by the Contractor as detailed therein. Alternatively, the Contractor may take a single policy covering the entire cost of the project including the cost of OSM. For this purpose, the Contractor shall submit documentary evidence for the premium paid for the entire project to the Employer and Employer shall reimburse to the Contractor the proportion of premium equal to value of OSM to total sum insured.

If during the execution of Contract, the Employer requests the Contractor to take any other add-on cover(s)/ supplementary cover(s) in aforesaid insurance, in such a case, the Contractor shall promptly take such add-on cover(s)/ supplementary cover(s) and the charges towards such premium for such add-on cover(s)/ supplementary cover(s) shall be reimbursed to the Contractor on submission documentary evidence of payment to the Insurance company. Therefore, charges towards premium for such add-on cover(s)/ supplementary cover(s) are not included in the Contract Price.

(c) Automobile Liability Insurance

The Contractor shall ensure that all the vehicles deployed by the Contractor or its Subcontractors (whether or not owned by them) in connection with the supply and installation of the Facilities in the project are duly insured as per RTA act. Further the Contractor or its Subcontractors may also take comprehensive policy (own damage plus third party liability) of each individual vehicles deployed in the project on their own discretion in their own name to protect their own interest.

(d) Workmen Compensation Policy:

- (I) Workmen Compensation Policy shall be taken by the Contractor in accordance with the statutory requirement applicable in India. The Contractor shall ensure that all the workmen employed by the Contractor or its Subcontractors for the project are adequately covered under the policy.
- (II) The policy may either be project specific covering all men of the Contractor and its Subcontractors. The policy shall be kept valid till the date of Operational Acceptance of the project.

Alternatively, if the Contractor has an existing 'Workmen Compensation Policy' for all its employees including that of the Subcontractor(s), the Contractor must include the interest of the Employer for this specific Project in its existing 'Workmen Compensation Policy'.

- (III) Without relieving the Contractor of its obligations and responsibilities under this Contract, before commencing work the Contractor shall insure against liability for death of or injury to persons employed by the Contractor including liability by statute and at common law. The insurance cover shall be maintained until all work including remedial work is completed including the Defect Liability Period. The insurance shall be extended to indemnify the Principal for the Principal's statutory liability to persons employed by the Contractor.

The Contractor shall also ensure that each of its Subcontractors shall effect and maintain insurance on the same basis as the 'Workmen Compensation Policy' effected by the Contractor.

(e) Contractor's Plant and Machinery (CPM) Insurance

The Employer (including without limitation any consultant, servant, agent or employee of the Employer) shall not in any circumstances be liable to the Contractor for any loss of or damage to any of the Contractor's Equipment or for any losses, liabilities, costs, claims, actions or demands which the Contractor may incur or which may be made against it as a result of or in connection with any such loss or damage.

The Employer shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 30.1, except for the Third Party Liability, Workmen Compensation Policy Insurances, and the Contractor's Subcontractors shall be named as co-insureds under all insurance policies taken out by the Contractor pursuant to GCC Sub-Clause 30.1 except for the Cargo Insurance During Transport and Workmen Compensation

Policy Insurances. All insurer's rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies.

B) Insurances to be taken out by the Employer

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

Amount	Deductible limits	Parties Insured	From	To
_____ NIL _____				

-- End --

Appendix-4 : TIME SCHEDULE

1. The Project Completion Schedule shall be as follows:

Sl. No.	Activities	Duration in Months from the effective date of Contract
	Taking Over by the Employer upon successful Completion of:	
1.	Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under DDUGJY/IPDS [Specification No.:XXXXXXX].	24 (Twenty Four) 25% work should get completed within 9 months, 25% balance works should get completed in next 5 months, 25% balance works should get completed in next 5 months and final 25% balance works should get completed in next 5 months. However, all Un-electrified villages covered under the package shall be electrified within 6 months from date of Letter of Intent (LoI).

1.1 The activity(ies) under the Contractor's programme for Project Completion shall be in the form a PERT chart and shall identify the various activities like engineering, vendor finalization, placement of orders to sub-vendors, survey, Resource mobilization, erection, testing & commissioning including submission of closure proposals. Format of PERT chart is enclosed at Annexure-A. The PERT Chart shall conform to the above Project Completion Schedule.

This PERT Chart shall be discussed and agreed before Award in line with above, engineering drawing and data submission schedule shall also be discussed and finalised before Award. Liquidated damages for delay in successful Completion of the Facilities or specific part thereof (where specific parts are specified in SCC) and Operational Acceptance at rates specified in Clause 21 of GCC shall be applicable beyond the date specified above.

1.2 The Employer reserves the right to request minor changes in the work schedule at the time of Award of Contract to the successful Bidder.

1.3 The successful Bidder shall be required to prepare detailed PERT Chart and finalise the same with the Employer as per the requirement, which shall form a part of the Contract.

Appendix-5 : LIST OF APPROVED SUBCONTRACTORS

Prior to award of Contract, the following details shall be completed indicating those sub-contractors proposed by the Bidder by Attachment to its bid that are approved by the Employer for engagement by the Contractor during the performance of the contract.

The following Subcontractors are approved for carrying out the item of the facilities indicated. Where more than one Subcontractor is listed, the Contractor is free to choose between them, but it must notify the Employer of its choice in good time prior to appointing any selected Subcontractor. In accordance with GCC Sub-Clause 15.1, the Contractor is free to submit proposals for Subcontractors for additional items from time to time. No Subcontracts shall be placed with any such Subcontractors for additional items until the Subcontractors have been approved in writing by the Employer and their names have been added to this list of Approved Subcontractors.

Item of Facilities	Approved Subcontractors	Nationality

Further, erection portion of the contract shall not be subcontracted without the prior approval of the Employer. However, such approval shall not be necessary for engaging labour.

Appendix-6 : SCOPE OF WORKS AND SUPPLY BY THE EMPLOYER

The following personnel, facilities, works and supplies will be provided/supplied by the Employer, and the provisions of GCC 6, 16, 17 and 20 as well as Employer responsibilities stated in technical specifications shall apply as appropriate.

All personnel, facilities, works and supplies will be provided by the Employer in good time so as not to delay the performance of the Contractor in accordance with the approved Time Schedule and Program of Performance pursuant to GCC Sub-Clause 14.2.

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

Personnel Charge to Contractor – None

-----NIL-----

Facilities Charge to Contractor - None except as noted

Electricity and Water Charge to Contractor - as noted

The Contractor shall be entitled to use for the purposes of the facilities such supplies of electricity and water as may be available on the Site and shall provide any apparatus necessary for such use. The Contractor shall pay the Employer at the applicable tariff plus Employer’s overheads, if any, for such use. Where such supplies are not available, the Contractor shall make his own arrangement for provision of any supplies he may require.

Works Charge to Contractor - None

-----NIL-----

Supplies Charge to Contractor – None

-----NIL-----

Appendix-7 : LIST OF DOCUMENTS FOR APPROVAL OR REVIEW

Pursuant to GCC Sub-Clause 16.3.1, the Contractor shall prepare, or cause its Subcontractor to prepare, and present to the Project Manager in accordance with the requirements of GCC Sub-Clause 14.2 (Program of Performance), the following documents for:

A. Approval

- 1.
- 2.
- 3.

B. Review

- 1.
- 2.
- 3.

Note:

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

Appendix-8 : GUARANTEES, LIQUIDATED DAMAGES FOR NON – PERFORMANCE

1. The equipment offered shall meet the rating and performance requirements stipulated in Technical Specification for various equipment or indicated in Data requirement.
2. The ratings and performance figures of the below mentioned equipment are guaranteed as per losses given in respective Indian Standard (up to date) by bidder.

Sl. No.	Description
A.	12/10/8/6.3/5/3.15/1.6 MVA 33/11kV, 3 ph. Power Transformer
B.	1000/630/500/315/200/100/63/25/16 KVA, 11/0.433kV, 3 phase Station & Distribution Transformer
C.	16/10KVA, 11/0.250kV, 1 phase Distribution Transformer

3. If the aforementioned guarantees are not established at factory tests, then the Employer shall reject the equipment.

6. PERFORMANCE SECURITY FORM

Bank Guarantee No.

Date.....

Contract No.....

.....[Name of Contract].....

To:[Name and address of Employer]

Dear Ladies and/or Gentlemen,

We refer to the Contract ("the Contract") signed on(insert date of the Contract)..... between M/s. XXXXX (Name of Employer), having its Registered Office at XXXXX (Registered Address of employer) ("the Employer"/" XXXXX (Name of Employer)") on behalf of XXXX (Name of owner) (hereinafter referred to as 'XXXX (Short Name of Owner)' / 'Owner'), and M/s (Name of Contractor), having its Principal place of business at(Address of Contractor) and Registered Office at(Registered address of Contractor) ("the Contractor") concerning (Indicate brief scope of work) for the complete execution of the (insert name of Package alongwith name of the Project)..... [Applicable for Bank Guarantees issued by Contractor/Associate for those Contracts awarded to them]

Or

We refer to the Contract signed on(insert date of the Contract)..... between M/s. XXXXX (Name of Employer), having its Registered Office at XXXXX (Registered Address of employer) ("the Employer"/" XXXXX (Name of Employer)") on behalf of XXXX (Name of owner) (hereinafter referred to as 'XXXX (Short Name of Owner)' / 'Owner'), and M/s (Name of Contractor), having its Principal place of business at(Address of Contractor) and Registered Office at(Registered address of Contractor) ("the Contractor") and the Contract ("the Contract") signed on(insert date of the Contract)..... between XXXXX (Name of Employer)on behalf of Owner and M/s (Name of Associate), having its Principal place of business at(Address of Associate) and Registered Office at(Registered address of Associate), the Associate of the Contractor for executing the Facilities concerning (Indicate brief scope of work) for the complete execution of the (insert name of Package alongwith name of the Project)..... [Applicable for Bank Guarantees to be issued by Contractor against those Contracts awarded to their Associate]

By this letter we, the undersigned,(insert name & address of the issuing bank), a Bank (which expression shall include its successors, administrators, executors and assigns) organized under the laws of and having its Registered/Head Office at(insert address of registered office of the bank)..... do hereby irrevocably guarantee payment to the Employer up to i.e., Ten percent (10%) of the Contract Price until ninety (90) days beyond the Defect Liability Period i.e., upto and inclusive of (dd/mm/yy).

We undertake to make payment under this Letter of Guarantee upon receipt by us of your first written demand signed by the Employer duly authorized officer or the authorized officer of Owner declaring the Contractor to be in default under the Contract and without cavil or argument any sum or sums within the above named limits, without your need to prove or show grounds or reasons for your demand and without the right of the Contractor to dispute or question such demand.

Our liability under this Letter of Guarantee shall be to pay to the Employer whichever is the lesser of the sum so requested or the amount then guaranteed hereunder in respect of any demand duly made hereunder prior to

expiry of the Letter of Guarantee, without being entitled to inquire whether or not this payment is lawfully demanded.

This letter of Guarantee shall remain in full force and shall be valid from the date of issue until ninety (90) days beyond the Defect Liability Period of the Facilities i.e. upto and inclusive of (dd/mm/yy) and shall be extended from time to time for such period (not exceeding one year), as may be desired by M/s. on whose behalf this Letter of Guarantee has been given.

Except for the documents herein specified, no other documents or other action shall be required, notwithstanding any applicable law or regulation.

Our liability under this Letter of Guarantee shall become null and void immediately upon its expiry, whether it is returned or not, and no claim may be made hereunder after such expiry or after the aggregate of the sums paid by us to the Employer shall equal the sums guaranteed hereunder, whichever is the earlier.

All notices to be given under shall be given by registered (airmail) posts to the addressee at the address herein set out or as otherwise advised by and between the parties hereto.

We hereby agree that any part of the Contract may be amended, renewed, extended, modified, compromised, released or discharged by mutual agreement between you and the Contractor, and this security may be exchanged or surrendered without in any way impairing or affecting our liabilities hereunder without notices to us and without the necessity for any additional endorsement, consent or guarantee by us, provided, however, that the sum guaranteed shall not be increased or decreased.

No action, event or condition which by any applicable law should operate to discharge us from liability hereunder shall have any effect and we hereby waive any right we may have to apply such law so that in all respects our liability hereunder shall be irrevocable and, except as stated herein, unconditional in all respects.

For and on behalf of the Bank

[Signature of the authorised signatory(ies)]

Signature_____

Name_____

Designation_____

POA Number_____

Contact Number(s): Tel._____ Mobile_____

Fax Number_____

email _____

Common Seal of the Bank_____

Witness:

Signature_____

Name_____

Address_____

Contact Number(s): Tel._____ Mobile_____

email _____

Note :

1. For the purpose of executing the Bank Guarantee, the non-judicial stamp papers of appropriate value shall be purchased in the name of Bank who issues the 'Bank Guarantee'.
2. The Bank Guarantee shall be signed on all the pages by the Bank Authorities indicating their POA nos. and should invariably be witnessed.
3. The Bank Guarantee should be in accordance with the proforma as provided. However, in case the issuing bank insists for additional paragraph for limitation of liability, the following may be added at the end of the proforma of the Bank Guarantee [i.e., end paragraph of the Bank Guarantee preceding the signature(s) of the issuing authority(ies) of the Bank Guarantee]:

Quote

"Notwithstanding anything contained herein:

1. Our liability under this Bank Guarantee shall not exceed _____ (value in figures) _____ [_____ (value in words) _____].
2. This Bank Guarantee shall be valid upto _____ (validity date) _____.
3. We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only & only if we receive a written claim or demand on or before _____ (validity date) _____."

Unquote

7. BANK GUARANTEE FORM FOR ADVANCE PAYMENT

Bank Guarantee No.

Date.....

Contract No.....

.....[Name of Contract].....

To: [Name and address of the Employer]

Dear Ladies and/or Gentlemen,

We refer to the Contract ("the Contract") signed on(insert date of the Contract)..... between you and M/s (Name of Contractor), having its Principal place of business at(Address of Contractor) and Registered Office at(Registered address of Contractor) ("the Contractor") concerning (Indicate brief scope of work) for the complete execution of the (insert name of Package alongwith name of the Project).....

Whereas, in accordance with the terms of the said Contract, the Employer has agreed to pay or cause to be paid to the Contractor an Advance Payment in the amount of(Amount in figures and words).....

By this letter we, the undersigned,(insert name & address of the issuing bank), a Bank (which expression shall include its successors, administrators, executors and assigns) organized under the laws of and having its Registered/Head Office at(insert address of registered office of the bank)..... do hereby irrevocably guarantee repayment of the said amounts upon the first demand of the Employer without cavil or argument in the event that the Contractor fails to commence or fulfill its obligations under the terms of the said Contract, and in the event of such failure, refuses to repay all or part (as the case may be) of the said advance payment to the Employer.

Provided always that the Bank's obligation shall be limited to an amount equal to the outstanding balance of the advance payment, taking into account such amounts, which have been repaid by the Contractor from time to time in accordance with the terms of payment of the said Contract as evidenced by appropriate payment certificates.

This Guarantee shall remain in full force from the date upon which the said advance payment is received by the Contractor upto ninety (90) days beyond the date on which the entire advance so advanced alongwith the interest if any due thereon has been fully adjusted in terms of the Contract i.e., upto of ninety (90) days beyond the date of Completion of the Facilities under the Contract. This Guarantee may be extended from time to time, as may be desired by M/s. on whose behalf this Guarantee has been issued.

Any claims to be made under this Guarantee must be received by the Bank during its period of validity, i.e. upto ninety (90) days beyond the date of Completion of the Facilities by the Employer i.e. upto and inclusive of (dd/mm/yy).

For and on behalf of the Bank

[Signature of the authorised signatory(ies)]

Signature_____

Name_____

Designation_____

POA Number_____

Contact Number(s): Tel._____ Mobile_____

Fax Number_____

email _____

Common Seal of the Bank_____

Witness:

Signature_____

Name_____

Address_____

Contact Number(s): Tel._____ Mobile_____

email _____

Note:

1. For the purpose of executing the Bank Guarantee, the non-judicial stamp papers of appropriate value shall be purchased in the name of Bank who issues the 'Bank Guarantee'.
2. The Bank Guarantee shall be signed on all the pages by the Bank Authorities indicating their POA nos. and should invariably be witnessed.
3. The Bank Guarantee should be in accordance with the proforma as provided. However, in case the issuing bank insists for additional paragraph for limitation of liability, the following may be added at the end of the proforma of the Bank Guarantee [i.e., end paragraph of the Bank Guarantee preceding the signature(s) of the issuing authority(ies) of the Bank Guarantee]:

Quote

"Notwithstanding anything contained herein:

1. Our liability under this Bank Guarantee shall not exceed _____ (value in figures)_____ [_____ (value in words)_____].
2. This Bank Guarantee shall be valid upto _____(validity date)_____.
3. We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only & only if we receive a written claim or demand on or before _____ (validity date) _____."

Unquote

8. FORM OF TAKING OVER CERTIFICATE

Date.....
Name of Contract.....
Contract No.....

To :

(Name and address of the Contractor)

Dear Ladies and/or Gentlemen,

Pursuant to GCC 20 (Completion of the Facilities) of the General Conditions of the Contract entered into between yourselves and the Employer dated relating to the (insert brief description of the Facilities)..... we hereby notify you that the following part(s) of the Facilities was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Employer hereby takes over the said part(s) of the Facilities, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below :

1. Description of the Facilities or part thereof
2. Date of Completion :.....

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defects Liability Period.

Very truly yours,

Title
(Project Manager)

9. FORM OF INDEMNITY BOND TO BE EXECUTED BY THE CONTRACTOR FOR THE EQUIPMENT HANDED OVER IN ONE LOT BY(abbreviated name of the Employer)..... FOR PERFORMANCE OF ITS CONTRACT

INDEMNITY BOND

THIS INDEMNITY BOND is made this..... day of 20..... by a Company registered under the Companies Act, 1956/2013 (with amendment from time to time)/Partnership firm/proprietary concern having its Registered Office at.....(hereinafter called as 'Contractor' or "Obligor" which expression shall include its successors and permitted assigns) in favour of (insert name of the Employer)....., a Company incorporated under the Companies Act, 1956/2013 (with amendment from time to time) having its Registered Office at(insert registered address of the Employer) and its project at (hereinafter called ".....(abbreviated name of the Employer)....." which expression shall include its successors and assigns):

WHEREAS(abbreviated name of the Employer)..... has awarded to the Contractor a Contract for..... vide its Notification of Award/Contract No..... dated..... and its Amendment No. (applicable when amendments have been issued) (hereinafter called the "Contract") in terms of which(abbreviated name of the Employer)..... is required to hand over various Equipment to the Contractor for execution of the Contract.

And WHEREAS by virtue of Clause No.....of the said Contract, the Contractor is required to execute an Indemnity Bond in favour of(abbreviated name of the Employer)..... for the Equipment handed over to it by(abbreviated name of the Employer)..... for the purpose of performance of the Contract/Erection portion of the contract (hereinafter called the "Equipment").

AND THEREFORE, This Indemnity Bond witnesseth as follows:

1. That in consideration of various Equipment as mentioned in the Contract, valued at (amount in words.....) handed over to the Contractor for the purpose of performance of the Contract, the Contractor hereby undertakes to indemnify and shall keep(abbreviated name of the Employer)..... indemnified, for the full value of the Equipment. The Contractor hereby acknowledges receipt of the Equipment as per despatch title documents handed over to the Contractor duly endorsed in their favour and detailed in the Schedule appended hereto. It is expressly understood by the Contractor that handing over of the despatch title documents in respect of the said Equipments duly endorsed by(abbreviated name of the Employer)..... in favour of the Contractor shall be construed as handing over of the Equipment purported to be covered by such title documents and the Contractor shall hold such Equipment in trust as a Trustee for and on behalf of(abbreviated name of the Employer).....
2. That the Contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the Equipment at(abbreviated name of the Employer)..... project Site against all risks whatsoever till the Equipment are duly used/erected in accordance with the terms of the Contract and the Plant/Package duly erected and commissioned in accordance with the terms of the Contract, is taken over by(abbreviated name of the Employer)..... The Contractor undertakes to keep(abbreviated name of the Employer)..... harmless against any loss or damage that may be caused to the Equipment.
3. The Contractor undertakes that the Equipment shall be used exclusively for the performance/execution of the Contract strictly in accordance with its terms and conditions and no part of the equipment shall be utilised for any other work of purpose whatsoever. It is clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal/penal consequences.

4. That(abbreviated name of the Employer)..... is and shall remain the exclusive Employer of the Equipment free from all encumbrances, charges or liens of any kind, whatsoever. The equipment shall at all times be open to inspection and checking by the Employee or Employer's Representative in this regard. Further,(abbreviated name of the Employer)..... shall always be free at all times to take possession of the Equipment in whatever form the equipment may be, if in its opinion, the Equipment are likely to be endangered, misutilised or converted to uses other than those specified in the Contract, by any acts of omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions of demand of(abbreviated name of the Employer)..... to return the equipment without any demur or reservation.

5. That this indemnity Bond is irrevocable. If at any time any loss or damage occurs to the Equipment or the same or any part thereof is misutilised in any manner whatsoever, then the Contractor hereby agrees that the decision of the Employer's Representative as to assessment of loss or damage to the Equipment shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Equipment at his own cost and/or shall pay the amount of loss to(abbreviated name of the Employer)..... without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to(abbreviated name of the Employer)..... against the Contractor under the Contract and under this Indemnity Bond.

6. NOW THE CONDITION of this Bond is that if the Contractor shall duly and punctually comply with the terms and conditions of this Bond to the satisfaction of(abbreviated name of the Employer)....., THEN, the above Bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorized representative under the common seal of the Company, the day, month and year first above mentioned.

SCHEDULE

Particulars of the Equipment handed over	Quantity	Particulars of Despatch title Documents		Value of the Equipment	Signature of the Attorney in token of receipt
		RR/GR No. date of lading	Carrier		

For and on behalf of
M/s.....

WITNESS

1. Signature.....
Name.....
Address.....

2. Signature.....
Name.....
Address.....

- Signature.....
Name.....
Address.....
- Authorised representative

(Common Seal)

(In case of Company)

Indemnity Bonds are to be executed by the authorised person and (i) in case of contracting Company under common seal of the Company or (ii) having the power of attorney issued under common seal of the company with authority to execute Indemnity Bonds, (iii) In case of (ii), the original Power of Attorney if it is specifically for this Contract or a Photostat copy of the Power of Attorney if it is General Power of Attorney and such documents should be attached to Indemnity Bond.

10. FORM OF INDEMNITY BOND TO BE EXECUTED BY THE CONTRACTOR FOR THE EQUIPMENT HANDED OVER IN INSTALLMENTS BY(abbreviated name of the Employer)..... FOR PERFORMANCE OF ITS CONTRACT

INDEMNITY BOND

THIS INDEMNITY BOND is made this day of 20..... by a Company registered under the Companies Act, 1956/2013 (with amendment from time to time)/Partnership firm/proprietary concern having its Registered Office at(hereinafter called as 'Contractor' or 'Obligor' which expression shall include its successors and permitted assigns) in favour of (insert name of the Employer)....., a company incorporated under the Companies Act, 1956/2013 (with amendment from time to time) having its Registered Office at(insert registered address of the Employer)..... and its project at (hereinafter called ".....(abbreviated name of the Employer)....." which expression shall include its successors and assigns):

WHEREAS(abbreviated name of the Employer)..... has awarded to the Contractor a Contract forvide its Notification of Award/Contract No. datedand Amendment No. (applicable when amendments have been issued) (hereinafter called the "Contract") in terms of which(abbreviated name of the Employer)..... is required to handover various Equipment to the Contractor for execution of the Contract.

AND WHEREAS by virtue of Clause No.....of the said Contract, the Contractor is required to execute an Indemnity Bond in favour of(abbreviated name of the Employer)..... for the Equipment handed over to it by(abbreviated name of the Employer)..... for the purpose of performance of the contract/Erection portion of the Contract (hereinafter called the "Equipment".)

NOW THEREFORE, This Indemnity Bond witnesseth as follows:

1. That in consideration of various Equipments as mentioned in the Contract, valued at (amount in words _____) to be handed over to the Contractor in installments from time to time for the purpose of performance of the contract, the Contractor hereby undertakes to indemnify and shall keep(abbreviated name of the Employer)..... indemnified, for the full value of Equipment. The Contractor hereby acknowledges receipt of the initial installment of the equipment per details in the schedule appended hereto. Further, the Contractor agrees to acknowledge receipt of the subsequent installments of the Equipment as required by(abbreviated name of the Employer)..... in the form of Schedules consecutively numbered which shall be attached to this Indemnity bond so as to form integral parts of this Bond. It is expressly understood by the Contractor that handing over the despatch title documents in respect of the said Equipments duly endorsed by(abbreviated name of the Employer)..... in favour of the Contractor shall be construed as handing over the Equipment purported to be covered by such title documents and the Contractor shall hold such Equipments in trust as a Trustee for and on behalf of(abbreviated name of the Employer).....

2. That the Contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the Equipment at(abbreviated name of the Employer)..... project Site against all risks whatsoever till the Equipment are duly used/erected in accordance with the terms of the Contract and the Plant/Package duly erected and commissioned in accordance with the terms of the Contract, is taken over by(abbreviated name of the Employer)..... The Contractor undertakes to keep(abbreviated name of the Employer)..... harmless against any loss or damage that may be caused to the Equipment.

3. The Contractor undertakes that the Equipment shall be used exclusively for the performance/execution of the Contract strictly in accordance with its terms and conditions and no part of the equipment shall be utilised for any other work or purpose whatsoever. It is clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia

constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal/penal consequences.

4. That(abbreviated name of the Employer)..... is and shall remain the exclusive Employer of the Equipment free from all encumbrances, charges or liens of any kind, whatsoever. The equipment shall at all times be open to inspection and checking by the Employer or Employer's Representative in this regard. Further,(abbreviated name of the Employer)..... shall always be free at all times to take possession of the Equipment in whatever form the Equipment may be, if in its opinion, the Equipment are likely to be endangered, misutilised or converted to uses other than those specified in the Contract, by any acts of omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions of demand of(abbreviated name of the Employer)..... to return the equipment without any demur or reservation.

5. That this indemnity Bond is irrevocable. If at any time any loss or damage occurs to the Equipment or the same or any part thereof is misutilised in any manner whatsoever, then the Contractor hereby agrees that the decision of the Employer's Representative as to assessment of loss or damage to the Equipment shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Equipment at its own cost and/or shall pay the amount of loss to(abbreviated name of the Employer)..... without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to(abbreviated name of the Employer)..... against the Contractor under the Contract and under this Indemnity Bond.

6. NOW THE CONDITION of this Bond is that if the Contractor shall duly and punctually comply with the terms and conditions of this Bond to the satisfaction of(abbreviated name of the Employer)....., THEN, the above Bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorised representative under the common seal of the Company, the day, month and year first above mentioned.

SCHEDULE No. 1

Particulars of the Equipment handed over	Quantity	Particulars of Despatch title Documents		Value of the Equipment	Signature of the Attorney in token of receipt
		RR/GR No. date of lading	Carrier		

For and on behalf of
M/s.....

WITNESS

1. Signature.....
Name.....
Address.....

Signature.....
Name.....
Address.....

2. Signature.....

Authorised representative

Name.....

(Common Seal)

Address.....

(In case of Company)

Indemnity Bonds are to be executed by the authorised person and (i) in case of contracting Company under common seal of the Company or (ii) having the power of attorney issued under common seal of the company with authority to execute Indemnity Bonds, (iii) In case of (ii), the original Power of Attorney if it is specifically for this Contract or a photostat copy of the Power of Attorney if it is General Power of Attorney and such documents should be attached to Indemnity Bond.

11. FORM OF AUTHORISATION LETTER

Ref. No:

Date :

To

M/s.....
.....
.....

REF.: Contract No. dated for awarded by(insert name of the Employer).....

Dear Sir,

Kindly refer to Contract No. dated for You are hereby authorised on behalf of (Name of Employer)..... a company incorporated under the laws of Companies Act 1956/2013 (with amendment from time to time) and having its Registered Office at(registered address of the Employer) and its Project at to take physical delivery of materials/equipments covered under Despatch Document/Consignment Note No.* datedand as detailed in the enclosed schedule for the sole purpose of successful performance of the aforesaid contract and for no other purpose, whatsoever.

(Signature of Project Authority)**

Designation.....

Date.....

Encl: As Above.

** To be signed not below the rank of Manager.

* Mention LR/RR No.

Schedule of Material/Equipment covered under Despatch Title Document (RR No./LR No.)

Sl. No.	Contract Name	NOA No./ CA No.	Description of Materials/ Equipments	Spec. No.	Qty.	Value	Remarks

(Signature of the Project Authority)

(Designation)

(Date)

12. FORM OF TRUST RECEIPT FOR PLANT, EQUIPMENT AND MATERIALS RECEIVED

We M/s.(insert name of the Contractor) having our Principal place of business at having been awarded a Contract No. dated for (insert Package name alongwith name of the Project)..... by(insert name of the Employer)

We do hereby acknowledge the receipt of the Plant, Equipment and Materials as are fully described and mentioned under Documents of Title/RR/LR etc. and in the schedule annexed hereto, which shall form an integral part of this receipt as "Trustee" of (insert name of the Employer)..... The aforesaid materials etc. so received by us shall be exclusively used in the successful performance of the aforesaid Contract and for no other purpose whatsoever. We undertake not to create any charge, lien or encumbrance over the aforesaid materials etc, in favour of any other person/institution(s)/Banks.

For M/s
(Contractor's Name)

Dated :

(AUTHORISED SIGNATORY)

Place :

SEAL OF COMPANY

13. FORM OF EXTENSION OF BANK GUARANTEE

Ref. No.....

Dated:.....

To: [Name and address of the Employer]

Dear Sirs,

Sub.: Extension of Bank Guarantee No. dated for, issued to you on behalf of M/s.(insert name of the Contractor) in respect of Contract No. dated for (insert name of the Package alongwith the Project name) (hereinafter called original Bank Guarantee).

At the request of M/s..... (insert name of the Contractor), We(insert name & address of the issuing bank), a Bank organized under the laws of and having its Registered/Head Office at(insert address of registered office of the bank)..... do hereby extend our liability under the above-mentioned Guarantee No. Dated for a further period of Years/Months from to expire on Except as provided above, all other terms and conditions of the original Bank Guarantee No. dated shall remain unaltered and binding.

Please treat this as an integral part of the original Guarantee to which it would be attached.

For and on behalf of the Bank

[Signature of the authorised signatory(ies)]

Signature_____

Name_____

Designation_____

POA Number_____

Contact Number(s): Tel._____ Mobile_____

Fax Number_____

email _____

Common Seal of the Bank_____

Witness:

Signature_____

Name_____

Address_____

Contact Number(s): Tel._____ Mobile_____

email _____

Note:

1. For the purpose of executing the Bank Guarantee, the non-judicial stamp papers of appropriate value shall be purchased in the name of Bank who issues the 'Bank Guarantee'.
2. The Bank Guarantee shall be signed on all the pages by the Bank Authorities indicating their POA nos. and should invariably be witnessed.

14. FORM OF POWER OF ATTORNEY FOR JOINT VENTURE

KNOW ALL MEN BY THESE PRESENTS THAT WE , the Partners whose details are given hereunder have formed a Joint Venture under the laws of and having our Registered Office(s)/Head Office(s) at (hereinafter called the 'Joint Venture' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assigns) acting through M/s being the Partner in-charge do hereby constitute, nominate and appoint M/s..... a Company incorporated under the laws of and having its Registered/Head Office at as our duly constituted lawful Attorney (hereinafter called "Attorney" or "Authorised Representative" or "Partner In-charge") to exercise all or any of the powers for and on behalf of the Joint Venture in regard to Specification No..... Package the bids for which have been invited by (insert name of the Employer alongwith address) (hereinafter called the 'Employer') to undertake the following acts :

- i) To submit proposal and participate in the aforesaid Bid Specification of the Employer on behalf of the "Joint Venture".
- ii) To negotiate with the Employer the terms and conditions for award of the Contract pursuant to the aforesaid Bid and to sign the Contract with the Employer for and on behalf of the "Joint Venture".
- iii) To do any other act or submit any document related to the above.
- iv) To receive, accept and execute the Contract for and on behalf of the "Joint Venture".

It is clearly understood that the Partner In-charge (Lead Partner) shall ensure performance of the Contract(s) and if one or more Partner fail to perform their respective portions of the Contract(s), the same shall be deemed to be a default by all the Partners.

It is expressly understood that this Power of Attorney shall remain valid binding and irrevocable till completion of the Defect Liability Period in terms of the Contract.

The Joint Venture hereby agrees and undertakes to ratify and confirm all the whatsoever the said Attorney/Authorised Representatives/Partner in-charge quotes in the bid, negotiates and signs the Contract with the Employer and/or proposes to act on behalf of the Joint Venture by virtue of this Power of Attorney and the same shall bind the Joint Venture as if done by itself.

IN WITNESS THEREOF the Partners Constituting the Joint Venture as aforesaid have executed these presents on this day of under the Common Seal(s) of their Companies.

for and on behalf of the
Partners of Joint Venture

.....
.....
.....

The Common Seal of the above Partners of the Joint Venture:

The Common Seal has been affixed there unto in the presence of:

WITNESS

1. Signature.....

Name

Designation

Occupation

2. Signature.....

Name

Designation

Occupation

Note:

1. For the purpose of executing the Agreement, the non-judicial stamp papers of appropriate value shall be purchased in the name of Joint Venture.
2. The Agreement shall be signed on all the pages by the authorised representatives of each of the partners and should invariably be witnessed.

15. FORM OF UNDERTAKING BY THE JOINT VENTURE PARTNERS

THIS JOINT DEED OF UNDERTAKING executed on this..... day of..... Two Thousand and..... by a company incorporated under the laws of and having its Registered Office at(hereinafter called the "Party No.1" which expression shall include its successors, executors and permitted assigns) and M/s.....a company incorporated under the laws of and having its Registered Office at (hereinafter called the "Party No.2" which expression shall include its successors, executors and permitted assigns) and M/s..... a Company incorporated under the laws of and having its Registered Office at (hereinafter called the "Party No.3" which expression shall include its successors, executors and permitted assigns) for the purpose of making a bid and entering into a contract [hereinafter called the "Contract" {in case of award}] against the Specification No..... for (insert name of the package alongwith project name)of (insert names of the Employer), a Company incorporated under the Companies Act of1956/2013 (with amendment from time to time) having its registered office at(insert registered address of the Employer)..... (hereinafter called the "Employer").

WHEREAS the Party No.1, Party No.2 and Party No.3 have entered into an Agreement dated.....

AND WHEREAS the Employer invited bids as per the above mentioned Specification for the design, manufacture, supply, erection, testing and commissioning of Equipment/ Materials stipulated in the Bidding Documents under (insert name of the package alongwith project name)

AND WHEREAS Clause 9.3, Section-ITB and BDS (documents establishing the Qualification of Bidder) & Qualification Criteria in Annexure-A to BDS forming part of the Bidding Documents, inter-alia stipulates that an Undertaking of two or more qualified manufacturers as partners, meeting the requirements of Qualification Criteria in Annexure-A to BDS, as applicable may bid, provided, the Joint Venture fulfills all other requirements under Clause 9.3 (c) of ITB and Qualification Criteria in Annexure-A to BDS and in such a case, the Bid Forms shall be signed by all the partners so as to legally bind all the Partners of the Joint Venture, who will be jointly and severally liable to perform the Contract and all obligations hereunder.

The above clause further states that this Undertaking shall be attached to the bid and the Contract performance guarantee will be as per the format enclosed with the Bidding Documents without any restrictions or liability for either party.

AND WHEREAS the bid is being submitted to the Employer vide proposal No.....dated by Party No.1 based on this Undertaking between all the parties; under these presents and the bid in accordance with the requirements of Clause 9.3, Section-ITB and BDS (documents establishing the Qualification of Bidder) & Qualification Criteria in Annexure-A to BDS, has been signed by all the parties.

NOW THIS UNDERTAKING WITNESSETH AS UNDER:

In consideration of the above premises and agreements all the parties of this Deed of Undertaking do hereby declare and undertake:

1. In requirement of the award of the Contract by the Employer to the Joint Venture Partners, we, the Parties do hereby undertake that M/s..... the Party No.1, shall act as Lead Partner and further declare and confirm that we the parties to the Joint Venture shall jointly and severally be bound unto the Employer for the successful performance of the Contract and shall be fully responsible for the design, manufacture, supply and successful performance of the equipment in accordance with the Contract:
2. In case of any breach or default of the said Contract by any of the parties to the Joint Venture, the party(s) do hereby undertake to be fully responsible for the successful performance of the Contract and to carry out all the obligations and responsibilities under the Contract in accordance with the requirements of the Contract.

3. Further, if the Employer suffers any loss or damage on account of any breach in the Contract or any shortfall in the performance of the equipment in meeting the performances guaranteed as per the specification in terms of the Contract, the Party(s) of these presents undertake to promptly make good such loss or damages caused to the Employer, on its demand without any demur. It shall not be necessary or obligatory for the Employer to proceed against Lead Partner to these presents before proceeding against or dealing with the other Party(s), the Employer can proceed against any of the parties who shall be jointly and severally liable for the performance and all other liabilities/obligations under the Contract to the Employer.
4. The financial liability of the Parties of this Deed of Undertaking to the Employer, with respect to any of the claims rising out of the performance or non-performance of the obligations set forth in this Deed of Undertaking, read in conjunction with the relevant conditions of the Contract shall, however not be limited in any way so as to restrict or limit the liabilities or obligations of any of the Parties of this Deed of Undertaking.
5. It is expressly understood and agreed between the Parties to this Undertaking that the responsibilities and obligations of each of the Parties shall be as delineated in Appendix – I (to be suitably appended by the Parties alongwith this Undertaking in its bid) to this Deed of Undertaking. It is further undertaken by the parties that the above sharing of responsibilities and obligations shall not in any way be a limitation of joint and several responsibilities of the Parties under the Contract.
6. It is also understood that this Undertaking is provided for the purposes of undertaking joint and several liabilities of the partners to the Joint Venture for submission of the bid and performance of the Contract and that this Undertaking shall not be deemed to give rise to any additional liabilities or obligations, in any manner or any law, on any of the Parties to this Undertaking or on the Joint Venture, other than the express provisions of the Contract.
7. This Undertaking shall be construed and interpreted in accordance with the provisions of the Contract.
8. In case of an award of a Contract, we the parties to this Deed of Undertaking do hereby agree that we shall be jointly and severally responsible for furnishing a Contract performance security from a bank in favour of the Employer in the currency/currencies of the Contract.
9. It is further agreed that this Deed of Undertaking shall be irrevocable and shall form an integral part of the bid and shall continue to be enforceable till the Employer discharges the same or upon the completion of the Contract in accordance with its provisions, whichever is earlier. It shall be effective from the date first mentioned above for all purposes and intents.

IN WITNESS WHEREOF, the Parties to this Deed of Undertaking have through their authorised representatives executed these presents and affixed Common Seals of their companies, on the day, month and year first mentioned above.

Common Seal of
has been affixed in my/ our
presence pursuant to Board of
Director's Resolution dated

For Lead Partner (Party No.-1)
For and on behalf of M/s
.....

Name

Designation

Signature

(Signature of the authorized
representative)

WITNESS :

I.

II.

Common Seal of
has been affixed in my/ our
presence pursuant to Board of
Director's Resolution dated

For Party No.-2
For and on behalf of M/s.....

(Signature of the authorized
representative)

Name

Designation

Signature

WITNESS :

I.

II.

Common Seal of
has been affixed in my/ our
presence pursuant to Board of
Director's Resolution dated

For Party No.-3
For and on behalf of M/s.
.....

(Signature of the authorized
representative)

Name

Designation

Signature

WITNESS :

I.

II.

Note:

1. For the purpose of executing the Joint Deed of Undertaking, the non-judicial stamp papers of appropriate value shall be purchased in the name of Joint Venture.
2. The Undertaking shall be signed on all the pages by the authorised representatives of each of the partners and should invariably be witnessed.

16. FORMAT FOR EVIDENCE OF ACCESS TO OR AVAILABILITY OF CREDIT/FACILITIES

BANK CERTIFICATE

This is to certify that M/s. _____ (insert Name & Address of the Contractor) _____ who have submitted their bid to(insert name of the Employer)..... against their tender specification Vide ref. No. for (insert name of the package alongwith the project name) is our customer for the past years.

Their financial transaction with our Bank have been satisfactory. They enjoy the following fund based and non fund based limits including for guarantees, L/C and other credit facilities with us against which the extent of utilization as on date is also indicated below:

Sl. No.	Type of Facility	Sanctioned Limit as on Date	Utilisation as on Date

This letter is issued at the request of M/s. _____.

Signature _____

Name of Bank _____

Name of Authorised Signatory

Designation _____

Phone No. _____

Address _____

SEAL OF THE BANK

17. FORM OF OPERATIONAL ACCEPTANCE

Date.....

Name of Contract.....

Contract No.....

To :

(Name and address of the Contractor)

Dear Ladies and/or Gentlemen,

Pursuant to GCC 20 (Completion of the Facilities) of the General Conditions of the Contract entered into between yourselves and the Employer dated relating to the (insert brief description of the Facilities)..... we hereby notify you that the we System tests and Acceptance tests of the following part(s) of the Facilities were satisfactorily completed on the date specified below :

1. Description of the Facilities or part thereof
.....
2. Date of Operational Acceptance:.....

This letter does not relieve you of your obligation during the Defects Liability Period and Latent Defect warranty.

Very truly yours,

Title
(Project Manager)

18. FORM OF SAFETY PLAN TO BE SUBMITTED BY THE CONTRACTOR WITHIN SIXTY DAYS OF AWARD OF CONTRACT

[TO BE EXECUTED ON A NON JUDICIAL STAMP PAPER WORTH RS. TWENTY ONLY]

SAFETY PLAN

THIS SAFETY PLAN is made this day of 20..... by a Company registered under the Companies Act, 1956/2013 (with amendment from time to time)/Partnership firm/proprietary concern having its Registered Office at[to be modified suitably for JV Contractor] (hereinafter called as 'Contractor' which expression shall include its successors and permitted assigns) for approval of(insert name of the Employer)....., a company incorporated under the Companies Act, 1956/2013 (with amendment from time to time) having its Registered Office at(insert registered address of the Employer)..... for its Contract for (insert package name, project name alongwith Specification number of the Contract).....

WHEREAS(abbreviated name of the Employer)..... has awarded to the Contractor the aforesaid Contract vide its Notification of Award/Contract No. datedand Amendment No. (applicable when amendments have been issued) (hereinafter called the "Contract") in terms of which the Contractor is required to submit 'Safety Plan' alongwith certain documents to the Engineer In-Charge/Project Manager of the Employer within Sixty (60) days of Notification of Award for its approval.

NOW THEREFORE, the Contractor undertakes to execute the Contract as per the safety plan as follows:

1. THAT the Contractor shall execute the works as per provisions of Bidding Documents including those in regard to Safety Precautions / provisions as per statutory requirements.
2. THAT the Contractor shall execute the works in a well planned manner from the commencement of Contract as per agreed mile stones of work completion schedule so that planning and execution of construction works goes smoothly and consistently through out the contract duration without handling pressure in last quarter of the financial year/last months of the Contract and the shall be finalized in association with XXXX (Name of Employer) Engineer In-charge/Project Manager from time to time as required.
3. THAT the Contractor has prepared the safe work procedure for each activity i.e. foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc. to be executed at site, which is enclosed at Annexure – 1A (SP) for acceptance and approval of Engineer In-charge/Project Manager. The Contractor shall ensure that on approval of the same from Engineer In-charge/Project Manager , the approved copies will be circulated to Employer's personnel at site [Supervisor(s)/Executive(s)] and Contractor's personnel at site [Gang leader, supervisor(s) etc.] in their local language / language understood by gang.

THAT the Contractor has prepared minimum manpower deployment plan, activity wise as stated above, which is enclosed at Annexure – 1B (SP) for approval of Engineer In-charge/Project Manager.

4. THAT the Contractor shall ensure while executing works that they will deploy minimum 25% of their own experienced work force who are on the permanent roll of the company and balance 75% can be a suitable mixed with the hired gangs / local workers / casual workers if required. The above balance 75% work force should be provided with at least 10 days training by the construction agencies at sites and shall be issued with a certificate. No worker shall be engaged without a valid certificate. Hired gang workers shall also follow safe working procedures and safety norms as is being followed by company's workmen. It should also be ensured by the contractor that certified workers fitters who are climbing towers / doing stringing operations can be easily identifiable with a system like issue of Badge / Identification cards (ID cards) etc. Colour identification batches should be worn by the workers.

Contractor has to ensure that inexperience workers / unskilled workers should not be deployed for skilled job.

5. THAT the Contractor's Gang leader / Supervisor / Senior most member available at every construction site shall brief to each worker daily before start of work about safety requirement and warn about imminent dangers and precautions to be taken against the imminent dangers (Daily Safety Drill). This is to be ensured without fail by Contractor and maintain record of each gang about daily safety instructions issued to workers and put up to XXXX(Name of Employer) site In-charge for his review and record.
6. THAT the Contractor shall ensure that working Gangs at site should not be left at the discretion of their Gang Leaders who are generally hired and having little knowledge about safety. Gang leader should be experienced and well versed with the safe working procedures applicable for transmission line/ Sub Station works. In case gang is having Gang leader not on permanent roll of the company then additional Supervisor from company's own roll having thorough knowledge about the works would be deployed so as to percolate safety instructions upto the grass root level in healthy spirits. Contractor has to ensure close supervision while executing critical locations of transmission lines / sub stations and ensures that all safety instructions are in place and are being followed.
7. THAT the Contractor shall maintain in healthy and working condition all kind of Equipments / Machineries / Lifting tools / Lifting tackles / Lifting gears / All kind of Ropes including wire ropes / Polypropylene ropes etc. used for Lifting purpose during execution of the project and get them periodically examined and load tested for safe working load in accordance with relevant provisions and requirement of Building & other construction workers Regulation of Employment and Conditions of Services Act and Central Rule 1998 or latest, Factories Act 1948 or latest, Indian Electricity Act 2003 before start of the project. A register of such examinations and tests shall be properly maintained by the contractor and will be promptly produced as and when desired by the Engineer In-charge/Project Manager or by the person authorised by him. The Contractor has to ensure to give special attention on the formation / condition of eye splices of wire rope slings as per requirement of IS 2762 Specification for wire rope slings and sling legs.

THAT the Contractor has prepared a list of all Lifting machines, lifting Tools / Lifting Tackles / Lifting Gears etc. / All types of ropes and Slings which are subject to safe working load is enclosed at Annexure – 2 (SP) for review and approval of Engineer In-charge/Project Manager.

8. THAT the Contractor has to procure sufficient quantity of Personal Protective Equipment (PPE) conforming to Indian / International standards and provide these equipment to every workman at site as per need and to the satisfaction of Engineer-in-charge/Project Manager of XXXX (Name of the Employer). The Contractor's Site Supervisor/ Project Manager has to ensure that all workmen must use Personal Protective Equipment at site. The Contractor shall also ensure that Industrial Safety helmets are being used by all workmen at site irrespective of their working (at height or on ground). The Contractor shall further ensure use of safety shoes by all ground level workers and canvas shoes for all workers working at height, Rubber Gum Boots for workers working in rainy season and concreting job, Use of Twin Lanyard Full body Safety Harness with attachment of light weight such as aluminium alloy etc. and having features of automatic locking arrangement of snap hook, by all workers working at height for more than three meters and also for horizontal movement on tower shall be ensured by contractor. The Contractor shall not use ordinary half body safety harness at site. The Contractor has to ensure use of Retractable type fall arrestors by workers for ascending / descending on suspension insulator string and other similar works etc., Use of Mobile fall arrestor for ascending / descending from tower by all workers. The contractor has to provide cotton / leather hand gloves as per requirement, Electrical Resistance Hand gloves for operating electrical installations / switches, Face shield for protecting eyes while doing welding works and Dust masks to workers as per requirement. The Contractor will have to take action against the workers not using Personal Protective Equipment at site and those workers shall be asked to rest for that day and also their Salary be deducted for that day. XXXX (Name of the Employer) may issue warning letter to Project Manager of contractor in violation of above norms.

THAT the Contractor shall prepare a detailed list of PPEs, activity wise, to commensurate with manpower deployed, which is enclosed at Annexure – 3 (SP) for review and approval of Engineer In-charge/Project Manager. It shall also be ensured that the sample of these equipment shall be got approved from XXXX (Name of the Employer) supervisory staff before being distributed to workers. The contractor shall submit relevant test certificates as per IS / International Standard as applicable to PPEs used during execution of work. All the PPE's to be distributed to the workers shall be checked by XXXX (Name of the Employer) supervisory staff before its usage.

The Contractor also agrees for addition / modification to the list of PPE, if any, as advised by Engineer In-Charge/Project Manager.

9. THAT the Contractor shall procure, if required sufficient quantity of Earthing Equipment / Earthing Devices complying with requirements of relevant IEC standards (Generally IECs standards for Earthing Equipments / Earthing Devices are – 855, 1230, 1235 etc.) and to the satisfaction of Engineer In-Charge/Project Manager and contractor to ensures to maintained them in healthy condition.

THAT the Contractor has prepared / worked out minimum number of healthy Earthing Equipments with Earthing lead confirming to relevant IS / European standards per gang wise during stringing activity/as per requirement, which is enclosed herewith at Annexure – 4 (SP) for review and acceptance of Engineer In-Charge/Project Manager prior to execution of work.

10. THAT the Contractor shall provide communication facilities i.e. Walky – Talkie / Mobile Phone, Display of Flags / whistles for easy communication among workers during Tower erection / stringing activity, as per requirement.

11. THAT the Contractor undertakes to deploy qualified safety personnel responsible for safety as per requirements of Employer/Statutory Authorities.

THAT the Contractor employing more than 250 workmen whether temporary, casual, probationer, regular or permanent or on contract, shall employ at least one full time officer exclusively as qualified safety officer having diploma in safety to supervise safety aspects of the equipment and workmen who will coordinate with Engineer In-charge /Project Manager/Safety Co-ordinator of the Employer. In case of work being carried out through sub contractors the sub – contractor's workmen / employees will also be considered as the contractor's employees / workmen for the above purpose. If the number of workers are less than 250 then one qualified safety officer is to be deployed for each contract. He will report directly to his head of organization and not the Project Manager of contractor He shall also not be assigned any other work except assigning the work of safety. The curriculum vitae of such person shall be got cleared from XXXX (Name of the Employer) Project Manager / Construction staff.

The name and address of such safety officers of contractor will be promptly informed in writing to Engineer In-charge with a copy to safety officer - In-charge before start of work or immediately after any change of the incumbent is made during the currency of the contract. The list is enclosed at Annexure – 5A (SP).

THAT the Contractor has also prepared a list including details of Explosive Operator (if required), Safety officer / Safety supervisor / nominated person for safety for each erection / stringing gang, list of personnel trained in First Aid Techniques as well as copy of organisation structure of the Contractor in regard to safety. The list is enclosed at Annexure – 5B (SP).

12. The Project Manager shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and/or property, and/or equipment. In such cases, the Contractor shall be informed in writing about the nature of hazards and possible injury/accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary, appeal against the order of stoppage of

work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor.

13. THAT, if, any Employer's Engineer/ supervisor at site observes that the Contractor is failing to provide safe working environment at site as per agreed Safety Plan / XXXX (Name of the Employer) Safety Rule/ Safety Instructions / Statutory safety requirement and creates hazardous conditions at site and there is possibility of an accident to workmen or workmen of the other contractor or public or the work is being carried out in an un safe manner or he continues to work even after being instructed to stop the work by Engineer / Supervisor at site / RHQ / Corp. Centre, the Contractor shall be bound to pay a penalty of Rs. 10,000/- per incident per day till the instructions are complied and as certified by Engineer / Supervisor of Employer at site. The work will remain suspended and no activity will take place without compliance and obtaining clearance / certification of the Site Engineer / Supervisor of the Employer to start the work.

14. THAT, if the investigation committee of Employer observes any accident or the Engineer In-charge/Project Manager of the Employer based on the report of the Engineer/Supervisor of the Employer at site observes any failure on the Contractor's part to comply with safety requirement / safety rules/ safety standards/ safety instruction as prescribed by the Employer or as prescribed under the applicable law for the safety of the equipment, plant and personnel and the Contractor does not take adequate steps to prevent hazardous conditions which may cause injury to its own Contractor's employees or employee of any other Contractors or Employer or any other person at site or adjacent thereto, or public involvement because of the Contractor's negligence of safety norms, the Contractor shall be liable to pay a compensation of Rs. 10,00,000/- (Rupees Ten Lakh only) per person affected causing death and Rs. 1,00,000/- (Rupees One Lakh only) per person for serious injuries / 25% or more permanent disability to the Employer for further disbursement to the deceased family/ Injured persons. The permanent disability has the same meaning as indicated in Workmen's Compensation Act 1923 or latest. The above stipulations is in addition to all other compensation payable to sufferer as per workmen compensation Act / Rules

THAT as per the Employer's instructions, the Contractor agrees that this amount shall be deducted from their running bill(s) immediately after the accident, That the Contractor understands that this amount shall be over and above the compensation amount liable to be paid as per the Workmen's Compensation Act /other statutory requirement/ provisions of the Bidding Documents.

15. THAT the Contractor shall submit Near-Miss-Accident report alongwith action plan for avoidance such incidence /accidents to Engineer – In-charge/ Project Manager. Contractor shall also submit Monthly Safety Activities report to Engineer – In-charge/ Project Manager and copy of the Monthly Safety Activities report also to be sent to Safety In-charge at RHQ of the Employer for his review record and instructions.

16. THAT the Contractor is submitting a copy of Safety Policy/ Safety Documents of its Company which is enclosed at Annexure – 6 (SP) and ensure that the safety Policy and safety documents are implemented in healthy spirit.

17. THAT the Contractor shall make available of First Aid Box [Contents of which shall be as per Building & other construction workers (Regulation of Employment and Conditions of Services Act and Central Rule 1998 or latest / XXXX (Name of the Employer) Guidelines)] to the satisfaction of Engineer In-Charge/ Project Manager with each gang at site and not at camp and ensures that trained persons in First Aid Techniques with each gang before execution of work.

18. THAT the Contractor shall submit an 'Emergency Preparedness Plan' for different incidences i.e. Fall from height, Electrocution, Sun Stroke, Collapse of pit, Collapse of Tower, Snake bite, Fire in camp / Store, Flood, Storm, Earthquake, Militancy etc. while carrying out different activities under execution i.e. foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc. which is enclosed at Annexure – 7 (SP) for approval of the Engineer In-Charge/ Project Manager before start of work.

19. THAT the Contractor shall organise Safety Training Programs on Safety, Health and Environment and for safe execution of different activities of works i.e. foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc. for their own employees including sub-contractor workers on regular basis.

The Contractor, therefore, submits copy of the module of training program, enclosed at Annexure – 9 (SP), to Engineer In-charge/Project Manager for its acceptance and approval and records maintained.

20. THAT the Contractor shall conduct safety audit, as per Safety Audit Check Lists enclosed at Annexure – 8 (SP), by his Safety Officer(s) every month during construction of Transmission Lines / Sub Stations / any other work and copy of the safety audit report will be forwarded to the Employer's Engineer In-charge / Site In-charge/Project Manager for his comments and feedback. During safety audit, healthiness of all Personal Protective Equipment (PPEs) shall be checked individually by safety officer of contractor and issue a certificate of its healthiness or rejection of faulty PPEs and contractor has to ensure that all faulty PPEs and all faulty lifting tools and tackles should be destroyed in the presence of XXXX (Name of the Employer) construction staff. Contractor has to ensure that each gang be safety audited at least once in two months. During safety audit by the contractor, Safety officer's feedback from XXXX (Name of the Employer) concerned shall be taken and recorded. The Employer's site officials shall also conduct safety audit at their own from time to time when construction activities are under progress. Apart from above, the Employer may also conduct surveillance safety audits. The Employer may take action against the person / persons as deemed fit under various statutory acts/provisions under the Contract for any violation of safety norms / safety standards.
21. THAT the Contractor shall develop and display Safety Posters of construction activity at site and also at camp where workers are generally residing.
22. THAT the Contractor shall ensure to provide potable and safe drinking water for workers at site / at camp.
23. THAT the Contractor shall do health check up of all workers from competent agencies and reports will be submitted to Engineer In-Charge within fifteen (15) days of health check up of workers as per statutory requirement.
24. THAT the Contractor shall submit information alongwith documentary evidences in regard to compliance to various statutory requirements as applicable which are enclosed at Annexure – 10A (SP).
- The Contractor shall also submit details of Insurance Policies taken by the Contractor for insurance coverage against accident for all employees are enclosed at Annexure – 10B (SP).
25. THAT a check-list in respect of aforesaid enclosures alongwith the Contractor's remarks, wherever required, is attached as Annexure – Check List herewith.

THE CONTRACTOR shall incorporate modifications/changes in this 'Safety Plan' necessitated on the basis of review/comments of the Engineer In-Charge/Project Manager within fourteen (14) days of receipt of review/comments and on final approval of the Engineer In-Charge/Project Manager of this 'Safety Plan', the Contractor shall execute the works under the Contract as per approved 'Safety Plan'. Further, the Contractor has also noted that the first progressive payment towards Services Contract shall be made on submission of 'Safety Plan' alongwith all requisite documents and approval of the same by the Engineer In-Charge/Project Manager.

IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorised representative under the common seal of the Company, the day, month and year first above mentioned.

For and on behalf of

M/s.....

WITNESS

1. Signature.....

Signature.....

Name.....

Name.....

Address.....

Address.....

2. Signature.....

Authorised representative

Name.....

(Common Seal)

Address.....

(In case of Company)

Note:

All the annexure referred to in this "Safety Plan" are required to be enclosed by the contractor as per the attached " Check List "

1. Safety Plan is to be executed by the authorised person and (i) in case of contracting Company under common seal of the Company or (ii) having the power of attorney issued under common seal of the company with authority to execute such contract documents etc., (iii) In case of (ii), the original Power of Attorney if it is specifically for this Contract or a Photostat copy of the Power of Attorney if it is General Power of Attorney and such documents should be attached to this Safety Plan.
2. For all safety monitoring/ documentation, Engineer In-charge / Regional In-charge of safety at RHQ will be the nodal Officers for communication.

CHECK LIST FOR SEFETY PLAN

S. N.	Details of Enclosure	Status of Submission of information/ documents	Remarks
1.	<p>Annexure – 1A (SP)</p> <p>Safe work procedure for each activity i.e. foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc. to be executed at site.</p>	Yes/No	
2.	<p>Annexure – 1B (SP)</p> <p>Manpower deployment plan, activity wise foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc.</p>	Yes/No	
3.	<p>Annexure – 2 (SP)</p> <p>List of Lifting Machines i.e. Crane, Hoist, Triffor, Chain Pulley Blocks etc. and Lifting Tools and Tackles i.e. D shackle, Pulleys, come along clamps, wire rope slings etc. and all types of ropes i.e. Wire ropes, Poly propylene Rope etc. used for lifting purposes along with test certificates.</p>	Yes/No	
4.	<p>Annexure – 3 (SP)</p> <p>List of Personal Protective Equipment (PPE), activity wise including the following along with test certificate of each as applicable:</p> <ol style="list-style-type: none"> 1. Industrial Safety Helmet to all workmen at site. (EN 397 / IS 2925) with chin strap and back stay arrangement. 2. Safety shoes without steel toe to all ground level workers and canvas shoes for workers working on tower. 3. Rubber Gum Boot to workers working in rainy season / concreting job. 4. Twin lanyard Full Body Safety harness with shock absorber and leg strap arrangement for all workers working at height for more than three meters. Safety Harness should be with attachments of light weight such as of aluminium alloy etc. and having a feature of automatic locking arrangement of snap hook and comply with EN 361 / IS 3521 standards. 5. Mobile fall arrestors for safety of workers during their ascending / descending from tower / on 	Yes/No	

S. N.	Details of Enclosure	Status of Submission of information/ documents	Remarks
	<p>tower. EN 353 -2 (Guided type fall arresters on a flexible anchorage line.)</p> <p>6. Retractable type fall arrestor (EN360: 2002) for ascending / descending on suspension insulator string etc.</p> <p>7. Providing of good quality cotton hand gloves / leather hand gloves for workers engaged in handling of tower parts or as per requirement at site.</p> <p>8. Electrical Resistance hand gloves to workers for handling electrical equipment / Electrical connections. IS : 4770</p> <p>9. Dust masks to workers handling cement as per requirement.</p> <p>10. Face shield for welder and Grinders. IS : 1179 / IS : 2553</p> <p>11. Other PPEs, if any, as per requirement etc.</p>		
5.	<p>Annexure – 4 (SP)</p> <p>List of Earthing Equipment / Earthing devices with Earthing lead conforming to IECs for earthing equipment are – (855, 1230, 1235 etc.) gang wise for stringing activity/as per requirement</p>	Yes/No	
6.	<p>Annexure – 5A (SP)</p> <p>List of Qualified Safety Officer(s) alongwith their contact details</p>	Yes/No	
7.	<p>Annexure – 5B (SP)</p> <p>Details of Explosive Operator (if required), Safety officer / Safety supervisor for every erection / stringing gang, any other person nominated for safety, list of personnel trained in First Aid as well as brief information about safety set up by the Contractor alongwith copy of organisation of the Contractor in regard to safety</p>	Yes/No	
8.	<p>Annexure – 6 (SP)</p> <p>Copy of Safety Policy/ Safety Document of the Contractor's company</p>	Yes/No	
9.	<p>Annexure – 7 (SP)</p> <p>'Emergency Preparedness Plan' for different incidences i.e. Fall from height, Electrocution, Sun Stroke, Collapse of pit, Collapse of Tower, Snake bite, Fire in camp / Store, Flood, Storm, Earthquake, Militancy etc. while carrying out different activities under execution i.e. foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc.</p>	Yes/No	

S. N.	Details of Enclosure	Status of Submission of information/ documents	Remarks
10.	Annexure – 8 (SP) Safety Audit Check Lists (Formats to be enclosed)	Yes/No	
11.	Annexure – 9 (SP) Copy of the module of Safety Training Programs on Safety, Health and Environment, safe execution of different activities of works for Contractor's own employees on regular basis and sub-contractor employees.	Yes/No	
12.	Annexure – 10A (SP) Information alongwith documentary evidences in regard to the Contractor's compliance to various statutory requirements including the following:		
(i)	Electricity Act 2003 _____ [Name of Documentary evidence in support of compliance]	Yes/No	
(ii)	Factories Act 1948 or latest _____ [Name of Documentary evidence in support of compliance]	Yes/No	
(iii)	Building & other construction workers (Regulation of Employment and Conditions of Services Act and Central Act 1996 or latest) and Welfare Cess Act 1996 or latest with Rules. _____ [Name of Documentary evidence in support of compliance]	Yes/No	
(iv)	Workmen Compensation Act 1923 or latest and Rules. _____ [Name of Documentary evidence in support of compliance]	Yes/No	
(v)	Public Insurance Liabilities Act 1991 or latest and Rules. _____ [Name of Documentary evidence in support of	Yes/No	

S. N.	Details of Enclosure	Status of Submission of information/ documents	Remarks
	compliance]		
(vi)	Indian Explosive Act 1948 or latest and Rules. _____ [Name of Documentary evidence in support of compliance]	Yes/No	
(vii)	Indian Petroleum Act 1934 or latest and Rules. _____ [Name of Documentary evidence in support of compliance]	Yes/No	
(viii)	License under the contract Labour (Regulation & Abolition) Act 1970 or latest and Rules. _____ [Name of Documentary evidence in support of compliance]	Yes/No	
(ix)	Indian Electricity Rule 2003 and amendments if any, from time to time. _____ [Name of Documentary evidence in support of compliance]	Yes/No	
(x)	The Environment (Protection) Act 1986 or latest and Rules. _____ [Name of Documentary evidence in support of compliance]	Yes/No	
(xi)	Child Labour (Prohibition & Regulation) Act 1986 or latest. _____ [Name of Documentary evidence in support of compliance]	Yes/No	
(xii)	National Building Code of India 2005 or latest (NBC 2005). _____ [Name of Documentary evidence in support of compliance]	Yes/No	

S. N.	Details of Enclosure	Status of Submission of information/ documents	Remarks
(xiii)	Indian standards for construction of Low/ Medium/ High/ Extra High Voltage Transmission Line _____ [Name of Documentary evidence in support of compliance]	Yes/No	
(iv)	Any other statutory requirement(s) [please specify] _____ [Name of Documentary evidence in support of compliance]	Yes/No	
13.	Annexure – 10B (SP) Details of Insurance Policies alongwith documentary evidences taken by the Contractor for the insurance coverage against accident for all employees as below:		
(i)	Under Workmen Compensation Act 1923 or latest and Rules. _____ [Name of Documentary evidence in support of insurance taken]	Yes/No	
(ii)	Public Insurance Liabilities Act 1991 or latest _____ [Name of Documentary evidence in support of insurance taken]	Yes/No	
(iii)	Any Other Insurance Policies _____ [Name of Documentary evidence in support of insurance taken]	Yes/No	

19. FORM OF JOINT DEED OF UNDERTAKING BY THE SUB-CONTRACTOR ALONGWITH THE BIDDER/CONTRACTOR

THIS DEED OF UNDERTAKING executed this day of Two Thousand and by M/s., a Company incorporated under the laws of and having its Registered Office at (hereinafter called the "Sub-contractor" which expression shall include its successors, executors and permitted assigns), and M/s., a Company incorporated under the laws of having its Registered Office at (hereinafter called the "Bidder"/"Contractor" which expression shall include its successors, executors and permitted assigns) in favour of XXXX (Name of the Employer) a Company incorporated under the Companies Act of 1956/2013 (with amendment from time to time) having its registered office at XXXX (Registered Address of the Employer) (hereinafter called the "Employer" which expression shall include its successors, executors and permitted assigns)

WHEREAS the "Employer" invited Bid as per its Specification No.....for DDUGJY/IPDS works of including installation of Sub-stations, lines, bays, DTs and providing service connections etc.

AND WHEREAS Clause No., Section, of, Vol.-I... forming part of the Bid Documents inter-alia stipulates that the Bidder and/or Sub-contractor must fulfill the Qualifying Requirements and be jointly and severally bound and responsible for the quality and timely execution of DDUGJY/IPDS works in the event the Bid submitted by the Bidder is accepted by the Employer resulting in a Contract.

AND WHEREAS the Bidder has submitted its Bid to the Employer vide Proposal No. dated based on tie-up with the Sub-contractor for execution of aforesaid DDUGJY/IPDS works.

NOW THEREFORE THIS UNDERTAKING WITNESSETH as under:

- 1.0 In consideration of the award of Contract by the Employer to the Bidder (hereinafter referred to as the "Contract") we, the Sub-contractor and the Bidder/Contractor do hereby declare that we shall be jointly and severally bound unto the XXXX (Name of the Employer), for execution of DDUGJY/IPDS works in accordance with the Contract Specifications.
- 2.0 Without in any way affecting the generality and total responsibility in terms of this Deed of Undertaking, the Sub-contractor hereby agrees to depute their representatives from time to time to the Employer's Project site as mutually considered necessary by the Employer, Bidder/Contractor and the Sub-contractor to ensure proper quality, manufacture, testing and supply on FOR destination delivery at site basis and successful performance of DDUGJY/IPDS works in accordance with Contract Specifications. Further, if the Employer suffers any loss or damage on account of non-performance of the material fully meeting the performance guaranteed as per Bid Specification in terms of the contract. We the Sub-contractor and the Contractor jointly and severally undertake to pay such loss or damages to the Employer on its demand without any demur.
- 3.0 This Deed of Undertaking shall be construed and interpreted in accordance with the laws of India and the Courts in xxxxx (Headquarter of Employer) shall have exclusive jurisdiction in all matters arising under the Undertaking.
- 4.0 We, the Bidder/Contractor and Sub-contractor agree that this Undertaking shall be irrevocable and shall form an integral part of the Contract and further agree that this Undertaking shall continue to be enforceable till the Employer discharges it. It shall become operative from the effective date of Contract.

IN WITNESS WHEREOF the Sub-contractor and/or the Bidder/Contractor have through their Authorised Representatives executed these presents and affixed Common seals of their respective Companies, on the day, month and year first above mentioned.

WITNESS (For Sub-contractor)

Signature (Signature of the authorized representative)

Name Name

Office Address Common Seal of Company

WITNESS (For Bidder)

Signature (Signature of the authorized representative)

Name Name

Office Address Common Seal of Company

Note:

1. For the purpose of executing the Deed of Joint Undertaking, the non-judicial stamp papers of appropriate value shall be purchased in the name of executant(s).
2. The Undertaking shall be signed on all the pages by the authorised representatives of each of the partners and should invariably be witnessed.
3. This Deed of Joint Undertaking duly attested by Notary Public of the place(s) of the respective executant(s), shall be submitted alongwith the bid.
4. In case the bid is submitted by a Joint Venture (JV) of two or more firms as partners, then the Joint deed of undertaking shall be modified accordingly.

20. FORM OF CERTIFICATE OF FINANCIAL PARAMETERS FOR QR
(as per clause ref. no. 1.02 and 2.0 of Annexure-A(BDS))

(Rupees in Lakhs)

S. No.	Financial parameters	2014-15	2013-14	2012-13	2011-12	2010-11
1.	Net Worth					
a)	Paid up Capital					
b)	Free Reserves and Surplus*					
c)	Misc expenses to the extent not written off					
	Net Worth (a+b-c)					
2.	Annual Turnover **					
3.	Liquid Asset (Total Current Asset – Inventories)					

* Free Reserve and Surplus should be Exclusive of Revaluation Reserve, written back of Depreciation Provision and Amalgamation.

** Annual total Income/ turnover as incorporated in the Profit and Loss Account excluding non recurring income, i.e. sale of fixed asset etc.

It is certified that all the figures are based on audited accounts read with auditors report and Notes to Accounts etc.

Date

Certified By

Place

(Chartered Accountants)

Membership No.

Seal

VOLUME-I: SECTION – VII

SCOPE OF WORKS

Scope of works

The scope of works also include General Technical Instructions enclosed at Annexure-A.

Accordingly, scope of works under this contract is as under:

1. Supply, Erection, Testing & Commissioning of all materials as per tender document.
2. Execution of all other works as per tender document. All Steel structure shall be hot dip galvanized as per relevant Indian Standard.
3. The Distribution Transformers must be BIS certified in line with Electrical Transformers (Quality Control) order, 2015 (along with its latest amendments).
4. A set of drawings are enclosed with this bid document. These are tender drawings and are to be approved by the Project Manager. These drawings are indicative in nature and therefore, must be referred while preparing drawings for approval.
5. The engraving of word "DDUGJY" in materials viz., Poles, Transformers (All types), Cables, Energy Meter etc is mandatory requirement. The Project Manager shall ensure strict compliance of this requirement. Also, while processing payments to the Contractor, suitable documentary evidence / photographs must be asked by the Project Manager in support of the compliance.
6. The Manufacturing Quality Plan (MQP) shall be finalized by the Employer in consultation with the contractor/manufacturer in line with the Technical Specifications.

The section wise scope of works are covered as under:

- New 33 kV Lines
- New 66/11 kV Power Substation
- New 33/11 kV Power Substation
- New 11 kV Lines
- DTR Substations
- LT Line
- Augmentation & Renovation
- HVDS
- Metering
- Ring Main Unit (RMU)
- 11 KV Sectionaliser under IPDS

A. New 33 KV Lines

1.00 Survey

Mapping of route of proposed new 33 kV line by foot survey in rural/urban areas be performed mentioning various milestones. While surveying, existing electrical infrastructure in the locality should also be mapped. Line alignment (single line diagram) on political map with fair correctness, be prepared. SLD and foot survey report shall be approved by Project Manager and shall be used as basic document for assessment of works under the contract. On completion of line work, as built Single Line Diagram and pole wise line diagram showing pole wise materials used and pole-to-pole span should be submitted to Project Manager. This details shall be used as reference documents by Quality and Quantity Inspecting officials to execute inspection works.

2.00 Support (pole):

Following type of supports are envisaged for new 33 KV overhead lines-

- a. 9.1 meter long /280 KG PCC Poles (PCC Pole as per state practice)
- b. 13 m long H-Beam 152x152 mm 37.1 kg/m
- c. 11 M long steel Tubular poles of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)
- d. 13 M long steel Tubular poles of Designation 540 SP 72 (IS 2713, Pt I, II, III 1980)

In rural area, PCC poles are to be used. In urban area, PCC or H-Beam supports are to be used of suitable length. In hilly areas where handling of material is a challenge, tubular poles may be used. In location specific conditions like forest area, vicinity of other existing overhead lines or permanent structures etc, H- beam or tubular poles may be used. Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

H-Beam support and steel tubular poles shall be cleaned till good surface finish and painted with 2 or more coats of red oxide paint and 2 or more coats of aluminium paint till good finish. Steel tubular poles and H-Beams shall also be painted with 2 or more coats till good surface finish with anti-corrosive paint (in case of tubular poles shall also be painted on the inner walls) which goes in to the foundation. Project Manager shall approved brand and shade of paints.

Painting of H-Beams and Steel Tubular Poles shall be performed at stores. Before shifting to site for erection, poles shall be offered for inspection and approval by Project Manager.

3.00 Fabricated steel items:

Fabricated steel items like V cross arm, top clamp, DC cross arm, bracket, clamps, cross bracings, bracings, strain plate, guarding channels, back clamp, transformer mounting structure etc shall be made of MS Channels, MS angle, MS flats as per approved drawings. While fabricating, good quality electrical cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

Fabricated steel structure items shall be hot dip galvanized and cleaned till good surface finish. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633 (with latest amendments).

Galvanizing shall be checked and tested in accordance with IS: 2633. Fabricated steel structure items shall be offered for inspection and approval by Project Manager.

4.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

5.00 Stay Set:

Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (2Nos.), anchor plate (300x300x8mm) , nut-bolts, 2 Nos turn-buckles, 1.8 m long, 20 mm diameter solid GS stay rod & 7/4.00 mm dia GI stranded wire complete.

Stay set shall be used at all turning locations, conductor dead end location, double pole structure, triple pole structure, four pole structure to nullify the tension of conductor. At dead end locations, stay sets shall be used in pairs in separate foundations. Erection of storm guys at suitable location in straight line may also be provided.

0.3 cmt cement concreting in mixture 1 part cement, 3 part coarse sand, 6 part 40mm size aggregate stone chips (1:3:6) shall be provided in each stay set foundation. 2 Nos. guy insulator shall be provided in stranded GI wire at middle location between two turn buckles. Shuttering and vibrator shall be used for cement concreting works.

6.00 Earthing:

Following earthing arrangements are envisaged for new 33 kV lines:

- a. 40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories complete
- b. GI Earthing spike made of 20mm solid rod
- c. Chemical rod earthing including electrode, chemical, with 2000mm long, 50 mm diameter GI pipe, GI Strip of 24x3mm minimum in hard rock locations only.
- d. 8 SWG GI Earthing Coil.
- e. 6 SWG GI wire for earthing and guarding
- f. 8 SWG GI wire for earthing and guarding

Each 33 kV line support shall be provided with one GI earthing spike made of 20 mm solid rod or 8 SWG GI Earthing Coil and connected with 8 SWG GI wire. Overhead line structure shall be connected to GI earthing spike or GI Earthing Coil using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod. Project Manager shall decide use of GI Earthing Coil or GI Solid earth Road for earthing of individual poles.

At railway crossing, line crossing and other specific locations 40 mm dia, 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories shall be used. Overhead line structure at these locations shall be connected to GI earth pipe using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 40 mm GI earth pipe.

In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used. Overhead line structure shall be connected to chemical earth electrode using 8SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod.

GI flats and GI wires must be properly dressed, bundled and fixed on supporting structure at 1 to 2 feet intervals.

7.00 Insulator and hardware –

33 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator should be tied properly using binding wire and tape/helical form fitting. In road crossing and line crossing locations bridling cross arms and pin insulator shall be used.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator should properly be cleaned before installation. No damage/crack insulator should be used.

8.00 ACSR/AAAC Conductors:

Following ACSR Conductors (or equivalent AAAC conductor) are envisaged for new 33 kV lines:

- a. 6/4.09 + 1/4.09 mm (80 mm² Al. Area) - Raccoon
- b. 6/4.72 mm+7/1.57 mm (100 mm² Al. Area) – Dog
- c. 30/2.59 mm + 7/2.59 mm (150 mm² Al. Area) – Wolf
- d. 30/3.00 + 7/3.00 mm (200 mm² Al. Area) - Panther

Care should be taken while drawing conductor from the drum. Proper roller should be used while handling conductors during erection. Jointing sleeves, binding materials, PG clamps, bi-metallic conductor shall be used for conductor jointing, insulators fixing, jumpering and termination at equipment respectively.

Proper sag should be maintained using sag chart table. While tensioning, care should be taken to avoid tension on pin insulator. Therefore, proper alignment of line to be ensured. Conductor joint should not be in the middle span but may be planned nearer the support.

At terminal location, care should be taken while connecting two sections to avoid bird faults. Therefore, pin insulator is to be used to handle the conductor on DC cross arm (as per state practice).

9.00 Pole numbering:

Each support pole should be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint. Warning instruction, if any, of availability of two sources of 33 kV supply on same structure, at source structure, at cut points should exclusively be provided as per state practice.

10.00 Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each 33 kV support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

11.00 Danger board:

Each support should be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

12.00 33 KV AB Switch:

33 kV, 3-ph, 600 A, 3 Pin type, Vertical/Horizontal Mounting type, Gang Operated, AB Switch shall be installed at cut points and at suitable locations as per instructions of Project Manager. B Class GI pipe shall be used (without any joints) for operation of switch. AB Switch structure and handle must be earthed using 8 SWG GI wire.

13.00 Support foundation:

Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40mm size aggregate stone chips (1:3:6) shall be used in all the types of 33 kV line supports.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shuttering and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular and H-Beam poles to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

14.00 33 kV line for underground railway crossing –

A separate composite item of railway crossing is kept in BoQ. 2 Nos. separate cables shall be laid in separate GI pipe enclosures. At a time, one shall be used and another shall be kept idle as spare in ready to join condition. Cable termination, cable identification, protective covering, laying of jumpering cable etc shall all be completed in this head. This composite item shall contain following key items:

- a. 3Cx300 Sqmm XLPE armored cable (approx. length is 0.3 km each) – 2 sets
- b. 150mm dia GI pipe of A class (red color painted on edges) for cable protection in underground laying – 2 sets
- c. 150mm dia GI pipe of B class (blue color painted on edges) for cable support at DP structure – 2 sets
- d. Outdoor heat shrinkable cable jointing kits for main cable and jumpering cable – 4 Nos for main cable, 8 Nos for jumpering cables.
- e. 33 kV lightning arrestor station class 10kA (6 nos.),
- f. 4 Nos GI 3-meters long pipe earthing,
- g. 6 SWG GI wires with GI nuts, bolts & washers,
- h. Cable markers,
- i. Bi-metallic clamps,
- j. Jumpering with 33 kV Arial Bunched Cables 200 Sqmm dia (10 mtr) etc – 4 sets

Detail survey of location of railway crossing be performed by contractor to avoid multi-crossing at nearby location. Prior railway permission for execution of this work shall be obtained by Project Manager for which necessary technical support shall be provided by contractor. Line crossing shall be performed using underground cabling. Block on railway traffic shall be arranged by Project Manager. Contractor should ensure timely completion of work during block period by mobilizing requisite man, materials and machine at crossing locations.

Horizontal drilling machine shall be used for horizontal bore below railway tracks.

15.00 Quality&Quantity inspection and compliance to the observation:

The line works, before or after commissioning/energisation, shall be inspected by Quality Inspectors and State Inspection Inspectorate. Contractor shall provide all requisite details of line like approved survey report, as built drawings and joint measurement sheet etc to the inspector. Contractor shall rectify defects/deficiencies and submit compliance to the observations with supporting photographs in digital form within one month from receipt of observations.

16.00 Tree-cutting/trimming of tree:

The Contractor shall count, mark and put proper numbers with suitable quality of paint at his own cost on all the trees that are to be cut/trim to obtain required tree clearance. Contractor shall pay compensation for any loss or damage for tree cutting due to Contractor's work. Wherever forest clearance is envisaged for execution of work, clearance of forest department for tree cutting, if required, shall be arranged by the Project Manager and compensation shall also be paid by the Project Manager. Necessary fee if required to pay to Govt. dept. for arranging such clearances shall paid by Project Manager. However, the contractor would require to provide all necessary assistance for execution of this work.

17.00 Statutory clearances:

During execution of 33 KV Line work, all statutory clearances shall be ensured for ground clearance, line-to-line clearance, road crossing clearance, horizontal and vertical clearances from buildings/objects etc. All road crossings and line crossings shall be guarded as per specifications. Conductor joint should not be provided in mid span length. Instead, it should be nearer to the support.

B. 66/11KV new Substation

1.00 Electrical Details of New 66/11 KV Grid Substations –

No	Name of Proposed Substation	Circle/ town	66 KV line LILO or Radial	Capacity in MVA	Nos of proposed 11 KV outgoing feeders

2.00 Following works are in the scope of Owner:

- a) Acquisition of land for the substation and its possession to start constructional activities,
- b) Approach road to the substation land,
- c) Leveling of the substation land,
- d) Construction of retaining wall wherever required including cutting, digging or filling of earth as required,
- e) Availability of up-stream source and plan for incomer 66KV line (if the same is not part of package)
- f) General layout of the substation
- g) Three (3phase) 415V AC power supply at one point on contractor's expense & as per prevailing electricity tariff provided LT network is available in the vicinity of the proposed substation.
- h) Space for construction office & store yard for agency provided free of charge provided it is available at site.

Since above works are not covered under substation works, Owner shall provide all above input before start of substation work by turnkey contractor. A format protocol note for handing over/taking over of sub-station land, approach road, retaining wall(wherever needed) and layout plan shall be signed between Project Manager and authorized representative of Turnkey Contractor.

3.00 Following works are in the scope of Contractor:

The scope of works include on turnkey basis for design, engineering, manufacturing, shop testing, transportation, supply, storage, erection, testing & commissioning of the following:

- a. 66/11 KV new Sub-station at specified locations with 66 KV outdoor switchyard comprising ofnos. bays withnos. 66/11 KV 16/20/25/30 MVA Power Transformers, 66/11 KV transforms bays, 66 KV bus coupler bay and 11 KV indoor switchgear along with switchyard control room and all associated facilities (to be modified suitably by utility).

The Scope includes:

- a) Complete design and engineering of all the systems, sub-systems, equipment, material and services.
- b) Providing engineering data, drawings and O&M manuals for Owner's review, approval and records.
- c) Manufacturing, supply, testing, packing, transportation and insurance from the manufacturer's work to the site including port and customs clearance, if required.
- d) Receipt, storage, insurance, preservation and conservation of equipment at site.
- e) All civil and structural works as required.

- f) Fabrication, pre-assembly (if any), erection, testing and putting into satisfactory operation of all the equipment/material including successful commissioning
- g) Satisfactory conclusion of the contract.
- h) Enabling work as per the site requirement.

In addition to the requirements indicated herein, all the requirements as stated in other sections shall also be considered as a part of this specification as if completely bound herewith.

The Bidder shall be responsible for providing all material, equipment and services specified or otherwise which are required to fulfill the intent of ensuring operability, maintainability and the reliability of the complete work covered under this specification.

It is not the intent to specify all aspects of design and construction of equipment mentioned herein. The systems, sub-systems and equipment shall conform in all respect to high standards of engineering, design and workmanship, and shall be capable of performing in continuous commercial operation.

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or trade mark, the specific item shall be understood as establishing type, function and quality desired. Products of other manufacturers may also be considered, provided sufficient information is furnished so as to enable the owner to determine that the products are equivalent to those named.

The scope of work shall comprise, but not limited to the design, engineering, manufacture, testing and inspection at manufacture's works, packing, supply, transportation, transit insurance, delivery to site, unloading, and storage and equipment erection including associated civil and structural works. Further it shall include the cabling, lighting, earthing, supervision, site testing, inspection and commissioning of Sub-Station. The scope shall also include all enabling works required for modification to existing facilities within the project area.

a. Bay Details:

The Sub-Station shall comprise ofnos. of 66/11 kV Transformer bay, 1 No. 66 kV Bus-Coupler bay. The Sub-Station shall be with Double-Main bus-switching scheme for 66 kV (to be modified suitably by utility).

66 kV Bus bar shall be of ACSR zebra/..... conductor (to be filled by utility).

The equipment and materials to be supplied by the Bidder shall form a complete 66 kV Sub-Station.

Any items though not specifically mentioned but which are required to make the switchyard complete in all respects for its safe, efficient, reliable and trouble free operation shall also be deemed to be included and the same shall be supplied and erected by the Bidder without any additional cost to owner. The following items of works are covered under scope-

- 66 kV equipment including structures: Circuit Breakers, Isolators with/without earth-switch, current transformers, surge arresters, bus-post insulators and capacitor voltage transformers.
- Sub-Station Control Room Building or extension of existing one.
- 66/11 kV Power Transformer of rating as specified (16/20/25/30 MVA as specified in BOQ)
- Structures for supporting XLPE Power Cables connected to Secondary Terminals of Power Transformer.

- 11 KV MVAR Capacitor bank, isolator, series reactor & associated equipments forbanks of MVAR with structure (details to be filled by utility).
- 100 kVA, 11 kV / 415V Station Transformer.
- 11kV metal clad indoor switchgear with draw out type VCB, CT and PT, all control, protection and mimic arrangement.
- Vacuum Contactor Panel for capacitor feeder.
- DC System: 220V.
- 66 kV Sub-Station including internal roads, drains, boundary wall, gates, Barbed wire fencing for complete substation boundary & Chain Link fencing for Switchyard, Borewell, oil sump pit, Geo Technical Survey, soil investigation, Soil filling & compaction including construction of retaining wall for Civil Works as required.
- Supply & Erection of material for all Civil Works including equipment & gantry structure complete for 66KV outdoor yard equipment for transformer bay & line bay including earthing system & lightening protection etc. Erection including supply of material for transformer foundation, cable trench extension, fire wall for new power transformer.
- 66 kV Sub-Station Materials.
- ACSR Zebra Conductor.
- G.S. Earth wire.
- Insulators and Hardware.
- Clamps, Connectors and Spacers.
- Bay Marshalling Box.
- Fire Fighting Equipment
- Complete earthing grid for a system fault current of 31.5 KA and 1s duration (to be modified suitably by utility if required), earthing of all switchyard equipment including transformers and direct stroke lightning protection system and its connection to earthing grid.
- Bidder shall make earth resistivity measurements at site and design the earthing grid as per latest edition of relevant standards.
- Complete Direct Stroke Lightning Protection using Lightning Mast and/or shield wire and its connection to earth mat.
- Power & Control cables, cabling (including inter pole and inter panel), Cabling between equipment and panels, cable support angles, cable trays and accessories necessary for cable erection such as glands, lugs, clamps for cables, ferrules, cable ties, hume pipe etc., cable route markers for buried cables, cable trench with covers also included in the scope.
- Power & Control cable schedule & termination schedules shall be prepared by the Bidder.
- Internal and outdoor lighting system for control room building and 66 kV Sub-Station. The substation area inside the fencing should be illuminated provided with 100 Watts LED flood light fittings. Tubular poles 12m high as per IS: 2713 (Latest Version) shall be used for installation of area light fixtures in Urban as well as Rural substations. Internal electrification of the control room includes provision of fans, exhaust fans, LED illumination fixtures, switches and sockets. Control Room lighting shall be designed to ensure 300 lux illumination level through LED lamp fittings. The bidder shall submit calculation for achieving the above illumination before start of lighting work for approval of project manager.
- Control, protection and metering system.

b. Services and Items:

The scope includes but not limited to the following services/items described herein and elsewhere in specification:

- a) System design and engineering
- b) Supply of equipment and material
- c) Civil works
- d) Structural works
- e) Erection works
- f) Project management and site supervision
- g) Testing and commissioning
- h) Clearances from statutory authorities.

c. System Design and Engineering:

- i. The Bidder shall be responsible for detailed design and engineering of overall system, sub-systems, elements, system facilities, equipments, auxiliary services, etc. It shall include proper definition and execution of all interfaces with systems, equipment, material and services of Owner for proper and correct design, performance and operation of the project.
- ii. Bidder shall provide complete engineering data, drawings, reports, manuals etc. for Owner's review, approval and records.
- iii. The scope shall also include the design and engineering as per details elaborated elsewhere in this specification.
- iv. The Bidder shall carry out earth resistivity measurements at the switchyard site
- v. Relay setting calculations shall also be submitted by the Bidder for approval.
- vi. For all civil and structural works, the Bidder shall carry out design calculations; prepare all the detailed construction and fabrication drawings.

4.00 Arrangement by the Contractor

Contractor shall make his own necessary arrangements for the following and for those not listed anywhere else:

1. Distributions of power supply at all work areas in the substation premises.
2. Construction of office and store (open & covered)
3. Construction of workshop and material/field testing laboratory
4. Fire protection and security arrangements during construction stage

5.00 Civil works:

Details scope under civil works have been provided in Volume II section I – "Civil Works and Soil Investigation".

6.00 Basic Reference Drawings

The reference drawings, which are indicative of the type of specifications owner intends to accept, shall be developed by contractor and approved by Project Manager. The contractor shall maintain the overall dimensions of the substation, buildings, bay length, bay width, phase to earth clearance, phase to phase clearance and sectional clearances, clearances between buses, bus heights but may alter the locations of equipment to obtain the statutory electrical clearances required for the substation.

C. New 33/11 kV Power Substation

1.00 Electrical Details of New 33/11 KV Grid Substations –

No	Name of Proposed Substation	Division	33KV line LILO or Radial	Capacity in KVA	Nos of proposed 11 KV outgoing feeders

2.00 Following works are in the scope of Employer and shall be executed by Project Manager:

- i) Acquisition of land for the substation and its possession to start constructional activities,
- j) Approach road to the substation land,
- k) Leveling of the substation land,
- l) Construction of retaining wall wherever required including cutting, digging or filling of earth as required,
- m) Availability of up-stream source and plan for incomer 33 KV line (if the same is not part of package)
- n) General layout of the substation
- o) Three (3phase) 415V AC power supply at one point on contractor's expense & as per prevailing electricity tariff provided LT network is available in the vicinity of the proposed substation.
- p) Space for construction office & store yard for agency provided free of charge provided it is available at site.

Since above works are not covered under substation works, Employer/Owner shall provide all above input before start of substation work by turnkey contractor. A format protocol note for handing over/taking over of sub-station land, approach road, retaining wall(wherever needed) and layout plan shall be signed between Project Manager and authorized representative of Turnkey Contractor.

3.00 Types of substation: Two types of substations are envisaged under this head as per following:

- a. Partly-Outdoor substation – in this type, 33KV section comprising breakers, isolators, 11/0.4 KV station transformer, CTs, PT, Lightning Arrester, Power Transformer, feeder metering equipment & 11 KV Capacitor Bank, 33KV gantry shall be installed in out-door switch yard. Control panels of breakers shall be installed inside the control room. All 11KV equipment like CTs, Breakers and control panels, feeder meter shall be installed inside the control room. 11 KV cables shall be used for connection of power transformer and breaker and Breaker to outgoing isolators. 11KV feeder isolators and 11KV Lightning Arresters shall be installed outdoor.
- b. Fully-Outdoor substation – in this type, all 33KV and 11 KV equipment comprising Breakers, Isolators, CTs, PT, 11/0.4 KV Station Transformer, feeder metering equipment, Lightning Arrester, Power Transformer, metering equipment and 11 kV capacitor bank shall be installed in substation yard i.e. outdoor. Control panels and feeder meter shall be installed indoor. Fully outdoor substation shall be constructed using H-beam support or gantry structure supports as decided by Project Manager.

4.00 Power Transformers:

Power Transformers shall be 33/11 kV, 3 ph, 50 Hz, ONAN, Cu Wound, Outdoor Conventional type Power Transformer along with transformer oil, Buchholtz relay, breather, OTI & WTI, Marshalling Box, Conservator tank, oil level indicator, valves, Vent explosion plug, control wiring between sensing equipment and marshalling box, cable supporting tray on the body of transformer, transformer

wheels, LV/HV bushing etc as required. Following type and capacity of power transformers are envisaged under the scheme:

- a) 1.60 MVA without tap changer
 - b) 3.15 MVA without tap changer
 - c) 5.00 MVA with off load / on load tap changer
 - d) 6.3 MVA with off load / on load tap changer
 - e) 8.00 MVA with off load / on load tap changer
 - f) 10.0 MVA with off load / on loadtap changer
 - g) 12.5 MVA with off load / on loadtap changer
- Or any other rating as per latest Indian Standard Specification.

Transformer foundations shall be designed by turnkey contractor considering manufacturer's recommendations. Cement concrete including reinforcement steel shall be used for the foundation. Project Manager shall approved design and drawings of foundations. Proper shuttering, vibrator, curing shall be performed while constructing the foundations. Transformer rails shall also be provided for mounting of transformers on wheels.

2 sets of 50x8 mm galvanized neutral earthing strips shall be supplied with the transformer along with braided copper conductor links for connections at bushing ends. Two distinct earth connection shall be provided for neutral earthing. The earthing strips shall be mounted on 11KV post insulators. An isolating link shall be provided on individual earth strips for testing purposes.

Transformer protective equipment like OTI, WTI and Buchholtz relay shall be tested during pre-commissioning stage. Their electric connection upto marshalling box shall be performed as per Original Equipment Manufacturer recommendations. Cable tray shall be installed for laying of control cable shall be laid on cable tray on transformer body so that cable shall not get heated by transformer temperature. While commissioning the transformer tripping of breaker through all these equipment must be checked.

5.00 Breaker:

33 kV & 11 kV Vacuum Circuit Breakers shall be used for protection and control of power circuits. In partly outdoor substation, all 11 KV switchgears shall be indoor mounted type and 33 KV breakers shall be outdoor mounting type whereas in fully outdoor substation, 11 KV as well as 33 KV breakers shall be outdoor mounting type. In both the type of substation, control panels shall be indoor type. Outdoor breakers are to be supplied with Current Transformers. The outdoor mounting type breakers shall be supplied with its mounting galvanized steel structures.

Detailed cable schedules, termination details and circuit diagrams of control panels, transformer marshalling box, breaker marshalling box, and capacitor banks equipment shall be prepared and submitted by turnkey contractor for approval of Project Manager before commencing the work.

Cement concrete including reinforcement steel shall be used for the foundation. Project Manager shall approved design and drawings of foundations. Proper shuttering, vibrator, curing shall be performed while constructing the foundations for breaker.

Permanent maintenance platform shall be constructed for outdoor breakers and CT. Project Manager shall approve design of platform.

Control wiring between CT/breaker and control panel for outdoor mounting breakers/CT shall be routed through Junction box. Metallic Junction box shall be installed on support gantry structure of substation or on MS angle (50x50x6 mm) support. The boxes are to be erected, electrically connected

with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks shall be prepared and submitted. All CT terminals are to be ring type and other terminals are of fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided between CT and Meter keeping 20% spare terminals. The Junction box are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the distribution box shall be provided of 10mm dia.

6.00 Station Transformer:

100 KVA, aluminium / copper wound, 11/0.4 KV (or 33/0.4 KV) Station Transformers shall be installed on DP structure made of H-Beam 152x152 mm 37.1 kg 8 meter long. Outdoor type Distribution Box for station transformer shall be comprising of 200 A switch fuse unit, 6 Nos SP MCCB– 90 A, 2 Nos 32 A SP MCCB, 3-ph, 63A, contactor controlled yard lighting timer unit, tri-vector electronic energy meter (mounted in separate metallic LTCT cum meter box) with suitable CT, control/power cabling and terminals, 1 No 20 A Industrial socket and switch for local power supply requirements, mounting channel, clamps and hardware.

The Station Transformer substation shall be provided with Station Class LA, 33KV / 11KV AB Switch and 33KV / 11KV DO Fuse. Except type of Distribution Board, Lightening Arresters, and DP Structures, all other scope of work as mentioned under 100 KVA capacity Distribution Transformer work shall be the scope of work under 100 KVA Station Transformer on LT side.

7.00 Gantry structures:

There are two type of gantry structures envisaged under the scheme.

- a) Gantry structures made of H-Beam 152x152 mm 37.1 kg 8 meter long, double MS Channel 100x50mm for bus bar supports (Beam), 65x65x6mm angle for cross arms/supporting structures and 50x8mm flats for clamps along with hardware items duly painted etc., and
- b) Gantry structures made of Lattice structures of equal angles sections, flat as per approved drawings. State practices are to be adopted in the design. All structural steel members and bolts shall be galvanized after fabrication as per IS:4759 and zinc coating shall not be less than 610gm/sq. meter for all structural steel members. All L45x45x5 will have 23 mm back mark. All L50x50x6 will have 28mm back mark. 3.5mm spring washers are to be used under each nut, structural steel shall conform to IS 2026. All weld shall be 6mm filled weld unless specified otherwise. All nuts and bolts shall be of property class 5.6 of IS 1367. Plain washers shall be as per IS 2016 & spring washers shall be IS: 3063.

H-Beam support shall be cleaned till good surface finish and painted with 2 or more coats of red oxide paint and 2 or more coats of aluminium paint till good finish. Steel tubular poles and H-Beams shall also be painted with 2 or more coats till good surface finish with anti-corrosive paint (in case of tubular poles shall also be painted on the inner walls) which goes in to the foundation. Project Manager shall approved brand and shade of paints. Painting of H-Beams shall be performed at stores. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

Cement concrete in mixture 1 part cement, 3 part coarse sand, 4 part 20mm size aggregate stone chips (1:3:4) shall be used in all the types of gantry supports.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provider. While starting work of support erection, gang

wise shutting and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

300x300mm X 12" inch height muffing shall be provided on gantry support to prevent direct entry of rain water along the support. Cement Concrete of 1:2:4 (1 part Cement, 4 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

8.00 AC Distribution board (ACDB)

415 Volts, ACDB shall be indoor floor mounted with mounting arrangements, three phase-neutral voltmeter, three phase ammeter and Selector switches, 63 Amps TPN switch fuse unit in incomer circuit, 32 Amps TPN switches in outgoing circuits equals the number of indoor breaker control panels plus number of outdoor VCB kiosk panel and having 20% spare outgoing circuits, etc. Alternatively, ACDB can also be erected on separate MS frame made of 50x50x6 angle.

Substation flooring shall be provided with suitable inserts to fix ISMC 75 channel. This channel shall hold ACDB board. The board shall be installed on indoor trench. Cables shall have bottom entry. The board shall be grounded by 50x6mm GI strip at two distinct connections.

9.00 DC Distribution board (DCDB)

Indoor floor mounted, two pole 100 Amp 2 pole DC Switch Fuse unit as incomer, two pole 40 Amp Switch Fuse units in outgoing circuits equals the numbers of indoor breaker control panels plus numbers of outdoor VCB kiosks panels plus control room lighting panel and 20% spares outgoing circuits. Direct Current Distribution Board shall be installed in each substation. It would comprises of DC volt meter including mounting arrangements etc as required as per technical specifications, approved drawings and scope of works. Alternatively, DCDB can also be erected on separate MS frame made of 50x50x6 angle.

Substation flooring shall be provided with suitable inserts to fix ISMC 75 channel. This channel shall hold DCDB board. The board shall be installed on indoor trench. Cables shall have bottom entry. The board shall be grounded by 50x6mm GI strip at two distinct connections.

10.00 Cables:

- a. Control cables: 1.1 KV grade 2.5 mm² PVC insulated and PVC sheathed, armored, stranded, copper control cable with 2 core, 6 core and 10 core are envisaged in the substation.
- b. HT Power Cables: In partly outdoor substation, 11KV XLPE Cables shall be used as per following requirements;
 - Between Power Transformer and Main transformer breaker
 - Between Feeder breaker and outdoor feeder DP structures
 - Between capacitor bank switch and capacitor bank
- c. LT Power cables: 1.1 KV grade, armored, stranded, aluminum power cable PVC insulated and PVC sheathed with complete accessories as per detailed engineering
 - 3.5Cx150mm² (between station transformer & Distribution Box)
 - 3.5Cx70mm² (between Distribution Box & yard receptacles)
 - 3.5Cx35mm² to be used from Station Transformer Distribution Board to:
 - Control room building Internal Electrification DB,
 - ACDB Board,
 - Tube well Start Panel,
 - Outdoor area lighting control and distribution panel

- 2 core x16 mm² for supply to area lighting masts.
- d. LT cable for Internal Electrification works: following cables shall be used for internal electrification purpose:
- 1.1 KV PVC insulated PVC sheathed ISI marked, IS 694, 10mm², copper conductor, stranded, for internal electrification works between main DB and Sub DB or Su DB to switch board,
 - 1.1 KV PVC insulated PVC sheathed ISI marked, IS 694, 2.5mm² /4.00mm², copper conductor, stranded, for internal electrification works light & Fan and Power circuits respectively,
 - 1.1 KV PVC insulated PVC sheathed ISI marked, IS 694, 4.00mm², copper conductor, stranded weather proof cable for connection between outdoor area lighting luminary fixtures and its junction boxes,

Power Cables are to be laid as per best engineering practices. Power and control cables are to be laid in different alignments in cable trench. However, in case power/control cable is required to extend up to the equipment where cable trench is not constructed, they shall be laid in underground trench of width 300 – mm wide, provided with 2nd class brick protection (Approx. 10 bricks per meter length of laying) and sand protective covering (200 mm thick) and laid at the depth of 750mm minimum for LT cables and 1000mm for 11 kV cables. Laying specification of cable shall be as detailed in CPWD specification of laying power cables. Suitable loop length of 1.5 meter to be kept at the end points. Excessive loop lengths shall not be paid.

11.00 Metering & metering equipment:

Following two types of metering equipment are envisaged in the work comprising of:

- a. 33 kV/110 V Metering equipment (CTPT unit) with CT of ratio 400-200/5 A
- b. 11 kV/110 V Metering equipment (CTPT unit) with CT of ratio 300-150/5 A

Meter shall be HT trivector DLMS compliant category suitable for substation/feeder metering. Meter shall be 3 ph 4 w 110 V 5 A accuracy class 0.5s with GSM (GPRS compatible) modem.

12.00 Junction Box and Control Cabling:

Junction box is to be installed on support gantry structure of substation or erected on separate galvanized steel structures in the yard nearer to metering equipment. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks shall be prepared and submitted.

All CT terminals are to be ring type and other terminals are of fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided between CT and Meter keeping 20% spare terminals.

The Meter-cum-meter box are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the distribution boards shall be provided of 10mm dia.

13.00 Capacitor banks:

Capacitor banks of 600 KVAR, 1200 KVAR and 1500 KVAR capacity shall be provided with 3.15 MVA, 5.0 MVA and 8.0 MVA capacity power Transformer respectively. Capacitor bank shall comprises of switching vacuum circuit breaker, current transformers (100-50/5-5A), fully automatic control panel mounted inside the substation buildings, 11 KV residual voltage transformer, 11 KV three phase

Isolator, Earthing system, capacitor banks complete with individual fuses, interconnection mounting rakes, external fuses mounting arrangement, base insulators & accessories, 3 Nos. 11 KV single phase Metal oxide (Gap less) lighting arresters, isolators etc as per requirements. Hot dip galvanized mounting structure made of sections of 100x50x6 mm channel or 75x40x6 mm channel or 75x75x8 mm equal angles only.

14.00 DC emergency lighting:

At-least four Philips make LED bulbs are to be provided of 7 watts {2 Nos in control room, 1 No in station battery room, 1 No in yard area). These bulbs shall be fed by DC station battery. The wiring of these bulbs shall be so designed that it will automatically turn ON in event of failure of normal power supply. Provision for putting these bulbs OFF by operator is also to be provided. Wiring is to be performed concealed using PVC insulated PVC sheathed 2.5 mm² stranded copper wire. An automatic change over switch is envisaged for this purpose. This may be installed at prominent location, generally easily approachable by operator in the substation control room.

15.00 Station Battery and battery Charger:

Station battery are to be supplied with wooden racks made of teak/sal wood planks of thickness not less than 25mm, support legs made of size not less than 2 inches X 2 inches. The battery may be placed on two-tier formation of stand. The construction of battery rack shall suit site conditions of their placement. The rack shall be painted with three coat of acid proof paint of reputed make as approved by Project Manager. No metal fasteners / nails shall be used for construction of battery racks. The stand shall be supported on insulators to obtain necessary insulation from the earth and there shall be insulators between each cell and stand.

Initial charging of stationary battery shall strictly be as per Original Equipment Manufacturer (OEM) recommendations. Detail charging and discharging cycle readings shall be recorded and submitted to Project Manager for approval.

Battery room shall be provided with exhaust fan of air displacement capacity more than six times volume of battery room per hour. Wooden doors and windows shall be provided in the battery room. Anti-acid tiles shall be used in the floor and upto six feet height of the wall of the battery room.

The battery connections / terminals are to be cleaned and provided with petroleum jelly. Terminals hardware is to be provided with connecting cables. The inter-battery wiring cable shall be neatly dressed using cable ties, clamped and wired using ferrules, tag mark. New battery sets are to be provided with battery chargers as per detail specifications enclosed. Interconnecting cables and power supply cables originating / terminating at the battery charger, shall be neatly dressed using cable ties, clamped and wired using ferrules, tag marks, double compression glands etc as applicable. Connecting cable and associated materials needed for commissioning of charger shall be treated as part of the battery charger. 1.1 KV multi-strands, 30 sqmm, copper conductors, PVC insulated and PVC sheathed cable for DC wiring between DCDB and Battery bank.

The agency shall provide following equipment at all the substations:

- a) Two copies of battery instruction sheet duly laminated,
- b) Two sets of ISI marked electrical hand gloves,
- c) One cell testing voltmeter 3 – 0 – 3 volts,
- d) Two syringe hydrometers
- e) One thermometer with specific gravity correction scale,
- f) One set of suitable spanners,
- g) Two acid resistant funnel,
- h) One acid resisting jar of 2 liters capacity,

16.00 Outdoor type Current Transformer and Potential Transformer:

Outdoor type CTs are to be erected on supporting structure provided on the breaker structure or suitable structure as per state practices. Potential Transformers shall be erected on gantry structures and connected with bus. In both the case, separate metallic Junction Box shall be installed on support gantry structure of substation or erected on separate galvanized steel structures in the yard nearer to equipment. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks shall be prepared and submitted for approval of Project Manager.

All CT terminals are to be ring type and other terminals are of fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided in the junction box keeping 20% each spare ring type/fork type terminals.

The junction box shall be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the junction box of 10mm dia.

Testing and pre commissioning checks shall be conducted in accordance with OEM recommendations and as approved by the owner. Terminal connectors at HT as well as LT side shall be provided with the CT/PT equipment.

17.00 Control Panels:

New panels as per the requirement of protection like feeder protection, transformer protection or incomer protection are to be supplied with each newly supplied breaker:

- a. In case of fully outdoor type substation, control Panel to be erected on ISMC75 (75x40x6 mm) MS channel duly welded on MS angle inserted on indoor trench. Panels shall then be properly aligned, Cables shall enter with double compression glands, codified, lugged, and dressed.
- b. Breaker cum control panel shall be erected on ISMC 100(75x50x6 mm) MS channel duly welded on MS angle inserted on indoor trench. Panels shall then be properly aligned, Cables shall enter with double compression glands, codified, lugged, and dressed.
- c. Functional checks shall be performed on the control panel as per control wiring diagram.
- d. All alarm, annunciation and trip circuits / indication & alarm circuits shall be tested and made operative,
- e. The indication lamp shall be LED type lamp as per given specifications and shall be made operative,
- f. Indicating instruments shall be calibrated,
- g. Grounding of panel at two different locations by 50x6mm flat shall be provided. ,
- h. Control relays shall be calibrated and checked for tripping and closing operations,
- i. Pick up time / trip time and tripping at normal and reduced voltages shall be checked, properly adjusted and recorded,
- j. Latching arrangement of relays shall be checked for operation,

18.00 Lightning Arrester:

Station Class LAs will be used in 33 KV and 11 KV with base steel structure, terminals bi – metallic connectors / PG clamps and earth connectors. LAs are to be connected with separate earth connection using 50x6mm GS flat. All LA terminals / connections are to be tightened. All lightening arresters installed in grid substations shall be Station Class Lightening Arresters.

19.00 Internal Electrification:

Indoor Distribution Board having 63A TPN MCB, outgoing MCBs of suitable ratings for power and light & fan circuits are to be installed. Internal electrification of the control room includes provision of fans, exhaust fans, LED illumination fixtures, switches and sockets.

Two nos separate 3 m long 40 mm dia earthing shall be provided for internal electrification works. 8 SWG GI wires shall connect following equipment:

- a. Main Distribution Board and Sub-Distribution Boards,
- b. ACDB, DCDB, Battery Chargers each at 2 distinct locations

Internal Electrification works' wiring shall be provided with single core PVC insulated & PVC sheathed 2.5 mm² stranded ISI 694 marked copper flexible wire (for light and fan circuits) and 4.0 mm² stranded ISI 694 marked copper flexible wire (for power points) in conceal arrangement in 25 mm dia 2 mm thick PVC ISI marked pipe and 2.5mm thick switch boards in flash arrangement. Neutral links are to be used in each switchboards. Jointing in neutral conductor other than at switching board shall not be permitted.

Iron junction box made of 18 gauges CRCA sheet shall be used for switchboard; 2 mm thick cotton impregnated hylum sheet is to be used for the purpose of switch board. ISI marked switched and sockets are to be used for Internal Electrification works. Earth wire must be made available duly connected with earth circuit for Earthing in each and every switchboard.

Reputed make indoor double door Miniature circuit breaker DB fitted with Miniature Circuit Breakers of MDS/ Havells/ Standard make or equivalent ISI marked shall be used for the protection. Reputed make LED fittings and fans are to be used for the substation. These materials are to be procured from authorized dealer of the materials manufacturers only. Documentary evidence may be submitted for source of supply of all electrical materials. Before procurement of materials Project Manager shall approve make, type and quality of materials.

Control Room lighting shall be designed to ensure 300 lux illumination level through LED lamp fittings. The bidder shall submit calculation for achieving the above illumination before start of lighting work for approval of project manager.

20.00 Yard Lighting:

The substation area inside the fencing shall be illuminated provided with 100 Watts LED flood light fittings. Each fitting and its Junction box enclosures shall be IP 55 protection type. Water and vermin proof-ness is a must. At least 4 Nos. fittings at all the four corners shall be provided. Acceptable make of fitting, fixtures and lamp are Philips, Crompton, Alstom, and Bajaj only.

Area light supply from Substation DB to be extended through 2X16 mm² PVC insulated PVC Sheathed aluminum stranded armored power cable laid in underground trench of width 300 – mm wide, provided with 2nd class brick protection (Appro. 10 bricks per meter length of laying) and sand protective covering (200 mm thick) and laid at the depth of 750mm minimum. Laying specification of cable shall be as detailed in CPWD specification of laying power cables. Suitable loop length of 1.5 metre to be kept at the end points.

Pole mounted junction box (and not the Control Gear Box supplied with the fitting) shall be made of 2mm thick CR steel sheet of size 300X300X200mm fitted with SPN terminal block of 32A capacity, 10A SPN miniature circuit breaker of ISI mark and reputed manufacture. The JB shall be hot dip galvanized. The JB shall also conform to IP 55 protection for enclosure. Neoprene gasket shall be used in JB. 2 Nos. earthing terminals of 10 – mm dia shall be provided with 25X6mm size of mounting clamps. Bidders shall get JB drawing approved before start of manufacturing.

4 Sq.mm, 1100V grade, weather proof three core (One core for phase, one core for Neutral and one core for earthing) aluminum stranded flexible conductor PVC sheathed and PVC insulated cable conforming to IS 694 shall be used for connection of fitting and its Control Gear Box from pole

mounted Junction Box. Control Gear box must provide ISI approved components. Copper wound heavy chocks shall be acceptable.

Tubular poles 12m high as per IS: 2713 (Latest Version) embossed with ISI certification mark and pole designation shall be used for installation of area light fixtures in Urban as well as Rural substations. Pole shall be designated as 410 – SP - 60. Poles and fitting structures shall be painted with two coat of anti – rusting bitumen paint inside and outside up to the planting depth and two coat zinc oxide paint followed by 2 or more coats of aluminum paint of approved make, brand and shade on portion of pole which will remain above ground level.

21.00 ACSR / AAAC Conductor:

Following ACSR conductors (or equivalent AAAC conductor) are envisaged for bus bars, jumpers, droppers:

- a. 6/4.72 mm + 7/1.57 mm (100 sqmm Dog conductor),
- b. 30/2.59 mm + 7/2.59 mm (150 sqmm Wolf conductor), and
- c. 30/3.00 mm + 7/3.00 mm (200 sqmm Panther conductor)

Conductor shall be provided with hardware fittings, T-clamps, bi-metallic clamps and PG clamps as per requirements. T – Clamps shall be provided on each jumper on bus bars. Line jumpers shall be provided with adequate size of PG Clamps (Two numbers PG Clamps at each end of jumper). Clamp shall be made of aluminum grade T-1F as per IS – 8309 having good electrical quality aluminum material and shall not be brittle in nature. Suitable Bi – metallic clamps shall be provided at bushings of transformers and circuit breakers. Also at all those points where joining of two different materials is found, bi –metallic clamps shall be provided.

Care shall be taken while drawing conductor from the drum. Proper roller shall be used while handling conductors during erection.

22.00 Insulator, hardware and connections to equipment:

33 KV and 11 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator shall be tied properly using binding wire/helical form fitting. In road crossing and line crossing locations bridling cross arms and pin insulator shall be used.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator shall properly be cleaned before installation. No damage/crack insulator shall be used.

23.00 Power receptacles:

Two power receptacles are envisages in switch yard area to provide power supply to Transformer Oil Filtration machine and other testing and commissioning related works. Each receptacles shall house 63A MCCB as incomer, 40A 3 phase socket/switch and 1 No, 20A single phase Industrial type socket/switch of reputed brand and type.

24.00 Tube well:

Deep Tube is envisaged for all the substations. Depending on the depth of the bore, suitable capacity of submerged pump shall be installed. Bore diameter shall be 6" which must be penetrated vertically in all type of soil condition. Before digging the bore, soil Resistivity needs to be checked to ascertain the location of the best site for the tube well. Following works are envisaged under this scope:

- Digging bore of diameter six inches. Providing MS casing on bore up to the suitable depth finalized during detailed engineering.
- Providing new 3 phase submersible pump 32 stages or 30 stages depending on technical requirements.
- Providing Start Panel of reputed make like L&T, Havells or equivalent make having single phase protection, Over load protection, Pre – set timer of L&T make, Star Delta Starter, Indications for Load currents in all three phases, Indications for Supply voltages in all three phases etc. Starting panel must conform to IP 52 protection for enclosure. It shall be mounted indoor inside the Control room on 50x50x6 mm GS angle supports. Start panel must be earthed with 2 Nos 8 SWG wires. 4 core 16 Sq mm aluminum armored cable must be used for energizing this Start Panel.
- Three phase, 4 wires, copper flexible supply cables suitable for submersible pump operations, ISI marked, 1100V grade shall be connected to submersible pump through underground trench up to the well as per CPWD specifications duly protected from brick and sand cushioning.
- A Heavy-duty gunmetal wheel valve (tap) may be provided on the discharge line for drinking water requirements.
- Provision for lifting the pump in case of overhauling / breakdown maintenance may also be provided.
- ISI marked PVC or 2nd GI Pipes are to be used for suction as well as discharge water lines.
- An open drain must be provided in the vicinity of the tube well. Detail arrangement shall be finalized in detailed engineering.

25.00 Yard Earthing:

Earthing shall be provided with GI earth pipe, GS solid rod 25 mm dia and 75x8mm GS flat forming earth mat. 50x6mm GI flat shall be used for earth-riser along with GI wires / Stay wires as per requirement of Project Manager. Project Manager shall approve arrangement of earthing network. Following arrangement envisaged for grid/earth rod/ earth pipe: (Indicative drawing is enclosed with the document)

Description of equipment	Fully outdoor Substation
Earth Pit made of 3 m long, 40 mm dia GI pipe	2 Nos for power transformer neutral direct connection, 1 No for 33 kV & 11 kV Lightning Arresters direct connection, 3 Nos. for station transformer, 2 Nos. for indoor panels, 2 Nos. for internal electrification works of control room, and 2 Nos. for substation fencing
Earth rod GI solid 25 mm dia	19 Nos (+/-) 20%
Earth mat	75X8 mm GS Flat
Laying of earth mat	Below ground 0.5 meter
Earth riser	50x6mm and 25x3 mm GI Flats

Description of equipment	Partly outdoor Substation
Earth Pit made of 3 m long, 40 mm dia GI pipe	2 Nos for power transformer neutral direct connection, 1 No for 33 kV & 11 kV Lightning Arresters direct connection, 3 Nos. for station transformer, 2 Nos. for indoor panels, 2 Nos. for internal electrification works of control room, and 2 Nos. for substation fencing
Earth rod GS solid 25 mm dia	14 Nos (+/-) 20%
Earth mat	75X8 mm GS Flat
Laying of earth mat	Below ground 0.5 meter
Earth riser	50x6mm and 25x3 mm GI Flats

Standard requirements / provisions of earthing are enclosed herewith. Connections of earth-grid / earth – pit with Lightning Arrester and Power Transformer Neutral and Transformer body (at two distinct points) are to be made using 50X6mm GS flat. Connections of other equipment may be

provided with 8 SWG GI wire or GI Stay wire as per approval of Project Manager. Following arrangements are envisaged for earth connection:

1. Power Transformer Neutral (Two distinct connections)	50x8 mm GS Flat
2. Transformer Body	50x6 mm GS Flat
3. Breaker body / legs (Two distinct connections)	50x6 mm GS Flat
4. Lightning Arrester	50x6 mm GS Flat
5. Station transformer Neutral (Two distinct connections)	25x3 mm GI flat
6. Fencing	50x6 mm GI Flat
7. Control Panels (Two distinct connections)	50x6 mm GI Flat
8. Isolator structure / handle	50x6 mm GI Flat
9. Steel structure of substation	50x6 mm GI Flat
10. Line meters	25x3 mm GI Flat
11. CT, PT and Cable Tray	25x3 mm GI Flat

Fencing and gate shall be grounded. Moving portion of gate shall be grounded with flexible braided conductors of equivalent aluminum 25 mm² sizes of conductors duly lugged and bolted.

In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used. Overhead line structure shall be connected to chemical earth electrode using 8SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod.

GI flats and GI wires must be properly dressed, bundled and fixed on supporting structure at 1 to 2 feet intervals.

26.00 33 KV & 11 KV Isolators:

33 KV & 11 kV, 3-ph, 3 Pin type, Horizontal Mounting type, Gang Operated, Isolator Switch shall be installed at suitable locations as per instructions of Project Manager to isolate line section, power transformer, bus bars etc. B Class GI pipe shall be used (without any joints) for operation of isolator switch. Isolator Switch structure and handle must be earthed using 50x6 GI flat.

27.00 Fabricated steel items:

Fabricated steel structure items DC cross arm, clamp, bracket, clamps, cross bracings, bracings, strain plate, guarding channels, back clamp, transformer mounting structure etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electrical cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set shall not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

Fabricated steel structure items shall be hot dip galvanized and cleaned till good surface finish. Items shall be offered for inspection and approval by Project Manager.

In lattice structure substation, gantry structure including all fabricated structure items like DC cross arm, clamp, bracket, cross bracing etc shall be galvanized.

28.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

29.00 Fire Protection System:

Fire Buckets filled with sand: The fire buckets conforming to IS 2546/1974 filled with sand shall be installed at two places in new s/s – in control room and in switchyard near power transformer. There shall be 4 no. of buckets at each location in a s/s. The buckets shall be hanging on a steel stand. The buckets and the stand shall be as per relevant standards and will be filled with sand.

30.00 Portable Fire Extinguishers:

Carbon dioxide type and Dry chemical powder type fire extinguishers are also to be installed in newly constructed substation. All the portable extinguishers shall be of free standing type and shall be capable of discharging freely and completely in upright position. Each extinguisher shall have the instructions for operating the extinguishers on its body itself. All extinguishers shall be supplied with initial charge and accessories as required. Portable type extinguishers shall be provided with suitable clamps for mounting on walls or columns. All extinguishers shall be painted with durable enamel paint of fire red color conforming to relevant Indian Standards. Capacities of each type shall be as indicated in the schedule of quantities. Carbon dioxide (CO₂, type) extinguisher shall of 4.5 kg for control room conform to IS:2878. Dry chemical powder type extinguisher shall be of 6 kg capacity for control room conform to IS:2171.

31.00 Safety and operation equipment:

The substation shall be equipped with one following equipment for smooth operation and maintenance:

- a. Megger 1000 Volt (Electrically as well as manually operated) of Megger/Fluke/Motwane or equivalent make
- b. Earth resistance meter, Megger/Fluke/Motwane or equivalent make
- c. Crimping tool for cable from 2.5 sqmm to 185 sqmm,
- d. Torque wrench M8 to M16
- e. Multi-meter Motwane make analogue type,
- f. Tong tester digital 0-600A capacity,
- g. Allen key set,
- h. ISI marked, Discharge rod 66 KV rating with discharging copper cables & terminals – 6 Nos
- i. Electrician tool box – Tapania standard kit
- j. Set of D-spanners
- k. 12" size electrical screw driver
- l. 12" size electrical hexagonal head screw driver
- m. Pipe wrench suitable for 2 ½ inch dia pipe
- n. ISI marked rubber mat rated for 11 KV insulation, ¾" thick, size 1000mm x 2000 mm – in front of all the control panels.

Project Manager shall approve make and type of equipment.

32.00 Following details shall be provided at each substations:

For suitable information to operating staff or the other related persons visiting the substation, following facilities shall be provided before commissioning of substation or on date of inauguration of the substation.

- Sketch of substations electrical circuit inside the substation in white cotton impregnated 2 mm thick hylum sheet 2x2 feet size installed on the wall,
- Notice board 3x3 feet made out of 10 mm thick water proof ply, painted suitably and provided with 1st class teak wood ribs at the sides of 2 x ½ inches size,
- Electrical safety charts,
- Provision for notifying name, address, telephone numbers, qualification details etc of the operational staff owner intends to post at the substations and their officials in hierarchy,
- Depicting working drawings of cable terminals details and cable laying details in laminated sheets
- Color coding of bus bars and terminal conductors of the feeders using enamel painting round marks and labeling name of feeders, equipment, etc as defined.

33.00 Others:

Buildings for substation control room – shall be 10mx12m size. Details are enclosed in the tender drawing.

Indoor trenches covered with 6 mm thick chequirred plates: Concrete trench are required inside control room with 50x50x6 mm GS angle inserted at the edges for erection of control panels. Unused part of cable trench shall be covered with 6mm thick MS chequirred plates inside control room. At the entry point of trench in control room, proper sealing arrangement shall be provided so as to stop entry of reptiles and rainwater inside control room through trench.

Bi-metallic connectors shall be provided wherever there is a connection between two metal parts on all electrical equipment like 33/11 KV Power transformer, 11/0.4 KV station transformer, vacuum circuit breakers, isolators, DO Fuse, Lighting Arrester, etc.

34.00 Labelling:

Each substation equipment shall be labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words shall be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles and equipment to site for erection. Base painting and marking of digits shall be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint. The identification of phases through Red, Yellow and Blue circles shall be provided on transformer, CT, PT, 33 KV and 11 KV feeder Double Pole structures.

Control panels shall be labelled from front as well as from the back by providing serial number and name of feeder/transformer. The color coding sign on two adjacent panels shall also be provided with 100mm dia color circle overlapping two adjacent panel sheet for safety purpose.

Labeling of following information is intended by the owner preferably in local HINDI language:

1. Transformer capacity and designated name like T - 1 or T – 2,
2. VCB designated name
3. Identification of CT & PT
4. Color coding of bus bars, transformer terminals, feeders phases (R-Y-B)

5. Name of incoming / outgoing feeder – like 11 KV Nandlapur Feeder I
6. Warning instruction, if any, of availability of two sources of HT supply on same structure.
7. Earth pit designation and date of checking,

35.00 Danger board:

Each substation equipment and structures shall be provided with a danger board as per approved drawing. Danger board shall be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

36.00 Site Testing and Pre – Commissioning Checks:

An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the Field Quality Plan/ instructions of the equipment manufacturer or owner without any extra cost to the Owner. The Contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to the Owner for approval. Detail test certificates duly signed by Employer's representative & agency representative of tests jointly carried out at site before putting the equipment in use, shall be submitted by the contractor in three copies.

Agency shall also be responsible to prepare Single Line Diagram of substations and an overall power distribution network of the circle showing 400KV, 220KV, 132KV, 33 KV network and point of metering. A set of drawings which includes drawing of Single phasing AB Switch, Substation earthing arrangement are enclosed for basic information. These drawings are not necessarily showing the exact dimensions of the substations.

37.00 Equipment test records, commissioning test records and drawings –

Factory test certificates of equipment, test certificates at the time of pre-dispatch inspections, pre-dispatch inspection reports, pre-commissioning check results and post commissioning check results shall be compiled and provided in three sets to Project Manager for his approval and records.

A copy of such test record shall be offered to electrical inspector and other inspecting officials during his/her visit to substation for inspection.

38.00 Electrical Inspection by state Electrical Inspectorate:

The substations shall be subjected to the inspection of state owned Electrical Inspectorate for which payment of fees shall be made by Employer.

The responsibility of contractor shall include rectification / alteration / addition of installation as per advice of electrical inspector for successful commissioning of the substations within timelimit.

39.00 Arrangement by the Contractor:

Contractor shall project-wise make his own separate arrangements for the following:

1. Opening of a site office-cum-store,
2. Distributions of power supply at all work areas in the substation premises.
3. Construction of office and store (open & covered)
4. Construction of steel fabrication workshop and material/field testing laboratory
5. Round the clock fire protection and security arrangements for site store-cum-office during construction stage

40.00 Civil works:

Details scope under civil works have been provided in "Civil Works and Soil Investigation" at point M below.

Foundation design for power transformer, outdoor type vacuum circuit breaker, control room building, fencing, gantry structure etc shall be submitted by contractor. While designing OEM recommendations must be considered. Foundation for power transformer, outdoor type vacuum circuit breaker, control room building and fencing shall be provided with reinforcement steel. Project Manager shall approve foundation designs.

41.00 Basic Reference Drawings:

The reference drawings, which are indicative of the type of specifications owner intends to accept, are annexed with the specification. The contractor shall maintain the overall dimensions of the substation, buildings, bay length, bay width, phase to earth clearance, phase to phase clearance and sectional clearances, clearances between buses, bus heights but may alter the locations of equipment to obtain the statutory electrical clearances required for the substation.

The enclosed drawings give the basic scheme, layout of substation, associated services, earthing arrangement. These drawings are provided for general information only.

Note: The insulation and RIV levels of the equipment shall be as per values given in the respective chapter of the equipment.

42.00 Commissioning spares:

The Contractor shall supply spares, which he expects to consume during installation testing and commissioning of system. The quantity of these spares shall be decided based on his previous experience, such that site works shall not be hampered due to non-availability of these spares. Contractor shall submit a complete list of such spares along with the bid, the cost of which shall be deemed to have been included in the lump-sum proposal price of the package. The contractor, if so agreed at a cost to be negotiated may leave the unused commissioning spares at the site for use of owner.

43.00 Recommended spares:

The Contractor shall provide a list of recommended spares giving unit prices and total prices for 3 years of normal continuous operation of equipment. This list shall take into consideration and shall be given in a separate list. The Owner reserves the right to buy any or all the recommended spares. The recommended spares parts shall be delivered at the site. The list of recommended spares to be furnished by the Bidder shall also contain the following:

1. Location of each item installed along with reference drawing number.
2. Service life expectancy of each item.
3. Offer validity period

Price of recommended spares will not be used for evaluation of bids. The prices of these spares will remain valid for a period of not less than 120 days after the date on which the validity of main bid expires. Whenever recommended spares are the same as mandatory spares, then the prices of the mandatory spares and such common recommended spares shall be the same. Further, the prices of any recommended spares shall be subject to review by the Owner and shall be finalized after mutual discussions.

D. New 11 KV Lines

1.00 Survey

Mapping of route of proposed new 11 kV line by foot survey in rural/urban areas be performed mentioning various milestones. While surveying, existing electrical infrastructure in the locality should also be mapped. Line alignment (single line diagram) on political map with fair correctness, be prepared. SLD and foot survey report shall be approved by Project Manager and shall be used as basic document for assessment of works under the contract. On completion of line work, as built Single Line Diagram and pole wise line diagram showing pole wise materials used and pole-to-pole span should be submitted to Project Manager. This details shall be used as reference documents by Quality Inspecting officials to execute inspection works.

In case of feeder separation, existing agriculture load shall be mapped during survey. A report to be presented indicating location wise pumps to be fed through separate feeder. Percentage voltage regulation at farthest point on various spur sections shall be examined during survey and submitted to project manager who will take a decision for feeder separation works.

2.00 Support (pole):

Following types of support are envisaged for 11 KV overhead line:

- a) 8 m/140 kgs PCC Poles - (PCC Pole as per state practice)
- b) 13 m long H-Beam 152x152 mm, 37.1 kg/mtr
- c) 11 m long H-Beam 152x152 mm, 37.1 kg/mtr
- d) 11 M long Steel Tubular poles of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)
- e) 9 M long Steel Tubular poles of Designation 540 SP 28 (IS 2713, Pt I, II, III 1980)

In rural area, PCC poles are to be used. In urban area, PCC or H-Beam supports are to be used of suitable length. In hilly areas where handling of material is a challenge, tubular poles may be used. In location specific conditions like forest area, vicinity of other existing overhead lines or permanent structures etc, H- beam or tubular poles may be used. Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

H-Beam support and steel tubular poles shall be cleaned till good surface finish and painted with 2 or more coats of red oxide paint and 2 or more coats of aluminium paint till good finish. Steel tubular poles and H-Beams shall also be painted with 2 or more coats till good surface finish with anti-corrosive paint (in case of tubular poles shall also be painted on the inner walls) which goes in to the foundation. Project Manager shall approved brand and shade of paints.

Painting of H-Beams and Steel Tubular Poles shall be performed at stores. Before shifting to site for erection, poles shall be offered for inspection and approval by Project Manager or authorized representative before erection.

3.00 Fabricated steel items:

Fabricated steel items like V cross arm, top clamp, DC cross arm, bracket, clamps, cross bracings, bracings, strain plate, guarding channels, back clamp, transformer mounting structure etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electrical cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have

any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

Fabricated steel structure items shall be hot dip galvanized and cleaned till good surface finish. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633. Items shall be offered for inspection and approval by Project Manager.

4.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

5.00 Stay Set:

Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (2Nos.), anchor plate (200x200x6mm) , nut-bolts, 2 Nos turn-buckles, 1.8 m long, 16 mm diameter solid GS stay rod & 7/3.15 mm dia GI stranded wire complete.

Stay set shall be used at all turning locations, conductor dead end supports, double pole structure, triple pole structure, four pole structure to nullify the tension of conductor. Erection of storm guys at suitable location in straight line may also be provided. Erection of storm guys at suitable location in straight line may also be provided.

0.2 cmt cement concreting in mixture 1 part cement, 3 part coarse sand, 6 part 40mm size aggregate stone chips (1:3:6). 2 Nos. guy insulator shall be provided in stranded GI wire at middle location between two turn buckles.

6.00 Earthing:

Following earthing arrangements are envisaged for new 11 kV lines:

- a) 40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories complete
- b) GI Earthing spike made of 20mm solid rod
- c) Chemical rod earthing including electrode, chemical, with 2000mm long, 50 mm diameter GI pipe, GI Strip of 24x3mm minimum in hard rock locations only.
- d) 6 SWG GI wire for earthing and guarding
- e) 8 SWG GI wire for earthing and guarding

Each 11 kV line support shall be provided with one GI earthing spike made of 20 mm solid rod or GI Earth Coil and connected with 8 SWG GI wire. Overhead line structure shall be connected to GI earthing spike or GI Earth Coil using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod. Project Manager shall decide use of GI Earth Coil or 20mm dia GI Solid Rod for individual pole earthing.

At railway crossing, line crossing and other specific locations 40 mm dia, 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories shall be used. Overhead line structure at these locations shall be connected to GI earth pipe using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 40 mm GI earth pipe.

In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used. Overhead line structure shall be connected to chemical earth electrode using 8SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod.

In road crossings and line crossings, 6 SWG GI wire shall be used for cross lacing and 8 SWG wire shall be used for guard wires.

GI flats and GI wires must be properly dressed, bundled and fixed on supporting structure at 1 to 2 feet intervals.

7.00 Insulator and hardware –

11 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator should be tied properly using binding wire & tape/helical form fitting. In road crossing and line crossing locations bridling cross arms and pin insulator shall be used.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator should properly be cleaned before installation. No damage/crack insulator should be used.

8.00 ACSR / AAAC Conductors:

Following ACSR Conductors (or equivalent AAAC Conductor) are envisaged for new 11 kV lines:

- a) 6/2.11 + 1/2.11 mm (20 mm² Al. Area) - Squirrel
- b) 6/2.59 + 1/2.59 mm (30 mm² Al. Area) - Weasel
- c) 6/3.35 + 1/3.35 mm (50 mm² Al. Area) - Rabbit
- d) 6/4.09 + 1/4.09 mm (80 mm² Al. Area) - Raccoon
- e) 6/4.72 mm + 7/1.57 mm (100 mm² Al. Area) - Dog

Project Manager shall decide size of conductor on proposed 11 KV line.

Care should be taken while drawing conductor from the drum. Proper roller should be used while handling conductors during erection. Jointing sleeves, binding materials, PG clamps, bi-metallic conductor shall be used for conductor jointing, insulators fixing, jumpering and termination at equipment respectively. There must not be uneven sag between conductor/spans.

Proper sag should be maintained using sag chart table. While tensioning, care should be taken to avoid tension on pin insulator. Therefore, proper alignment of line to be ensured.

At terminal location, care should be taken while connecting two sections to avoid bird faults. Therefore, pin insulator is to be used to handle the conductor on DC cross channel.

9.00 11 KV AB Switch:

11 kV, 3-ph, 600 A, 3 Pin type, Vertical/Horizontal Mounting type, Gang Operated, AB Switch shall be installed at cut points and at suitable locations as per instructions of Project Manager. B Class GI pipe shall be used (without any joints) for operation of switch. AB Switch structure and handle must be earthed using 8 SWG GI wire.

10.00 Pole numbering:

Each support pole shall be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint. Warning instruction, if any, of availability of two sources of 33 kV supply on same structure, at source structure, at cut points should exclusively be provided as per state practice.

11.00 Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each 11 kV support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

12.00 Danger board:

Each support shall be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

13.00 Support foundation:

Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40 mm size aggregate stone chips (1:3:6) shall be used in steel tubular poles and H-Beam 11 kV line supports.

In rural areas, PCC pole pit shall be refilled with 200 mm average size of bolder mixed with excavated earth. Proper ramming shall be performed for better compaction. All Double pole (DP), Triple pole (TP), cut point poles, Distribution Transformer substation poles and poles erected on water logging area shall be grouted using cement concrete mixture similar to H-Beam & Tubular poles. Prior approval of Project Manager shall be obtained for concreting of PCC poles in water logging area. While preparing route survey report, water logging areas shall be earmarked.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shuttering and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular and H-Beam poles to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

14.00 11 kV line for underground railway crossing –

Two separate composite items of 11 kV line railway crossing is kept in BoQ. One is with 300 sq.mm cable & another one with 185 sq.mm cable.

2 Nos. separate cables shall be laid in separate GI pipe enclosures. At a time, one shall be used and another shall be kept idle as spare in ready to connect condition. Cable termination, cable identification, protective covering, laying of jumpering cable etc shall all be completed in this head. These composite items shall contain following sub-items:

- a) 3Cx185 (3Cx300) sqmm XLPE armored cable (approx. length is 0.3 km each) – 2 sets
- b) 150mm dia GI pipe of A class (red color painted on edges) for cable protection in underground laying – 2 sets
- c) 150mm dia GI pipe of B class (blue color painted on edges) for cable support at DP structure – 2 sets
- d) Outdoor heat shrinkable cable jointing kits for main cable and jumpering cable – 4 Nos for main cable and 8 Nos for jumpering cables.
- e) 11 kV lightening arrester station class 10kA (6 nos.),
- f) 4 Nos GI 3-meters long pipe earthing,
- g) 6 SWG GI wires with GI nuts, bolts & washers,
- h) Cable markers,
- i) Bi-metallic clamps,
- j) Jumpering with 11 kV Arial Bunched Cables 200 Sqmm dia (10 mtr) etc – 4 sets

Detail survey of location of railway crossing be performed by contractor to avoid multi-crossing at nearby location. Prior railway permission for execution of this work shall be obtained by Project Manager for which necessary technical support shall be provided by contractor. Line crossing shall be performed using underground cabling. Block on railway traffic shall be arranged by Project Manager. Contractor should ensure timely completion of work during block period by mobilizing requisite man, materials and machine at crossing locations.

Horizontal drilling machine shall be used for horizontal bore below railway tracks.

15.00 Quality & Quantity inspection and compliance to the observation:

The line works, before or after commissioning/energisation, shall be inspected by Quality Inspectors and State Inspection Inspectorate. Contractor shall provide all requisite details of line like approved survey report, as built drawings and joint measurement sheet to the inspector to conduct. Contractor shall rectify defects/deficiencies and submit compliance to the observations with supporting photographs in digital form within one month from receipt of observations.

16.00 Tree-cutting/trimming of tree:

The Contractor shall count, mark and put proper numbers with suitable quality of paint at his own cost on all the trees that are to be cut/trim to obtain required tree clearance. Contractor shall pay compensation for any loss or damage for tree cutting due to Contractor's work. Wherever forest clearance is envisaged for execution of work, clearance of forest department for tree cutting, if required, shall be arranged by the Project Manager and compensation shall also be paid by the Project Manager. Necessary fee if required to pay to Govt. dept. for arranging such clearances shall be paid by Project Manager. However, the contractor would require to provide all necessary assistance for execution of this work.

17.00 Statutory clearances:

During execution of 11 KV Line work, all statutory clearances shall be ensured for ground clearance, line-to-line clearance, road crossing clearance, horizontal and vertical clearances from buildings/objects etc. All road crossings and line crossings shall be guarded as per specifications. Conductor joint should not be provided in mid span length. Instead, it should be nearer to the support.

E. Distribution Transformer Substations

1.00 Survey of Distribution Transformer Substations:

A detailed survey of existing habitation/village shall be performed in presentable document showing population residing in the un-electrified area/existing electrified area of habitation/ village, best location of installation of a new distribution transformer substation and the capacity of transformers to be selected for installation. The capacity of DTR shall be governed by following technical aspects:

- a) Optimistic lengths of LT lines needed to feed the beneficiaries,
- b) Space available for installation of support/transformers,
- c) Probable load expected to come on the transformer due to existing BPL beneficiaries /others connected /un-connected probable beneficiaries in the locality taking care of their expected load growth in next 5 years.
- d) Distribution Transformers of capacity 16 KVA to 315 KVA (single phase as well as three phase) shall be decided as per standard rating of distribution transformer as depicted in IS specifications. Nonstandard ratings of DTR shall not be installed.
- e) Distribution Transformers of capacity 16 KVA to 315 KVA (single phase as well as three phase) shall be installed on double pole structures. Hence, three phase 11 KV lines shall be laid for 16 KVA to 315 KVA (single phase as well as three phase) capacity sub-stations. Single phase lines shall only be permitted for 10 KVA single phase transformers mounted on single pole structure.
- f) Double pole support galvanized steel structures for 16 KVA and 25 KVA distribution transformers shall be designed in such a way that they can be augmented to 63 KVA transformer structures without any addition in near future on technical requirements.

Based on survey report, Project Manager shall decide type, capacity and location of Distribution Transformer sub-station.

2.00 Following types of support are envisaged for 11/0.4 or 11/0.25 KV Distribution Transformer Substation support:

- f) 8 m/140 kgs PCC Poles - (PCC Pole as per state practice) – up to 100 KVA rating only
- g) 13 m long H-Beam 152x152 mm, 37.1 kg/mtr
- h) 11 m long H-Beam 152x152 mm, 37.1 kg/mtr
- i) 11 M long Steel Tubular poles of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)
- j) 9 M long Steel Tubular poles of Designation 540 SP 28 (IS 2713, Pt I, II, III 1980)

In rural area, PCC poles are to be used. In urban area, PCC or H-Beam supports are to be used of suitable length. In hilly areas where handling of material is a challenge, tubular poles may be used. In location specific conditions like forest area, vicinity of other existing lines and permanent structures etc, H- beam or tubular poles may be used. Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

PCC supports shall be used for distribution transformer substation up to 100 KVA capacity only. Beyond 100 KVA rating, H-Beam supports shall be used for mounting of distribution transformer.

H-Beam support and steel tubular poles shall be cleaned till good surface finish and painted with 2 or more coats of red oxide paint and 2 or more coats of aluminium paint till good finish. Steel tubular poles and H-Beams shall also be painted with 2 or more coats till good surface finish with anti-corrosive paint (in case of tubular poles shall also be painted on the inner walls) which goes in the foundation. Project Manager shall approved brand and shade of paints.

Painting of H-Beams and Steel Tubular Poles shall be performed at stores yard. Before shifting to site for erection, poles shall be offered for inspection and approval by Project Manager before erection.

3.00 Fabricated steel items:

Fabricated steel items like DC cross arm (100x50x6 mm), back clamps (65x8 mm), pole clamp (65x8 mm), DO mounting channel (100x50x6 mm), transformer mounting channel (100x50x6 mm), transformer clamping set (50x50x6 mm), transformer belting set (50x50x6 mm), V cross arm, top clamp, DC cross arm, bracket, clamps, cross bracings, bracings, strain plate, back clamp, transformer mounting structure etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electric cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

Fabricated steel structure items shall be hot dip galvanized and cleaned till good surface finish. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633. Items shall be offered for inspection and approval by Project Manager.

4.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

5.00 Stay Set:

Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (2Nos.), anchor plate (200x200x6mm) , nut-bolts, 2 Nos turn-buckles, 1.8 m long, 16 mm diameter solid GS stay rod & 7/3.15 mm dia GI stranded wire complete.

Stay set shall be used at all sub-station location to nullify the tension of conductor/cable/transformer on the supports. 0.2 cmt cement concreting in mixture 1 part cement, 3 part coarse sand and 6 part 40mm size aggregate stone chips (1:3:6) shall be provided in the foundation of the stay set. 2 Nos. guy insulator shall be provided in 7/3.15 mm dia stranded GI wire at middle locations between two turn buckles.

6.00 Distribution Transformer:

Following type and sizes of minimum 4 star rated {as per Bureau of Energy Efficiency (BEE)}, distribution transformers are standardized in the project:

- a) 5/6 KVA 1 phase Aluminium / Copper wound DTR
- b) 10 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
- c) 16 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
- d) 25 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
- e) 63 KVA 3 phase Aluminium / Copper wound DTR

- f) 100 KVA 3 phase Aluminium / Copper wound DTR
 - g) 200 KVA 3 phase Aluminium / Copper wound DTR
 - h) 250 KVA 3 phase Aluminium / Copper wound DTR
 - i) 315 KVA 3 phase Aluminium / copper wound DTR
- Or any other rating as per latest Indian Standard Specification

The Distribution Transformers shall be 11/0.4 KV or 11KV/230 V or 22/0.44 KV non-sealed type BEE specified minimum 4 Star Distribution Transformers. The transformers shall be double wound, three phase, CRGO M3 Grade (0.23mm) or better (The core shall be constructed from high grade, non-ageing, Cold Rolled Grain Oriented (CRGO) silicon steel of M3 Grade (0.23mm) laminations only. PRIME CORE M3 Grade (0.23mm) materials are to be used for transformers core.

Distribution Transformers shall be subject to inspection during manufacturing (stage inspection), pre-delivery inspection, and inspection at site during pre-erection/post erection/post commissioning conditions. Project Manager shall select samples from the core laminations and get the same tested in CPRI/ NABL Accredited laboratory to prove the quality of the core material.

The distribution transformers shall be supplied with transformer oil filled up-to maximum permissible level and breather with silica gel.

The distribution transformers must have been successfully type tested within five years from date of Letter of Intent and the designs should have been in satisfactory operation for a period not less than two years as on the date of bid opening. Compliance shall be demonstrated by submitting, (i) authenticated copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./State Govt. or their undertakings.

4 STAR LEVEL: Each Distribution Transformers must contain minimum 4 Star Label with style and information provided by the Bureau of Energy Efficiency (B.E.E), Ministry of Power, Government of India.

The losses in Distribution Transformer should be as per Energy Efficiency Level-2 and above as specified in IS 1180 (Part-1):2014 for all kVA ratings of distribution transformers

Bimetallic connectors of suitable capacities are to be provided on LT side and on HT side of the transformer.

T-Clamps should be provided on each jumper on bus bars. Line jumpers should be provided with adequate size of PG Clamps (Two numbers PG Clamps at each end of jumper). Clamp should be made of aluminum grade T-1F as per IS-8309 having good electrical quality aluminum material and should not be brittle in nature.

Transformers should be tested for pre-commissioning checks which includes Insulation Resistance Test, ratio test and oil breakdown voltage test. Before formal energisation, oil leakages from the parts of the transformer, oil level in conservator tank, condition of silica gel, earth connection (two separate) between neutral and earthing, proper jointing of earth wires/flats at the joints and earth resistance of the individual earthing pits are to be checked and recorded. On commissioning of the transformer, phase current and phase to phase voltage, phase to neutral voltage are to be recorded. The loading on the transformers should be balanced. The quantum of neutral current flowing through neutral shall be recorded. A record of pre-commissioning checks/tests are to be prepared and submitted to the Project Manager.

7.00 ACSR / AAAC Conductor:

ACSR raccoon conductor (or equivalent AAAC Conductor) is to be used for connection between overhead lines to transformer studs/bushing.

8.00 Distribution box and Power Cabling:

Distribution boxes are to be installed as per specifications enclosed. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks should be prepared and submitted.

All CT terminals are to be ring type and other terminals are fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided between CT and Meter keeping 20% spare terminals.

The distribution boxes are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the distribution boards should be provided of 10mm dia.

The single core power cables should be terminated with proper size lugs and gland. Necessary tagging, identification of cores and dressing of cables with nylon cable ties shall be in the scope of work. The unutilized holes in the DBs provided for cable entry needs to be plugged properly in a manner that it must stop access to reptiles, dust and water ingress.

The Low Tension bus bars are to be painted with two or more coats of brush-able epoxy compound suitable to insulate the bus bars for 415 volts exposure.

The distribution box, for transformers upto and including 25 KVA, should also house three phase tri-vector energy meter / single phase meter depending on capacity and type of distribution transformer as per specifications. For higher capacity transformers, CT operated meters are to be installed. Separate LTCT cum Meter Box at eye height shall be installed for housing of meter, CTs, terminal block and wiring.

The single core un-armored power cables shall be used for connection from Distribution Transformer to Distribution Box and Distribution Box to Outgoing LT lines. Cable should not be used in underground laying arrangement. Cables should be dressed & tied properly using clamps /cable ties at 1 meter intervals and tied with substation structure/poles. At-least one meter cable is to be kept as spare at the individual ends.

Following arrangements shall be made for LT Distribution Transformers and LT Cables:

No	Type of DTR	Incomer		Outgoing	Cable	
		MCB/Isolator	HRC fuse	MCCB	1	2
1	5/6/10 KVA 1 Ph	45A SPN MCCB		2x32A SP MCCB	1Cx16 sqmm UA	
2	16 KVA 1 Ph	80A SPN MCCB		2x50A SP MCCB	1Cx16 sqmm UA	
3	16 KVA 3 Ph	25A TPN MCCB		6x16A SP MCCB	1Cx16 sqmm UA	
4	25 KVA 1 Ph	40A SPN MCCB		3x25A SP MCCB	1Cx35 sqmm UA	
5	25 KVA 3 Ph	40A TPN MCCB		6x25A SP MCCB	1Cx35 sqmm UA	
6	63 KVA 3 Ph	200A TPN Isolator	100 A	6x60A SP MCCB	1Cx50/70 sqmm UA	1Cx70 sqmm UA
7	100 KVA 3 Ph	200A TPN Isolator	160 A	6x90A SP MCCB	1Cx50/70 sqmm UA	1Cx150 sqmm UA
8	200 KVA 3 Ph	600A TPN Isolator	315 A	9x120A SP MCCB	1Cx150 sqmm UA	1Cx300 sqmm UA
9	315 KVA 3 Ph	600A TPN Isolator	500 A	12X120A SP MCCB	1CX150 sqmm UA	1CX300 sqmm UA

1.1 KV XLPE Aluminium Conductor, Stranded, un-armored cable be used for connection of transformer LV bushing to Distribution Box and Distribution box to overhead line.

9.00 Earthing:

Distribution Transformer Earthing shall be provided with 3 Nos earthing and making earth mat /risers using 50X6mm GI Flat. Earthing should be provided with GI earth pipe or Chemical Earthing depending of strata of soil in the location. Project Manager shall decide the type of earthing.

25x3mm GI Flat and 8 SWG GI shall be used for making earthing connection to various sub-station equipment as per given details. GI Flat and GI wire shall be properly dressed, bunched and clamped with the support at 2 feet intervals. An overlapping of 35mm shall be used at the place of flat to flat joint. Two sets of GI nuts, bolts and washers shall be used for flat-to-flat joints. GI nuts, bolts and washers must be used for GI Flat-to-GI wire & GI wire-to-GI wire joints.

Substation wise measurement of earth resistance of earth pits / mesh and corresponding drawing of existing earthing arrangement shall be recorded and submitted to Project Manager.

Description of equipment	Earth connection
Earthing pits	3 Nos. Earth Pipe 3 m long, 40 mm dia or Chemical Earthing
Earth mat and riser	50X6 mm GI Flat / 8 SWG GI wire
Laying of earth mat	Below ground 0.5 meter

Standard requirements of earthing shall be as under:

- a) Earth Pit – 1 for Transformer Neutral,
- b) Earth pit - 2 for Lightning Arrester,
- c) Earth pit – 3 for Equipment body earthing.

Following arrangement is envisaged for various equipment of distribution transformer substation:

- a) Transformer Neutral (Two distinct connections) : GS Flat 25X3mm
- b) Transformer Body : GS Flat 25X3mm
- c) Lightning Arrester : GS Flat 25X3mm
- d) Fencing (Wherever required) : GI wire 8 SWG
- e) LT Distribution Box (Two distinct connections) : GI wire 8 SWG
- f) AB Switch handle : GI wire 8 SWG
- g) Steel structure of substation : GI wire 8 SWG
- h) Line meters : GS wire 8 SWG

The location of earth pits should be at-least 3m apart, so that they their earth conductive areas do not overlap. In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used in place of normal GI pipe type earthing. Project Manager shall decide type of earthing pits.

10.00 Metering of DTR:

Single phase or three phase metering of DTR shall be provided. The meter shall be installed in a metallic enclosure. Enclosure shall be earthed at two locations. The meter board shall be provided with push-and clamp type terminals. All CT terminals are to be provided with ring type lugs. Meter shall be tested before installation as per prevailing practice Employer. There would be no testing charges levied by Employer for testing of meters in their authorized laboratories, if facilities are available. In case of CT operated meter, metallic LTCT cum Meter box shall be provided at working height.

Upto 25 KVA transformers, meter shall be installed in distribution box. For transformer capacity 63 KVA and above, LTCT-cum-meter box shall be installed at working height on substation support.

11.00 Insulator and hardware:

11 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator should be tied properly using binding wire/helical form fitting. Bi-metallic clamps must be used at terminals.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator should properly be cleaned before installation. No damage/crack insulator should be used.

12.00 Substation numbering:

Each Substation should be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint.

13.00 Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each sub-station support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

14.00 Danger board:

Each support should be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

15.00 Support foundation:

Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40 mm size aggregate stone chips (1:3:6) shall be used in PCC Pole, steel tubular poles and H-Beam support foundation.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shuttering and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular and H-Beam poles to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

16.00 11 KV AB Switch:

11 kV, 3-ph, 200 A, 3 Pin type, Horizontal/Vertical Mounting type, Gang Operated, AB Switch shall be installed on 100 KVA and more capacity distribution transformer substation only. B Class GI pipe shall be used (without any joints) for operation of switch. AB Switch structure and handle must be earthed using 8 SWG GI wire.

17.00 11 KV Drop Out Fuses:

11 kV, 3-ph, Drop Out fuse units (set of 3 units) along with Support Insulators, Base Channel, fuse barrel etc. shall be used for all capacity Distribution Transformer Substations. DO Fuse structure shall be earthed using 8 SWG GI wire.

18.00 Lighting Arrester:

Distribution Class LAs on each phase shall be provided in the sub-station with base steel structure, terminals bi – metallic connectors / PG clamps and earth connectors. LAs are to be connected with separate earth connection. 25x3 mm GI flat shall be used for earth connection.

F. New LT Line

1. Survey:

Mapping of route of proposed new LT line by foot survey in rural/urban areas be performed mentioning various milestones. While surveying, existing electrical infrastructure in the locality should also be mapped. Line alignment (single line diagram) on political map with fair correctness, be prepared. SLD and foot survey report shall be approved by Project Manager and shall be used as basic document for assessment of works under the contract. On completion of line work, as built Single Line Diagram and pole wise line diagram showing pole wise materials used and pole-to-pole span should be submitted to Project Manager. This details shall be used as reference documents by Quality & Quantity Inspecting officials to execute inspection works.

2. The LT line between distribution transformer and consumers shall be on LT Aerial Bunched cables.

3. Support for LT overhead Line:

- a) 8 M/140 kgs PCC Poles (PCC Pole as per state practice)
- b) 11 M long H-Beam 152x152 mm, 37.1kg/mtr
- c) 11 M long Steel Tubular poles of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)
- d) 9 M long Steel Tubular poles of Designation 540 SP 28 (IS 2713, Pt I, II, III 1980)

In rural area, PCC poles are to be used. In urban area, PCC or H-Beam supports are to be used of suitable length. In hilly areas where handling of material is a challenge, tubular poles may be used. In location specific conditions like forest area, vicinity of other existing overhead lines or permanent structures etc, H- beam or tubular poles may be used.

H-Beam support and steel tubular poles shall be cleaned till good surface finish and painted with 2 or more coats of red oxide paint and 2 or more coats of aluminium paint till good finish. Steel tubular poles and H-Beams shall also be painted with 2 or more coats till good surface finish with anti-corrosive paint (in case of tubular poles shall also be painted on the inner walls) which goes in to the foundation. Project Manager shall approved brand and shade of paints.

Painting of H-Beams and Steel Tubular Poles shall be performed at stores. Before shifting to site for erection, poles shall be offered for inspection and approval by Project Manager.

4. Fabricated steel items:

Fabricated steel items like clamps, stay clamp, etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electrical cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

Fabricated steel structure items shall be hot dip galvanized and cleaned till good surface finish. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633. Items shall be offered for inspection and approval by Project Manager.

5. Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure wherever required.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

6. Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (1 No.), anchor plate (200x200x6mm), nut-bolts, 2 Nos turn-buckles, 1.8 m long, 16 mm diameter solid GS stay rod shall be used with 7/3.15 mm dia GI stranded wire.

Stay set shall be used at all turning locations, cable dead end locations to nullify the tension of the cable. Erection of storm guys at suitable location in straight line may also be provided. Erection of storm guys at suitable location in straight line may also be provided.

0.2 cmt cement concreting in mixture 1 part cement, 3 part coarse sand, 6 part 40mm size aggregate stone chips (1:3:6). 2 Nos. guy insulator shall be provided in stranded GI wire at middle location between two turn buckles.

7. Following earthing arrangements are envisaged for new LT lines:

- 7.1.1. 40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories complete
- 7.1.2. GI Earthing spike made of 20mm solid rod or 8 SWG, 50 turns earthing coil
- 7.1.3. Chemical rod earthing including electrode, chemical, with 2000mm long, 50 mm diameter GI pipe, GI Strip of 24x3mm minimum in hard rock locations only.
- 7.1.4. 8 SWG GI wire for earthing and guarding

Every sixth LT line support shall be provided with one GI earthing spike made of 20 mm solid rod or GI Earth Coil and connected with 8 SWG GI wire. Overhead steel items shall be connected to GI earthing spike or GI Earth Coil using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod. Project Manager shall decide use of GI Earth Coil or 20mm dia GI Solid Rod for individual pole earthing.

In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used. Overhead line structure shall be connected to chemical earth electrode using 8SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod.

GI wires must be properly dressed and fixed on supporting structure at 1 to 2 feet intervals.

8. LT line shall form following areal bunched XLPE cables:

- 8.01 1X16 (Ph) + 1X25 (bare messenger cum neutral) SQ. MM.
- 8.02 1X16 (Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting)SQ. MM.
- 8.03 3X16(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 8.04 3 X 16(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 8.05 1X25(Ph)+1x25 (bare messenger cum neutral) SQ. MM.
- 8.06 1X25(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 8.07 3X25(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 8.08 3 X 25(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 8.09 1X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.

- 8.10 1x35(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 8.11 3X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 8.12 3X35 (Ph) + 1x25 (bare messenger cum neutral)+ 1x16 (insulated Street lighting) SQ. MM.
- 8.13 3X50(Ph)+1X35 (bare messenger cum neutral) SQ. MM.
- 8.14 3X50 (Ph)+1x35 (bare messenger cum neutral) +1x16 (insulated Street lighting) SQ. MM.
- 8.15 3X95(Ph)+1X70 (bare messenger cum neutral) SQ. MM.
- 8.16 3X95(Ph)+1X70 (bare messenger cum neutral) +1x16 (insulated Street lighting) SQ. MM.

9. Distribution box:

Single phase or three phase distribution box shall be provided for extending power supply to LT consumers. Distribution Box (DB) shall be mounted on LT pole with MS clamp of 40x3 mm size duly painted. DB shall be earthed using 8 SWG GI wire.

Single phase DB shall be suited for two core 25 sqmm aluminium conductor cable as incomer and 8 nos. two core 10 sqmm conductor cables as outgoing cables. Three phase DB shall be suited for four core 35 sqmm aluminium conductor cable as incomer and 4 nos. four core 16 sqmm conductor cables as outgoing cables.

The distribution box shall be installed only at locations where BPL connections are provided.

10. Connection from ABC cable:

2Cx25 sqmm cable or 4Cx35 sqmm cable shall be used between LT line and Distribution box. T-connector shall be used at LT line for tapping. While tapping connection from ABC cable, highly skilled lineman/wireman shall be deployed along with sophisticated cutting plier/tool so that no damage should result in AB cable conductor. T-connector should be crimped properly for resistance free/maintenance free electric connection. Alternately, piercing type connector may be used for tapping of LT connection from ABC cable conductor.

11. Pole numbering:

Each support pole should be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint.

12. Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each LT line support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

13. Danger board:

Each support should be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

14. Support foundation:

Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40 mm size aggregate stone chips (1:3:6) shall be used in steel tubular poles and H-Beam LT line supports.

In rural areas, PCC pole pit shall be refilled with 200 mm average size of bolder mixed with excavated earth. Proper ramming shall be performed for better compaction. PCC pole at cut point and PCC poles erected on water logging area shall be grouted using cement concrete mixture similar to H-Beam & Tubular poles. Prior approval of Project Manager shall be obtained for concreting of PCC poles in water logging area. While preparing route survey report, water logging areas shall be earmarked.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shuttering and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular and H-Beam poles to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

15. Quality & Quantity inspection and compliance to the observation:

The line works, before or after commissioning/energisation, shall be inspected by Quality Inspectors and State Inspection Inspectorate. Contractor shall provide all requisite details of line like approved survey report, as built drawings and joint measurement sheet to the inspector to conduct. Contractor shall rectify defects/deficiencies and submit compliance to the observations with supporting photographs in digital form within one month from receipt of observations.

16. Tree-cutting/trimming of tree:

The Contractor shall count, mark and put proper numbers with suitable quality of paint at his own cost on all the trees that are to be cut/trim to obtain required tree clearance. Contractor shall pay compensation for any loss or damage for tree cutting due to Contractor's work. Wherever forest clearance is envisaged for execution of work, clearance of forest department for tree cutting, if required, shall be arranged by the Project Manager and compensation shall also be paid by the Project Manager. Necessary fee if required to pay to Govt. dept. for arranging such clearances shall paid by Project Manager. However, the contractor would require to provide all necessary assistance for execution of this work.

17. Statutory clearances:

During execution of LT Line works, all statutory clearances shall be ensured for ground clearance, line-to-line clearance, road crossing clearance etc.

18. The earthing point of distribution transformer should be extended to the single phase beneficiary premises having en-route earth connection at every 6th supports. The earth conductor is to be connected with earth point provided in the premises of single phase consumers. The bearer wire shall be earthed at every sixth pole.

19. Bearer wire of LT AB cable shall be anchored through eyehook or dead end (anchor) clamps.

20. Extra length of continuous AB cable along with messenger / bearer wire shall be properly dressed and clamped.

21. LT Consumer Connection From Service Pole (As Per Rec Spec.5/1986)

21.1. General arrangement for LT consumer connection shall be as depicted in REC Construction Standard drawing H-1 and H-2. For all identified BPL (Below Poverty Line) consumers, the contractor shall carry out following works:

- a. Service line from nearby LT pole/Distribution Board/Distribution Transformer,
- b. Installation of energy meter, metal meter box, double pole miniature circuit breaker, meter board and earthing point,
- c. Internal wiring works comprising of separate wooden/ Fiber Glass Reinforced Polyester sheet moulding compound (SMC) board, 5 A switch & socket, one separate LED light point, bakelite/wooden round base to house pendant holder, LED lamp, internal wiring between meter board to switch board and switch board to pendant holder.
- d. Testing of consumer meter at distribution licensee's test laboratory,

Following materials shall be used for single phase service connection:

21.1.1. Service Cable: 2.5 mm² twin core (unarmoured) PVC insulated cables with aluminium conductors as per REC Specification 26/1983 shall be used, Alternatively, PVC insulated cables with embedded bearer wire as per REC Specification No27 /1983 can also be used. These are particularly useful for costal and polluted areas, where corrosion of G.I bearer wire is a problem. Following are instruction for service cables:

- a. The cable shall be free of joints,
- b. The cables shall have substantial weather proof and weather resisting properties.
- c. The span shall not be more than 35 meters or shorter as indicated in REC Construction Standards H-1 to H-9.
- d. The size of the bearer wire, which should be used invariably when insulated wire services are given should be 3.15 mm (10 SWG) GI wire (55-95 kg. quality)
- e. The service wire should be taken through suitable porcelain spool or any other insulating cleat attached with bearer wire by means of binding wire.

21.1.2. Meter Board: The meter board should be preferably of the box type with sides covered and back open i.e. the meter board will have a frame all round having a clear depth of 40mm to which front board will be fixed. Size of the meter board should be 350 x 200 mm. Each meter board shall be provided with 4(four) anchor bolts 6 mm. Meter board shall be of good quality wood or Fiber Glass Reinforced Polyester sheet moulding compound (SMC) board. The back part of the board should be covered.

21.1.3. Switch Board: Wooden / Fiber Glass Reinforced Polyester sheet moulding compound (SMC) board {200x150x40 (minimum)} should be installed at normal operating height. Following accessories shall be installed on switch board:

- i. 2 Nos. ISI mark, Piano type 5A, 240V, Switch,
- ii. 1 No ISI mark, 5A, 240V, three-pin socket,

21.1.4. Service Supports: Service supports comprising of G.I. Pipe, M.S. angle or Rigid Steel conduit and of sizes given in REC Construction Standard H-1 shall be used.

21.1.5. Single Phase energy meter: Fully Static, class 1.0, compatible with state's existing metering system, 5-30A, 240 Volts. Meter body and cover shall be sealed after testing and adjustment with the sealing plier in association with DISCOM officials.

- 21.1.6. PVC Pipe: PVC Pipe 25 mm² dia (ISI marked) as per IS-2509 (3 mtr piece) for service termination – if PVC pipe is being used to receive service wire, then 3 meter length angle 35x35x5mm duly painted shall be used to support the pipe.
- 21.1.7. GI Wire: 3.15mm dia hard quality GI wire as per IS 280 is to be used to support the service wire coming from the LT line pole and for guy. The service wire shall have ground clearance of 5800mm across the road, 5500mm along the road and 4000mm elsewhere. The span should not be more than 35 meters.
- 21.1.8. LT line support should be installed matching with the single-phase-service-wire length requirements of “up to 35 meters”.
- 21.1.9. GI pipe or MS angle 35mmx35mmx5mm shall be clamped firmly using 40x3mm MS flat clamps at at-least two locations.
- 21.1.10. GI Medium Class ISI marked, (Blue tripped painted) pipe 20 mm dia (3 mtr single length without joints) as per IS 1161
- 21.1.11. Double pole miniature circuit breaker - 16 amps (one number)
- 21.1.12. Meter box for single phase meter made of shall be provided for meter protection. The Polycarbonate Meter Box (MMBs) shall be 285mmx200mmx150mm(i.e. height x width x depth).
- 21.1.13. Reel Insulator and Egg Insulator as per requirements,
- 21.1.14. G.I. Wire No. 10 (3.15 MM) (For extension of system earth to meter board)
- 21.1.15. Protection and Earthing: Meter board {200x350x40mm(minimum)} should house earth terminal as per CEA regulations and 16 A two pole MCB. It should be installed at 1500mm min height on the wall. The earth terminal shall be installed and maintained by DISCOM/Distribution licensee. The back part of the board should also be covered.
- 21.1.16. House wiring: Each BPL Household shall be provided with internal house wiring between switch board and Angle Holder. 1 No. 9W screw type LED Lamp shall also be provided. PVC insulated and PVC sheathed single core 1.5 sq mm multi-strandscopper conductor cable as per IS 694/1990 (ISI marked) wiring on PVC pipe (IS marked) IS 2509 as per specification shall be used. Clips for supporting the pipes at every 1 feet distance shall be used.

All construction activities shall be performed as per REC construction standard H-1. The switch board shall be installed at operating height whereas lamp should be installed at a height of 7 to 8 feet above the ground level depending on availability of height in consumer house. Neutral wire should not be short-circuited. Earthing point of three-pin socket should be connected with earth point installed on the meter board.

G. Augmentation and Renovation

1. Section-I: 33/11 kV substation augmentation

Following types of augmentation works are envisaged in 33/11 kV substation:

- a. Installation of additional 3.15 MVA Transformer with two additional bay on 11 KV side.
- b. Installation of additional 5 MVA Transformer with two additional bay on 11 KV side.
- c. Installation of additional 6.3 MVA Transformer with three additional bay on 11 KV side.
- d. Installation of additional 8 MVA Transformer with four additional bay on 11 KV side.
- e. Installation of additional 10 MVA Transformer with four additional bay on 11 KV side.
- f. 11 KV out-door yard extension for additional bay H-beam structure.
- g. 11 KV out-door yard extension for additional bay by providing PCC support (pole).
- h. 33 KV out-door yard extension for additional bay by providing H-beam structure.
- i. Installation of 33 KV VCB for 1.6 MVA, 3.15 MVA, 5.0 MVA Transformer.
- j. Augmentation of Power Transformer without additional bay on 11 KV side 1.65 MVA to 3.15 MVA.
- k. Augmentation of Power Transformer without additional bay on 11 KV side 3.15 MVA to 5.0 MVA.
- l. Augmentation of Power Transformer without additional bay on 11 KV side 5.00 MVA to 8.0 MVA.
- m. Augmentation of Power Transformer without additional bay on 11 KV side with old transformer 1.6 MVA to 3.15 MVA.
- n. Augmentation of Power Transformer without additional bay on 11 KV side with old transformer 3.15 MVA to 5.0 MVA.
- o. Augmentation of Power Transformer using old transformer with 2 no. additional bay on 11 KV side 1.6 MVA to 3.15 MVA.
- p. Augmentation of Power Transformer using old transformer with 2 no. additional bay on 11 KV side 3.15 MVA to 5.0 MVA.
- q. Augmentation of Power Transformer with 2 no. additional bay on 11 KV side 1.6 MVA to 3.15 MVA.
- r. Augmentation of Power Transformer with 2 no. additional bay on 11 KV side 3.15 MVA to 5.0 MVA.
- s. Augmentation of Power Transformer with 2 no. additional bay on 11 KV side 5.00 MVA to 8.0 MVA.
- t. Capacitor Bank 600 KVAR - Fixed type.
- u. Capacitor Bank 1200 KVAR - Auto type.
- v. Capacitor Bank 1500 KVAR - Auto type.
- w. Revamping of 33/11 kV substation earth mat.

Above list is of various options of substation renovation/augmentation. The list of works is indicative. Employer shall provide location wise exact details of works to be executed on existing substation. Accordingly, various BoQ items (extracted from items of new 33/11 kV substations) shall be utilized. Item-wise scope of works under new 33/11 kV substations is detailed out under scope of new substation. It shall be utilized on item to item requirement under renovation/augmentation of 33/11 kV substation also. Under this head, only damaged/defective items with approval of Project Manager shall be replaced by good ones. All removed defective/damaged items and good replaced power transformers received should be returned to employer's stores within a time limit decided by the Project Manager in the same condition as replaced.

2. Section-II: Renovation/Augmentation of 33 kV line

- 1.00 Augmentation of 3 phase 33 kV line using additional supports matching with length and type of existing support is envisaged on following type of supports:
- i. 9.1 meter long /280 KG PCC Poles (PCC Pole as per state practice)
 - ii. 11 m or 13 m long H-Beam 152x152 mm 37.1 kg/m
 - iii. 11 M long steel Tubular poles with welded steel base plate of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)
 - iv. 13 M long steel Tubular poles with welded steel base plate of Designation 540 SP 72 (IS 2713, Pt I, II, III 1980)

- 2.00 Augmentation of existing conductor with following type of new ACSR conductor including jointing sleeves, binding materials and helical formed fittings etc as required are envisaged under this work-
- i. 6/4.72 mm+7/1.57 mm (100 mm² Al. Area) - Dog replacing existing raccoon conductor
 - ii. 6/4.09 + 1/4.09 mm (80 mm² Al. Area) - Raccoon replacing existing rabbit/weasel conductor
 - iii. 30/2.59 + 7/2.59 mm (150 mm² Al. Area) - Wolf replacing existing dog/raccoon conductor
 - iv. 30/3.00 + 7/3.00 mm (200 mm² Al. Area) - Panther replacing existing dog/raccoon/wolf conductor
- 3.00 While executing this work, mid span pole with all fittings may be provided matching with existing poles of the line.
- 4.00 Following works shall also be executed by contractor under this head –
- a. Replacement of damaged insulators
 - b. Straightening of tilted supports by providing additional foundation or by providing boulders etc as required.
 - c. Revamping of pole earthing and replacement of GI earth wire.
 - d. Labelling, providing danger board, providing anti climbing device and painting of all the poles shall be in the scope of work
 - e. Replacement of damaged/bent V-cross arms & top clamps with new ones
 - f. Providing of stay set wherever required
 - g. Providing of guarding wherever required
 - h. Removal of old conductor in coil form, removal of old steel structure, removal of old conductor fittings, removal of any other worn out/defective material and deposit them in Employer's store within a reasonable time as decided by Project Manager

Item-wise scope of works under renovation/augmentation of 33 kV line is detailed out under scope of new 33 kV line. It shall be utilized on item to item requirement under renovation/augmentation of 33 kV line also.

3. Section-III: Renovation/Augmentation of 11 kV line

- 1.00 Augmentation of 3 phase 11 kV line using additional supports matching with length and type of existing support is envisaged on following type of supports:
- a. 8 meter long /140 KG PCC Poles (PCC Pole as per state practice)
 - b. 9 m or 11 m or 13 m long H-Beam 152x152 mm 37.1 kg/m
 - c. 11 M long steel Tubular poles with welded steel base plate of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)
 - d. 13 M long steel Tubular poles with welded steel base plate of Designation 540 SP 72 (IS 2713, Pt I, II, III 1980)
- 2.00 Augmentation of existing conductor with following type of new ACSR conductor including jointing sleeves, binding materials and helical formed fittings etc as required are envisaged under this work-
- a. 6/3.35 + 1/3.35 mm (50 mm² Al. Area) - Rabbit by replacing existing weasel/squirrel conductor
 - b. 6/4.09 + 1/4.09 mm (80 mm² Al. Area) - Raccoon by replacing existing rabbit/weasel/squirrel conductor
 - c. 6/4.72 mm+7/1.57 mm (100 mm² Al. Area) - Dog by replacing existing raccoon/rabbit conductor

3.00 While executing this work, mid span pole with all fittings may be provided matching with existing poles of the line.

4.00 Following works shall also be executed by contractor under this head –

- a. Replacement of damaged insulators
- b. Straightening of tilted supports by providing additional foundation or by providing boulders etc as required.
- c. Revamping of pole earthing and replacement of GI earth wire.
- d. Labelling, providing danger board, providing anti climbing device and painting of all the poles shall be in the scope of work
- e. Replacement of damaged/bent V-cross arms & top clamps with new ones
- f. Providing of stay set wherever required
- g. Providing of guarding wherever required
- h. Removal of old conductor in coil form, removal of old steel structure, removal of old conductor fittings, removal of any other worn out/defective material and deposit them in Employer's store within a reasonable time as decided by Project Manager

Item-wise scope of works under renovation/augmentation of 11 kV line is detailed out under scope of new 11 kV line. It shall be utilized on item to item requirement under renovation/augmentation of 11 kV line also.

4. R & M and augmentation of Distribution Transformer Substations

1.00 Survey of Distribution Transformer Substations:

A detailed survey of overloaded Distribution Transformer substation shall be performed. Existing electrical connected loading and habitation/village shall be surveyed and a presentable document showing population residing in the un-electrified area/existing electrified area of habitation/ village shall be performed. Based on survey, best option for augmentation of distribution transformer substation and the capacity of new transformer shall be decided. The capacity of augmented DTR shall be governed by following technical aspects:

- a) Optimistic lengths of LT lines needed to feed the existing consumers, existing un-connected consumers and future growth in electrical loading,
- b) Space available for installation of support/transformers,
- c) Probable load expected to come on the transformer due to existing BPL beneficiaries /others connected /un-connected probable beneficiaries in the locality taking care of their expected load growth in next 5 years.
- d) Distribution Transformers of capacity 16 KVA to 315 KVA (single phase as well as three phase) shall be decided as per standard rating of distribution transformer as depicted in IS specifications. Nonstandard ratings of DTR shall not be installed.
- e) Distribution Transformers of capacity 16 KVA to 315 KVA (single phase as well as three phase) shall be installed on existing structures/plinth.

Based on survey report, Project Manager shall decide type, capacity and location of Distribution Transformer sub-station for augmentation/R&M works.

2.00 Following types of works are envisaged for Distribution Transformer sub-station for augmentation/R&M works:

- a. Replacement of defective materials of DTR substations
- b. Re-erection/re-concreting of substation supports
- c. Dismantling of defective/worn-out steel structure materials, 11 kV/LT equipment like Lightning Arrester, DO Fuse, Distribution box, LT cable, jumpering conductor, terminal

clamps, insulators etc as required. Shifting of dismantled material to Employer's store within reasonable period of time.

- d. Installation of stay set for strengthening of DTR substation structure.
- e. Topping up of new and filtered transformer oil wherever required.
- f. De-moisturizing of silica gel, filling of transformer oil in silica gel breather.
- g. Providing new DTR substation equipment like steel structure materials, 11 kV/LT equipment like Lightning Arrester, DO Fuse, Distribution box, LT cable, jumpering conductor, terminal clamps, insulators etc
- h. Renovation of DTR substation earthing by providing new earth pits, inter connection of earth pits and their connection to various equipment
- i. Cleaning of metallic structure items by rubbing through emery paper and re-painting using two coats of red oxide paint and two coats of aluminium oxide paints of reputed type and make as approved by Project Manager using painting brush.

3.00 Fabricated steel items:

Fabricated steel items like DC cross arm (100x50x6 mm), back clamps (65x8 mm), pole clamp (65x8 mm), DO mounting channel (100x50x6 mm), transformer mounting channel (100x50x6 mm), transformer clamping set (50x50x6 mm), transformer belting set (50x50x6 mm), V cross arm, top clamp, DC cross arm, bracket, clamps, cross bracings, bracings, strain plate, back clamp, transformer mounting structure etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electric cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

Fabricated steel structure items shall be hot dip galvanized and cleaned till good surface finish. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633. Items shall be offered for inspection and approval by Project Manager.

4.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

5.00 Stay Set:

Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (2Nos.), anchor plate (200x200x6mm) , nut-bolts, 2 Nos turn-buckles, 1.8 m long, 16 mm diameter solid GS stay rod & 7/3.15 mm dia GI stranded wire complete.

Stay set shall be used at all sub-station location to nullify the tension of conductor/cable/transformer on the supports. 0.2 cmt cement concreting in mixture 1 part cement, 3 part coarse sand and 6 part

40mm size aggregate stone chips (1:3:6) shall be provided in the foundation of the stay set. 2 Nos. guy insulator shall be provided in 7/3.15 mm dia stranded GI wire at middle locations between two turn buckles.

6.00 Distribution Transformer:

Following type and sizes of minimum 4 star rated {as per Bureau of Energy Efficiency (BEE)}, distribution transformers are standardized in the project for augmentation:

- a) 5/6 KVA 1 phase Aluminium / Copper wound DTR
- b) 10 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
- c) 16 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
- d) 25 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
- e) 63 KVA 3 phase Aluminium / Copper wound DTR
- f) 100 KVA 3 phase Aluminium / Copper wound DTR
- g) 200 KVA 3 phase Aluminium / Copper wound DTR
- h) 250 KVA 3 phase Aluminium / Copper wound DTR
- i) 315 KVA 3 phase Aluminium / copper wound DTR

Or any other rating as per latest Indian Standard Specification

The Distribution Transformers shall be 11/0.4 KV or 11KV/230 V or 22/.44 KV non-sealed type BEE specified minimum 4 Star Distribution Transformers. The transformers shall be double wound, three phase, CRGO M3 Grade (0.23mm) or better (The core shall be constructed from high grade, non-ageing, Cold Rolled Grain Oriented (CRGO) silicon steel of M3 Grade (0.23mm) laminations only. PRIME CORE M3 Grade (0.23mm) materials are to be used for transformers core.

Distribution Transformers shall be subject to inspection during manufacturing (stage inspection), pre-delivery inspection, and inspection at site during pre-erection/post erection/post commissioning conditions. Project Manager shall select samples from the core laminations and get the same tested in CPRI/ NABL Accredited laboratory to prove the quality of the core material.

The new distribution transformers shall be supplied with transformer oil filled up-to maximum permissible level and breather with silica gel.

The distribution transformers must have been successfully type tested within five years from date of Letter of Intent and the designs should have been in satisfactory operation for a period not less than two years as on the date of bid opening. Compliance shall be demonstrated by submitting, (i) authenticated copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./State Govt. or their undertakings.

4 STAR LEVEL: Each Distribution Transformers must contain minimum 4 Star Label with style and information provided by the Bureau of Energy Efficiency (B.E.E), Ministry of Power, Government of India.

The losses in Distribution Transformer should be as per Energy Efficiency Level-2 and above as specified in IS 1180 (Part-1):2014 for all kVA ratings of distribution transformers

Bimetallic connectors of suitable capacities are to be provided on LT side and on HT side of the transformer.

T-Clamps should be provided on each jumper on bus bars. Line jumpers should be provided with adequate size of PG Clamps (Two numbers PG Clamps at each end of jumper). Clamp should be made of aluminum grade T-1F as per IS-8309 having good electrical quality aluminum material and should not be brittle in nature.

Transformers should be tested for pre-commissioning checks which includes Insulation Resistance Test, ratio test and oil breakdown voltage test. Before formal energisation, oil leakages from the parts of the transformer, oil level in conservator tank, condition of silica gel, earth connection (two separate) between neutral and earthing, proper jointing of earth wires/flats at the joints and earth resistance of the individual earthing pits are to be checked and recorded. On commissioning of the transformer, phase current and phase to phase voltage, phase to neutral voltage are to be recorded. The loading on the transformers should be balanced. The quantum of neutral current flowing through neutral shall be recorded. A record of pre-commissioning checks/tests are to be prepared and submitted to the Project Manager.

7.00 ACSR / AAAC Conductor:

ACSR raccoon conductor (or equivalent AAAC conductor) is to be used for connection between overhead lines to transformer studs/bushing.

8.00 Distribution box and Power Cabling:

Distribution boxes are to be installed as per specifications enclosed. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks should be prepared and submitted.

All CT terminals are to be ring type and other terminals are fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided between CT and Meter keeping 20% spare terminals.

The distribution boxes are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the distribution boards should be provided of 10mm dia.

The single core power cables should be terminated with proper size lugs and gland. Necessary tagging, identification of cores and dressing of cables with nylon cable ties shall be in the scope of work. The unutilized holes in the DBs provided for cable entry needs to be plugged properly in a manner that it must stop access to reptiles, dust and water ingress.

The Low Tension bus bars are to be painted with two or more coats of brush-able epoxy compound suitable to insulate the bus bars for 415 volts exposure.

The distribution box 16 KVA should also house three phase tri-vector energy meter / single phase meter depending on capacity and type of distribution transformer as per specifications. For higher capacity transformers, CT operated meters are to be installed. Separate LTCT cum Meter Box at eye height shall be installed for housing of meter, CTs, terminal block and wiring.

The single core un-armored power cables shall be used for connection from Distribution Transformer to Distribution Box and Distribution Box to Outgoing LT lines. Cable should not be used in underground laying arrangement. Cables should be dressed & tied properly using clamps /cable ties at 1 meter intervals and tied with substation structure/poles. At-least one meter cable is to be kept as spare at the individual ends.

Following arrangements shall be made for LT Distribution Transformers and LT Cables:

No	Type of DTR	Incomer		Outgoing	Cable	
		MCB/Isolator	HRC fuse	MCCB	1	2
1	5/6/10 KVA 1 Ph	45A SPN MCCB		2x32A SP MCCB	1Cx16 sqmm UA	
2	16 KVA 1 Ph	80A SPN MCCB		2x50A SP MCCB	1Cx16 sqmm UA	
3	16 KVA 3 Ph	25A TPN MCCB		6x16A SP MCCB	1Cx16 sqmm UA	
4	25 KVA 1 Ph	40A SPN MCCB		3x25A SP MCCB	1Cx35 sqmm UA	

No	Type of DTR	Incomer		Outgoing	Cable	
		MCB/Isolator	HRC fuse	MCCB	1	2
5	25 KVA 3 Ph	40A TPN MCCB		6x25A SP MCCB	1Cx35 sqmm UA	
6	63 KVA 3 Ph	200A TPN Isolator	100 A	6x60A SP MCCB	1Cx50/70 sqmm UA	1Cx70 sqmm UA
7	100 KVA 3 Ph	200A TPN Isolator	160 A	6x90A SP MCCB	1Cx50/70 sqmm UA	1Cx150 sqmm UA
8	200 KVA 3 Ph	600A TPN Isolator	315 A	9x120A SP MCCB	1Cx150 sqmm UA	1Cx300 sqmm UA
9	315 KVA 3 Ph	600A TPN Isolator	500 A	12X120A SP MCCB	1CX150 sqmm UA	1CX300 sqmm UA

1.1 KV XLPE Aluminium Conductor, Stranded, un-armored cable be used for connection of transformer LV bushing to Distribution Box and Distribution box to overhead line.

9.00 Earthing:

Distribution Transformer Earthing shall be provided with 3 Nos earthing and making earth mat /risers using 50X6mm GI Flat. Earthing should be provided with GI earth pipe or Chemical Earthing depending of strata of soil in the location. Project Manager shall decide the type of earthing.

25x3mm GI Flat and 8 SWG GI shall be used for making earthing connection to various sub-station equipment as per given details. GI Flat and GI wire shall be properly dressed, bunched and clamped with the support at 2 feet intervals. An overlapping of 35mm shall be used at the place of flat to flat joint. Two sets of GI nuts, bolts and washers shall be used for flat-to-flat joints. GI nuts, bolts and washers must be used for GI Flat-to-GI wire & GI wire-to-GI wire joints.

Substation wise measurement of earth resistance of earth pits / mesh and corresponding drawing of existing earthing arrangement shall be recorded and submitted to Project Manager.

Description of equipment	Earth connection
Earthing pits	3 Nos. Earth Pipe 3 m long, 40 mm dia or Chemical Earthing
Earth mat and riser	50X6 mm GI Flat / 8 SWG GI wire
Laying of earth mat	Below ground 0.5 meter

Standard requirements of earthing shall be as under:

- d) Earth Pit – 1 for Transformer Neutral,
- e) Earth pit - 2 for Lightning Arrester,
- f) Earth pit – 3 for Equipment body earthing.

Following arrangement is envisaged for various equipment of distribution transformer substation:

- i) Transformer Neutral (Two distinct connections) : GS Flat 25X3mm
- j) Transformer Body : GS Flat 25X3mm
- k) Lightning Arrester : GS Flat 25X3mm
- l) Fencing (Wherever required) : GI wire 8 SWG
- m) LT Distribution Box (Two distinct connections) : GI wire 8 SWG
- n) AB Switch handle : GI wire 8 SWG
- o) Steel structure of substation : GI wire 8 SWG
- p) Line meters : GS wire 8 SWG

The location of earth pits should be at-least 3m apart, so that they their earth conductive areas do not overlap. In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used in place of normal GI pipe type earthing. Project Manager shall decide type of earthing pits.

10.00 Metering of DTR:

Single phase or three phase metering of DTR shall be provided. The meter shall be installed in a metallic enclosure. Enclosure shall be earthed at two locations. The meter board shall be provided with push-and clamp type terminals. All CT terminals are to be provided with ring type lugs. Meter shall be tested before installation as per prevailing practice Employer. There would be no testing charges levied by Employer for testing of meters in their authorized laboratories, if facilities are available. In case of CT operated meter, metallic LTCT cum Meter box shall be provided at working height.

11.00 Insulator and hardware:

11 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator should be tied properly using binding wire/helical form fitting. Bi-metallic clamps must be used at terminals.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator should properly be cleaned before installation. No damage/crack insulator should be used.

12.00 Substation numbering:

Each Substation should be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint.

13.00 Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each sub-station support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

14.00 Danger board:

Each support should be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

15.00 Support foundation:

Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40 mm size aggregate stone chips (1:3:6) shall be used in PCC Pole, steel tubular poles and H-Beam support foundation.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shuttering and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular and H-Beam poles to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

16.00 11 KV AB Switch:

11 kV, 3-ph, 200 A, 3 Pin type, Horizontal/Vertical Mounting type, Gang Operated, AB Switch shall be installed on 100 KVA and more capacity distribution transformer substation only. B Class GI pipe shall be used (without any joints) for operation of switch. AB Switch structure and handle must be earthed using 8 SWG GI wire.

17.00 11 KV Drop Out Fuses:

11 kV, 3-ph, Drop Out fuse units (set of 3 units) along with Support Insulators, Base Channel, fuse barrel etc. shall be used for all capacity Distribution Transformer Substations. DO Fuse structure shall be earthed using 8 SWG GI wire.

18.00 Lighting Arrester:

Distribution Class LAs on each phase shall be provided in the sub-station with base steel structure, terminals bi – metallic connectors / PG clamps and earth connectors. LAs are to be connected with separate earth connection. 25x3 mm GI flat shall be used for earth connection.

5. Section-IV: Renovation/Augmentation of LT line

1.00 Conversion of LT line using additional supports with all fittings matching with length and type of existing support is envisaged on following type of supports:

- a) 8 m/140 kgs PCC Poles (PCC Pole as per state practice)
- b) 13 m long H-Beam 152x152 mm, 37.1kg/mtr
- c) 11 m long H-Beam 152x152 mm, 37.1kg/mtr
- d) 11 M long Steel Tubular poles with welded steel base plate of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)
- e) 9 M long Steel Tubular poles with welded steel base plate of Designation 540 SP 28 (IS 2713, Pt I, II, III 1980)

2.00 Conversion of existing LT line of bare conductor with following type of new ABC cable LT line as required are envisaged under this work-

- 2.01 1X16 (Ph) + 1X25 (bare messenger cum neutral) SQ. MM.
- 2.02 1X16 (Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting)SQ. MM.
- 2.03 3X16(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 2.04 3 X 16(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 2.05 1X25(Ph)+1x25 (bare messenger cum neutral) SQ. MM.
- 2.06 1X25(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 2.07 3X25(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 2.08 3 X 25(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 2.09 1X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 2.10 1x35(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 2.11 3X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 2.12 3X35 (Ph) + 1x25 (bare messenger cum neutral)+ 1x16 (insulated Street lighting) SQ. MM.
- 2.13 3X50(Ph)+1X35 (bare messenger cum neutral) SQ. MM.
- 2.14 3X50 (Ph)+1x35 (bare messenger cum neutral) +1x16 (insulated Street lighting) SQ. MM.
- 2.15 3X95(Ph)+1X70 (bare messenger cum neutral) SQ. MM.
- 2.16 3X95(Ph)+1X70 (bare messenger cum neutral) +1x16 (insulated Street lighting) SQ. MM.

3.00 While executing this work, mid span pole with all fittings may be provided matching with existing poles of the line.

4.00 Following works shall also be executed by contractor under this head –

- a) Straightening of tilted supports by providing additional foundation or by providing boulders etc as required.
- b) Revamping of pole earthings and replacement of GI earth wire.
- c) Labelling, providing danger board, providing anti climbing device and painting of all the poles shall be in the scope of work
- d) Providing of stay set wherever required
- e) Removal of old bare conductor and depositing in Employer's store

Item-wise scope of works under renovation/augmentation of LT line is detailed out under scope of new LT line. It shall be utilized on item to item requirement under renovation/augmentation of LT line also.

5.00 Cable connection to distribution box and to consumer.

All removed old material shall be deposited to employer's store in a reasonable time as decided by Project Manager.

H. HIGH VOLTAGE DISTRIBUTION SYSTEM (HVDS)

1.00 HVDS system shall be used in following three situations:

- a. To provide LT power supply to remote/farthest locations particularly in hilly areas or farthest location in newly developed plain areas. In this case entire work of erecting 11 kV lines, providing Distribution Transformers shall be executed. While executing HVDS scheme, extreme care to be taken to estimate loading on distribution transformer as capacity of distribution transformer shall be between 10 KVA to 25 KVA.
- b. In areas where length of LT line is more than 300 meters causing line losses and in theft prone areas where unauthorized hooking is observed, HVDS is recommended. Existing LT line supports shall be used for erection of 11 kV lines.
- c. To provide dedicated distribution transformer at location of agriculture pump (for maximum two pumps) connections by either extending 11kV new line or by converting existing LT lines to 11 kV line.

2.00 Survey of 11 kV line:

Mapping of route of proposed new HVDS system or conversion of LT line to 11 kV line by foot survey in rural/urban areas be performed mentioning various milestones. While surveying, existing electrical infrastructure in the locality should also be mapped. Line alignment (single line diagram) on political map with fair correctness, be prepared. SLD and foot survey report shall be approved by Project Manager and shall be used as basic document for assessment of works under the contract. On completion of line work, as built Single Line Diagram and pole wise line diagram showing pole wise materials used and pole-to-pole span should be submitted to Project Manager. This details shall be used as reference documents by Quality Inspecting officials to execute inspection works.

3.00 Survey of Distribution Transformer Substations:

A detailed survey of existing habitation/village shall be performed in presentable document showing population residing in the un-electrified area/existing electrified area of habitation/ village, best location of installation of a new distribution transformer substation and the capacity of transformers to be selected for installation. The capacity of DTR shall be governed by following technical aspects:

- a) Optimistic lengths of service lines needed to feed the beneficiaries,
- b) Space available for installation of support/transformers,
- c) Probable load expected to come on the transformer due to existing BPL beneficiaries /others connected /un-connected probable beneficiaries in the locality taking care of their expected load growth in next 5 years.
- d) Distribution Transformers of capacity 16 KVA to 25 KVA (single phase as well as three phase as per detailed given) shall be installed on double pole structures. Hence, three phase 11 KV lines shall be laid for 16 KVA to 25 KVA (single phase as well as three phase) capacity sub-stations. Single phase 11 KV lines (2-wire) shall only be permitted for 10 KVA single phase transformers mounted on single pole structure. However, V-cross arms and top clamp shall be used on each line support so that whenever needed, this 2-wire line may be converted to 3-phase 11 kV line by erecting an additional conductor.
- e) Double pole support steel structures for 16 KVA and 25 KVA distribution transformers shall be designed in such a way that they can be augmented to 63 KVA transformer structures without any addition in near future on technical requirements.
- f) Single phase 10 KVA distribution transformer shall be installed on single pole structure.

Based on survey report, Project Manager shall decide type, capacity and location of Distribution Transformer sub-station.

4.00 Existing LT infrastructure:

Existing LT lines' conductor and fittings shall be dismantled. Tilted supports, if any, shall be straightened. Poles erected in water logging areas or loose soil areas shall be provided with cement concrete foundation.

5.00 Mid span support:

Requirement of mid span pole with all fittings, to suit 11 kV line conductor shall be examined during survey. Project Manager shall approve requirement of mid span poles and extra concreting on existing poles.

While deciding mid span poles, project manager shall decide type and length of poles matching with existing supports available in the field. Stay set wherever required in existing line to be converted may be provided.

6.00 Support for conversion of existing LT line into 11 KV overhead line and for new 11 kV line:

- i. 8 m/140 kgs PCC Poles (PCC Pole as per state practice)
- ii. 11 m long H-Beam 152x152 mm, 37.1 kg/mtr
- iii. 9 M long Steel Tubular poles of Designation 540 SP 28 (IS 2713, Pt I, II, III 1980)

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

7.00 Fabricated steel items:

Fabricated steel items like DC cross arm (100x50x6 mm), back clamps (65x8 mm), pole clamp (65x8 mm), DO mounting channel (100x50x6 mm), transformer mounting channel (100x50x6 mm), transformer clamping set (50x50x6 mm), transformer belting set (50x50x6 mm), V cross arm, top clamp, DC cross arm, bracket, clamps, cross bracings, bracings, strain plate, guarding channels, back clamp, transformer mounting structure etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electric cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

Fabricated steel structure items shall be hot dip galvanized and cleaned till good surface finish. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633. Items shall be offered for inspection and approval by Project Manager.

8.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

9.00 Stay Set:

Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (1No.), anchor plate (200x200x6mm) , nut-bolts, 2 Nos turn-buckles, 1.8 m long, 16 mm diameter solid GS stay rod & 7/3.15 mm dia GI stranded wire complete.

Stay set shall be used at all sub-station location to nullify the tension of conductor/cable/transformer on the supports. 0.2 cmt cement concreting in mixture 1 part cement, 3 part coarse sand and 6 part 40mm size aggregate stone chips (1:3:6) shall be provided in the foundation of the stay set. 2 Nos. guy insulator shall be provided in 7/3.15 mm dia stranded GI wire at middle locations between two turn buckles. Erection of storm guys at suitable location in straight line may also be provided.

10.00 Distribution Transformer:

Following type and sizes of minimum 4 star rated {as per Bureau of Energy Efficiency (BEE)}, distribution transformers with all accessories are standardized in the project under HVDS:

- a) 5/6 KVA 1 phase Aluminium / Copper wound DTR
 - b) 10 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
 - c) 16 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
 - d) 25 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
 - e) 63 KVA 3 phase Aluminium / Copper wound DTR
 - f) 100 KVA 3 phase Aluminium / Copper wound DTR
 - g) 200 KVA 3 phase Aluminium / Copper wound DTR
 - h) 250 KVA 3 phase Aluminium / Copper wound DTR
 - i) 315 KVA 3 phase Aluminium / copper wound DTR
- Or any other rating as per latest Indian Standard Specification

The Distribution Transformers shall be 11/0.4 KV or 11KV/230 V or 22/0.44 KV non-sealed type BEE specified minimum 4 Star Distribution Transformers. The transformers shall be double wound, three phase, CRGO M3 Grade (0.23mm) or better. The core shall be constructed from high grade, non-ageing, Cold Rolled Grain Oriented (CRGO) silicon steel of M3 Grade (0.23mm) laminations only. PRIME CORE M3 Grade (0.23mm) materials are to be used for transformers core.

Distribution Transformers shall be subject to inspection during manufacturing (stage inspection), pre-delivery inspection, and inspection at site during pre-erection/post erection/post commissioning conditions. Project Manager shall select samples from the core laminations and get the same tested in CPRI/ NABL Accredited laboratory to prove the quality of the core material at any time during pre-dispatch instruction/inspection at site etc.

The distribution transformers shall be supplied with transformer oil filled up-to maximum permissible level and all accessories viz. breather with silica gel etc.

The distribution transformers must have been successfully type tested within five years from date of Letter of Intent and the designs should have been in satisfactory operation for a period not less

than two years as on the date of bid opening. Compliance shall be demonstrated by submitting, (i) authenticated copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./State Govt. or their undertakings.

4 STAR LEVEL: Each Distribution Transformers must contain minimum 4 Star Label with style and information provided by the Bureau of Energy Efficiency (B.E.E), Ministry of Power, Government of India.

The losses in Distribution Transformer should be as per Energy Efficiency Level-2 and above as specified in IS 1180 (Part-1):2014 for all kVA ratings of distribution transformers

Bimetallic clamps of suitable capacities and size are to be provided on LT side and on HT side of the transformer.

T-Clamps should be provided on each jumper on bus bars. Line jumpers should be provided with adequate size of PG Clamps (Two numbers PG Clamps at each end of jumper). Clamp should be made of aluminum grade T-1F as per IS-8309 having good electrical quality aluminum material and should not be brittle in nature.

Transformers should be tested for pre-commissioning checks which includes Insulation Resistance Test, ratio test and oil breakdown voltage test. Before formal energisation, oil leakages from the parts of the transformer, oil level in conservator tank, condition of silica gel, earth connection (two separate) between neutral and earthing, proper jointing of earth wires/flats at the joints and earth resistance of the individual earthing pits are to be checked and recorded. On commissioning of the transformer, phase current and phase to phase voltage, phase to neutral voltage are to be recorded. The loading on the transformers should be balanced. The quantum of neutral current flowing through neutral shall be recorded. A record of pre-commissioning checks/tests are to be prepared and submitted to the Project Manager.

11.00 ACSR / AAAC Conductor:

ACSR raccoon conductor (or equivalent AAAC conductor) is to be used for connection between overhead lines to transformer studs/bushing. All road crossings and line crossings shall be guarded as per specifications. Conductor joint should not be provided in mid span length. Instead, it should be nearer to the support.

12.00 11 KV AB Switch:

11 kV, 3-ph, 600 A, 3 Pin type, Vertical/Horizontal Mounting type, Gang Operated, AB Switch shall be installed at cut points and at suitable locations as per instructions of Project Manager. B Class GI pipe shall be used (without any joints) for operation of switch. AB Switch structure and handle must be earthed using 8 SWG GI wire.

13.00 Distribution box and Power Cabling:

Distribution boxes are to be installed as per specifications enclosed. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks should be prepared and submitted.

The distribution boxes are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the distribution box should be provided of 10mm dia.

The single core power cables should be terminated with proper size lugs and gland. Necessary tagging, identification of cores and dressing of cables with nylon cable ties shall be in the scope of work. The unutilized holes in the DBs provided for cable entry needs to be plugged properly in a manner that it must stop access to reptiles, dust and water ingress.

The Low Tension bus bars are to be painted with two or more coats of brush-able epoxy compound suitable to insulate the bus bars for 415 volts exposure.

The distribution box should also house three phase tri-vector energy meter / single phase meter depending on capacity and type of distribution transformer as per specifications.

The single core un-armored power cables shall be used for connection from Distribution Transformer to Distribution Box and Distribution Box to Outgoing LT lines. Cable should not be used in underground laying arrangement. Cables should be dressed & tied properly using clamps /cable ties at 1 meter intervals and tied with substation structure/poles. At-least one meter cable is to be kept as spare at the individual ends.

Following arrangements shall be made for LT Distribution Transformers and LT Cables:

No	Type of DTR	Incomer		Outgoing	Cable	
		MCB/Isolator	HRC fuse	MCCB	1	2
1	5/6/10 KVA 1 Ph	45A SPN MCCB		2x32A SP MCCB	1Cx16 sqmm UA	
2	16 KVA 1 Ph	80A SPN MCCB		2x50A SP MCCB	1Cx16 sqmm UA	
3	16 KVA 3 Ph	25A TPN MCCB		6x16A SP MCCB	1Cx16 sqmm UA	
4	25 KVA 1 Ph	40A SPN MCCB		3x25A SP MCCB	1Cx35 sqmm UA	
5	25 KVA 3 Ph	40A TPN MCCB		6x25A SP MCCB	1Cx35 sqmm UA	
6	63 KVA 3 Ph	200A TPN Isolator	100 A	6x60A SP MCCB	1Cx50/70 sqmm UA	1Cx70 sqmm UA
7	100 KVA 3 Ph	200A TPN Isolator	160 A	6x90A SP MCCB	1Cx50/70 sqmm UA	1Cx150 sqmm UA
8	200 KVA 3 Ph	600A TPN Isolator	315 A	9x120A SP MCCB	1Cx150 sqmm UA	1Cx300 sqmm UA
9	315 KVA 3 Ph	600A TPN Isolator	500 A	12X120A SP MCCB	1CX150 sqmm UA	1CX300 sqmm UA

1.1 KV XLPE Aluminium Conductor, Stranded, un-armored cable be used for connection of transformer LV bushing to Distribution Box and Distribution box to overhead line.

14.00 Earthing:

Distribution Transformer Earthing shall be provided with 3 Nos earthing and making earth mat /risers using 50X6mm GI Flat. Earthing should be provided with GI earth pipe or Chemical Earthing depending of strata of soil in the location. Project Manager shall decide the type of earthing.

25x3mm GI Flat and 8 SWG GI wire shall be used for making earthing connection to various sub-station equipment as per given details. GI Flat and GI wire shall be properly dressed, bunched and clamped with the support at 2 feet intervals. An overlapping of 35mm shall be used at the place of flat to flat joint. Two sets of GI nuts, bolts and washers shall be used for flat-to-flat joints. GI nuts, bolts and washers must be used for GI Flat-to-GI wire & GI wire-to-GI wire joints.

Substation wise measurement of earth resistance of earth pits / mesh and corresponding drawing of existing earthing arrangement shall be recorded and submitted to Project Manager.

Description of equipment	Earth connection
Earthing pits	3 Nos. Earth Pipe 3 m long, 40 mm dia or Chemical Earthing
Earth mat and riser	50X6 mm GI Flat / 8 SWG GI wire

Laying of earth mat	Below ground 0.5 meter
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Standard requirements of earthing shall be as under:

- g) Earth Pit – 1 for Transformer Neutral,
- h) Earth pit - 2 for Lightning Arrester,
- i) Earth pit – 3 for Equipment body earthing.

Following arrangement is envisaged for various equipment of distribution transformer substation:

- q) Transformer Neutral (Two distinct connections) : GS Flat 25X3mm
- r) Transformer Body : GS Flat 25X3mm
- s) Lightning Arrester : GS Flat 25X3mm
- t) Fencing (Wherever required) : GI wire 8 SWG
- u) LT Distribution-cum-meter Box (Two distinct connections) : GI wire 8 SWG
- v) Steel structure of substation : GI wire 8 SWG

The location of earth pits should be at-least 3m apart, so that they their earth conductive areas do not overlap. In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used in place of normal GI pipe type earthing. Project Manager shall decide type of earthing pits.

15.00 Insulator and hardware –

11 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator should be tied properly using binding wire/helical form fitting. Bi-metallic clamps must be used at terminals.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator should properly be cleaned before installation. No damage/crack insulator should be used.

16.00 Substation numbering:

Each Substation should be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint.

17.00 Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each sub-station support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

18.00 Danger board:

Each support should be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

19.00 Support foundation:

Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40 mm size aggregate stone chips (1:3:6) shall be used in PCC Pole, steel tubular poles and H-Beam support foundation.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shutting and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular and H-Beam poles to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

20.00 11 KV Drop Out Fuses:

11 kV, 3-ph, Drop Out fuse units (set of 3 units) along with Support Insulators, Base Channel, fuse barrel etc. shall be used for all capacity Distribution Transformer Substations. DO Fuse structure shall be earthed using 8 SWG GI wire.

21.00 Lighting Arrester:

Distribution Class LAs shall be provided in the sub-station with base steel structure, terminals bi – metallic connectors / PG clamps and earth connectors. LAs are to be connected with separate earth connection. 25x3 mm GI flat shall be used for earth connection.

I. Feeder Metering (in existing substations):

The meters shall be procured centrally under New Initiative of Material Mobilisation. Supply and erection of meter Box as well as other accessories shall be under the scope of contractor including erection of meters provided by DISCOM/Power Department. Taking delivery of meters from DISCOM/Power Deptt. stores, loading, transportation, unloading at site etc shall be under the scope of contractor. The size of meter shall be provided by the Project Manager.

1.00 In existing substations, feeder metering shall be provided through two composite items. Payments against supply and erection shall be released on completion of supply as well as erection works as per composite item-wise scope as under:

- a. 33 KV Feeder Metering – Under this composite item, all required works like supply&erection of outdoor oil immersed type metering equipment comprising of 33kV/110V Potential Transformer and 3 ph 4 wire Current Transformer of ratio 400-200/5A including supporting steel fabricated structure, earthing coil, 2Cx2.5 sqmm copper control stranded unarmoured cable, 16 mm dia nuts & bolts, danger board, 8 SWG GI earth wire etc. The meter shall be provided by the employer.
- b. 11 KV Feeder Metering - Under this composite item, all required works like supply&erection of outdoor oil immersed type metering equipment comprising of 11 kV/110 V, 3 ph 4 wire CT ratio 300-150/5A including supporting steel fabricated structure, earthing coil, 2Cx2.5 sqmm copper control stranded unarmoured cable, 16 mm dia nuts & bolts, danger board, 8 SWG GI earth wire etc. The meter shall be provided by the employer.

2.00 Metering Equipment:

Following two types of metering equipment are envisaged in the work comprising of:

- a. 33 kV/110 V Metering Equipment (CTPT Unit) with CT of ratio 400-200/5 A
- b. 11 kV/110 V Metering Equipment (CTPT Unit) with CT of ratio 300-150/5 A

3.00 Meter shall be HT trivector DLMS compliant category suitable for substation/feeder metering. Meter shall be 3 ph 4 w 110 V 5 A accuracy class 0.5s with GSM (GPRS compatible) modem.

4.00 Fabricated steel items for mounting of metering equipment and meter-cum-meter box structure etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electrical cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

Fabricated steel structure items shall be hot dip galvanized and cleaned till good surface finish The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633. Items shall be offered for inspection and approval by Project Manager.

5.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of above steel overhead structure items.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

6.00 Earthing:

Following earthing arrangements are envisaged for feeder metering equipment:

- 21.2. GI Earthing spike made of 20mm solid rod or 8 SWG earthing coil
- 21.3. Chemical rod earthing including electrode, chemical, with 2000mm long, 50 mm diameter GI pipe, GI Strip of 24x3mm minimum in hard rock locations only.

a. 8 SWG GI wire for earthing

Each 11 kV or 33 kV metering equipment shall be provided with one GI earthing spike made of 20 mm solid rod or GI Earth Coil and connected with 8 SWG GI wire. Overhead line structure shall be connected to GI earthing spike or GI Earth Coil using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod.

In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used. Overhead line structure shall be connected to chemical earth electrode using 8SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod. GI wires must be properly dressed, bundled and fixed on supporting structure at 1 to 2 feet intervals.

Project Manager shall decide use of chemical earthing or GI Earth Coil or 20mm dia GI Solid Rod for individual pole earthing.

7.00 Meter-cum-meter box and Control Cabling:

Meter-cum-meter box are to be installed on support gantry structure of substation as per specifications enclosed. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks should be prepared and submitted.

All CT terminals are to be ring type and other terminals are of fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided between CT and Meter keeping 20% spare terminals.

The Meter-cum-meter box are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the distribution boards should be provided of 10mm dia.

8.00 Meter identification :

Each 33 kV/ 11 kV meter box shall be labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint.

9.00 Danger board:

Each 33 kV/ 11 kV meter box shall be provided with a danger board as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

J. 11 kV Capacitor Bank

- 1.00 Following three types of capacitor bank shall be installed in 33/11 kV power substation
- a. Fixed type 600 KVAR mounted with capacitor switch with all associated equipment like 11 kV 200 A Isolators with earth switch, RVT, 11 kV station class Lightning Arrestor, earth connection with substation earth mat by 50x6 GI flat.
 - b. Automatic type 1200 KVAR mounted with all associated equipment like 11 kV VCB, control & relay panel, CTs, junction box, 11 kV 200 A Isolators with earth switch, RVT, 11 kV station class Lightning Arrestor, earth connection with substation earth mat by 50x6 GI flat, control wiring between field equipment and indoor control & relay panel by 2.5 sqmm flexible stranded copper conductor PVC insulated and PVC sheathed armoured cable of suitable core including lugs, glands etc as required.
 - c. Automatic type 1500 KVAR mounted with all associated equipment like 11 kV VCB, control & relay panel, CTs, junction box, 11 kV 200 A Isolators with earth switch, RVT, 11 kV station class Lightning Arrestor, earth connection with substation earth mat by 50x6 GI flat, control wiring between field equipment and indoor control & relay panel by 2.5 sqmm flexible stranded copper conductor PVC insulated and PVC sheathed armoured cable of suitable core including lugs, glands etc as required.
- 2.00 A composite item is kept in BoQ for provision of above three capacities of capacitor bank in 33/11 kV power substations. Hence, execution of these items shall include supply of capacitor bank and associated accessories listed above. Composite items shall also include mounting structure for capacitor bank and associated equipment. Mounting structure shall be hot dip galvanized. All structural steel members and bolts shall be galvanized after fabrication as per IS:4759 and zinc coating shall not be less than 610gm/sq. meter for all structural steel members. All L45x45x5 will have 23 mm back mark. All L50x50x6 will have 28mm back mark. 3.5mm spring washers are to be used under each nut, structural steel shall conform to IS 2026. All weld shall be 6mm filled weld unless specified otherwise. All nuts and bolts shall be of property class 5.6 of IS 1367. Plain washers shall be as per IS 2016 & spring washers shall be IS: 3063.
- 3.00 Junction Box and Control Cabling:
- In automatic capacitor bank, junction box shall be installed near capacitor bank for extending control connection to control & relay panel. Junction box is to be installed on capacitor bank structure support or erected on separate steel structures in the yard nearer to capacitor bank. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks shall be prepared and submitted. All CT terminals are to be ring type and other terminals are of fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided between CT and Meter keeping 20% spare terminals. The Meter-cum-meter box are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the distribution boards shall be provided of 10mm dia.

K. DISTRIBUTION TRANSFORMER / STATION TRANSFORMER METERING

The meters shall be procured centrally under New Initiative of Material Mobilisation. Supply and erection of meter Box as well as other accessories shall be under the scope of contractor including erection of meters provided by DISCOM/Power Department. Taking delivery of meters from DISCOM/Power Deptt. stores, loading, transportation, unloading at site etc shall be under the scope of contractor. The size of meter shall be provided by the Project Manager.

1.00 Existing Distribution Transformer shall be metered on LT side as per following arrangement:

- a) Whole current meter for three phase 16 KVA transformer
- b) Whole current meter for three phase 25 KVA transformer
- c) CT operated meter for three phase 63 KVA transformer
- d) CT operated meter for three Phase 100 KVA
- e) CT operated meter for three Phase 200 KVA
- f) CT operated meter for three Phase 315 KVA

2.00 The metering shall be of two types:

- a. For transformer upto and including 25KVA transformers: Meter shall be installed inside the distribution box. The existing power cables shall be routed through the meter.
- b. For transformer of capacity 63KVA to 315 KVA, separate LT CT cum Meter box shall be installed and existing power cables shall be routed through CTs.

3.00 Meter shall be HT tri-vector DLMS compliant category suitable for DTR substation metering. Meter shall be 3 ph 4 w 110 V 5 A accuracy class 0.5s with GSM (GPRS compatible) modem.

4.00 Fabricated steel items for mounting of meter-cum- distribution box, LTCT box etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electrical cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

Fabricated steel structure items shall be hot dip galvanized and cleaned till good surface finish. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633. Items shall be offered for inspection and approval by Project Manager.

5.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of above steel overhead structure items.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

6.00 Meter-cum-Distribution box, LTCT cum Meter box and Control Cabling:

Meter-cum-Distribution box, LTCT cum Meter box are to be installed on substation support. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks should be prepared and submitted.

All CT terminals are to be ring type and other terminals are of fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided between CT and Meter keeping 20% spare terminals.

Meter-cum-Distribution box / LTCT cum Meter box are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the Meter-cum-Distribution box/ LTCT cum Meter box should be provided of 10mm dia. Meter-cum-Distribution box/ LTCT cum Meter box identification.

7.00 Labelling:

Each Meter-cum-Distribution box/LTCT cum Meter box shall be labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint.

8.00 Danger board:

Each Meter-cum-Distribution box/LTCT cum Meter box shall be provided with a danger board as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

L. Replacement of LT meters:

1.00 LT meters shall be changed in following three ways:

- a) Replacement of meter in the premises of consumer: The existing defective, electro-magnetic meters shall be replaced with static meter in the existing location of meter in the consumer premises without changing service cables, and
- b) Shifting of meter outside the consumer premises: The existing meter installed in consumer premises shall be dismantled and shifted outside consumer premises on working height. Meter shall be replaced either on boundary wall, LT pole, wall of consumer house, any other fixed structure near consumer premises. LT service line shall also be replaced in this activity. A distribution box shall be provided to extend LT supply from LT line.
- c) Installation of meters at un-metered agriculture pumps.

2.00 Following LT meters are envisaged under the work:

- a. 1-Ph 2 wire, 5-30Amp, 1.0 Accuracy class static electronic meter with metallic meter box, and
- b. 3-Ph 4 wire, 10-40Amp, 1.0 Accuracy class static electronic meter with metallic meter box.

3.00 Existing defective or electro-magnetic meters upon dismantling shall be deposited in the office of Employer.

4.00 Distribution Box:

Single phase or three phase Distribution Box (DB) shall be provided for extending power supply to LT consumers. Distribution Box (DB) shall be mounted on LT pole with MS clamp of 40x3 mm size duly painted. DB shall be earthed using 8 SWG GI wire.

Single phase Distribution Box (DB) shall be suited for two core 25 sqmm aluminium conductor cable as incomer and 8 nos. two core 10 sqmm conductor cables as outgoing cables. Three phase DB shall be suited for four core 35 sqmm aluminium conductor cable as incomer and 4 nos. four core 16 sqmm conductor cables as outgoing cables.

5.00 Meter-cum-meter box:

While shifting single phase LT meters from inside to outside the premises, a metallic meter box shall be provided to house individual meter. A box may also contain more than one meter, if situation permits for installation. The box shall be installed on boundary wall, LT pole, wall or at any other stationary support nearer to consumer premises. The box is to be earthed using 8 SWG GI wire.

The meter extracted from the consumer premises shall be installed inside metallic meter box and re-commissioned. Metallic meter box shall be sealed so that unauthorized opening of box should not take place.

Meter box shall be connected to distribution box (at the line end) and to main switch of consumer internal electrification network (at the consumer end).

6.00 Power cables:

Following sizes of power cables are envisaged under the scope:

- a. 2Cx25 sqmm LT XLPE cable

b. 4Cx35 sqmm LT XLPE cable

7.00 Connection from AB cable/Overhead LT conductor:

Two core 25 sqmm cable or four core 35 sqmm cable shall be used between ABC cable/overhead LT conductor and Distribution box. T-connector shall be used at ABC cable/overhead LT conductor and for tapping of LT connection. While tapping connection, highly skilled lineman/wireman shall be deployed along with sophisticated cutting plier/tool so that no damage should result in AB cable/Overhead conductor. T-connector should be crimped properly for resistance free/maintenance free electric connection. Alternately, piercing type connector may be used for tapping of LT connection from ABC cable conductor.

8.00 Labelling:

Each Meter-cum-meter box and distribution box shall be properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint.

9.00 Danger board:

Each Meter-cum-meter box and distribution box shall be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

10.00 Fabricated steel items:

Fabricated steel items like clamps, D-clamp, stay clamp, etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electrical cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

Fabricated steel structure items shall be hot dip galvanized and cleaned till good surface finish. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633. Items shall be offered for inspection and approval by Project Manager.

11.00 Cable accessories and Hardware:

Dead end clamp, eye hook and suspension clamp shall be supplied as per specifications. MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure wherever required.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip

galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

12.00 Following earthing arrangements are envisaged for Meter-cum-meter box and distribution box:

- a) GI Earthing spike made of 20mm solid rod or 8 SWG, 50 turns earthing coil
- b) Chemical rod earthing including electrode, chemical, with 2000mm long, 50 mm diameter GI pipe, GI Strip of 24x3mm minimum in hard rock locations only.
- c) 8 SWG GI wire for earthing

Each Meter-cum-meter box and distribution box shall be earthed with 8 SWG GI wire. Meter-cum-meter box and distribution box shall be connected to GI earthing spike or GI Earth Coil or system neutral-cum-earth conductor using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod. Project Manager shall decide use of GI Earth Coil or 20mm dia GI Solid Rod for individual pole earthing. GI wires must be properly dressed and fixed on supporting structure at 1 to 2 feet intervals.

In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used. Overhead line structure shall be connected to chemical earth electrode using 8SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod.

Project Manager shall decide type of earth pit. Project Manager shall also decide earth connection to existing system neutral-cum-earth conductor or to newly installed earth pit.

M. Ring Main Unit (RMU):

- 33 kV way RMU's (Manual) : Nos.
- 33 kVway RMU's (SCADA enabled) : Nos.
- 11 kV way RMU's (Manual) : Nos.
- 11 kVway RMU's (SCADA enabled) : Nos.

The scope of work shall include design, manufacture, pre-despatch testing, supply, and transportation, unloading at site complete erection, testing and commissioning of Ring Main Units capable of being monitored and controlled by the SCADA/DMS and also manually operated RMUs. This also includes supply of relevant 11 kV cable termination kits including the jointing as per specification.

Where relevant, the RMU scope of work shall be coordinated with the work to be carried out like providing of UG cable under the project's other construction packages.

Each RMU shall include its own power supply unit (including auxiliary power transformer, batteries, and battery charger), which shall provide a stable power source for the RMU. In case of remote operated RMUs, the same will be connected to the FRTU including the power supply required to be procured by utility separately.

Each new RMU shall be equipped with main-line load break switches and a fault passage indicator (FPI). Furthermore, to protect each of its lateral / transformer feeders, it shall be equipped with a corresponding set of circuit breakers and self-powered numerical relays. The RMU shall include potential-free contacts so as to connect to SCADA/DMS via FRTUs in case of remote operated RMUs, so as to:

- Monitor and control the open/closed status of the RMU circuit breakers and load break switches.
- Monitor the local/remote position of RMU manually-operated switches that can be used to enable and disable remote monitoring.
- Monitor the health of the power supply, which will include battery failure and low voltage indications.
- Monitor the open/closed status of RMU earthing switches.
- Monitor for low SF6 gas pressure indication in case of SF6 Breaker .
- Monitor for circuit breaker relay operations.
- Monitor for indication of main-circuit fault detected by the RMU's FPI.
- Power supply indications including battery failure and voltage alarms
- FPI reset control
- The civil works, foundations works including providing of Earth pits and earth flat and their connectivity to earth pits for erection and commissioning of the RMU's are in the scope of the Bidder.
- Any site/ equipment/ statutory approvals at site etc. required shall be in Utility scope.
- Construct foundations /support structures of all equipments as per standard construction practice and in accordance with OEM's foundation drawing, with proper size and strength of plinth.
- Provide necessary earthing for RMUs, Sectionalizers, etc as per IS Code and IE rules.

- Also render all the services and activities required to be given contractually, within the contract period.

1.00 Detailed Scope:

The details of SCADA compatible equipment/material/services to be procured under IPDS are-

- 33kV Ring Main Unit (RMU) – 2 way/ 3 way/ 4 way/5 way
- 11kV Ring Main Unit (RMU)- 2 way/ 3 way/ 4 way/5 way
- 11kV Sectionalizers.
- 33 KV and 11KV XLPE Cables.
- 33 KV and 11KV XLPE Cable termination kits.
- Control cable & other related works.
- Communication and integration with SCADA application.
- Earthing of RMUs, Sectionalizers, etc as per IS Code and IE rules.
- Foundations /support structures of all equipments as per OEM's drawing and standard construction practice with proper size and strength of plinth.

It is not the intent to specify all aspects of design and construction of equipments mentioned herein. The systems, subsystems and equipments shall conform in all respect to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation.

For termination of RMUs with the distribution lines the scope covers survey of spots where RMUs have to be provided with optimization of RMU location, fabrication and supply of all type of RMUs, erection of 11kV XLPE cable, with all accessories including GI Pipe, hume pipe, cable trench, cable jointing kits etc as required along with testing and commissioning. The provisional list of proposed location of RMUs, and Sectionalizers shall be provided by the owner.

All the raw materials such as steel, zinc for galvanizing, reinforcement steel and cement for foundation, coke for earthing, bolts, nuts & washers, conductor pieces, danger plates, phase plate, number plate etc. required for RMUs / Auto reclosers/ Sectionalizers and other equipments & its structures are envisaged as part of the scope of supply. Bidders shall clearly indicate in their offer, the sources from where they propose to procure the major materials /equipments.

Return of old material to area store of the owner: All the old equipment/material removed in the process should be returned to the local store in coordination with the project in-charge as soon as possible but in any case before the issuance of the Operational Acceptance of the facility.

The equipment/material to be supplied shall be complete in all respect with all minor fittings and accessories, even though these may not have been specifically mentioned in the Tender specification or Contractor 's offer.

Contractor shall not be eligible for any extra price in respect of such minor fittings and accessories which can be considered as an essential part of the basic equipment even though they had not been specifically mentioned in the specification or in the offer.

Equipment to be procured under this contract are required to be integrated with the SCADA application. The responsibility of making all equipment operable on receipt of signals sent through SCADA Control Centre/ Master Control Centre/FRTU/RTUs shall be of Contractor.

Contractor shall be responsible for sending / receiving all alarms/ annunciations/operation commands from Sectionalizers, RMUs etc. to RTU/FRTUs/SCADA control centre and vice versa.

N. 11 KV Sectionalizer under IPDS

The scope covers high-voltage three-phase 11-kV class automatic circuit-Sectionalizer, as well as its accessories, for outdoor installation, to be used in the overhead primary distribution.

The Sectionalizers should be provided with necessary take off terminal units for automations. Remote operation of the Sectionalizers must be possible. It should provide the control and monitoring of networks from remote central point. Location of problems and re-configuration is completed with minimum downtime & without manual intervention.

The Sectionalizer shall be three-phase, automatic, appropriate for pole installation. The Sectionalizer shall be supplied with its respective pole-fixing support. All the requirements shall be taken into account in its design so that the electrical operation of the Sectionalizer can be done from remote location using SCADA.

It shall also be self-sufficient in functioning of protection and control.

The Sectionalizer shall have the following electrical characteristics:

- Type: Three pole, operated simultaneously by a common shaft
- Arc interruption in dielectric medium SF6 gas
- Local/Remote operation selector switch be provided
- Motor rated voltage 24V / 48V DC
- Emergency trip / open push button on panel front
-

1.00 Mounting:

The sectionalizer shall be suitable for single pole mounting. It shall be fitted with an external M12 earthing stud, complete with a nut, lock nut and spring washer. The earth stud shall be welded to the tank for optimal earthing connection. A detailed drawing of the single pole sectionalizer mounting arrangement with surge arresters fitted shall be provided. The minimum phase-to-earth clearances shall be indicated on the drawing.

2.00 Detection characteristics:

- The following detection elements shall be available: over-current (O/C), earth fault (E/F) and sensitive earth fault (SEF).
- Each of the detection elements is monitored with independent definite time settings and fault thresholds.
- The ratio of drop-off current to pick-up current shall be at least 90% for all detection functions.
- The SEF function shall be equipped with harmonic filtering to prevent operation when harmonics are present in the primary residual earth currents.
- A low pass filter with 3rd harmonic rejection > 28dB shall be supplied.

3.00 Current Transformer and Voltage Transformer:

- Current transformer ratio: 200-100/1-1A and VA burden of the CTs shall be sufficient to supply the energy required by the relay and the MFT.

- Voltage ratio : Primary 11 KV (Phase to Phase), Secondary 230 V ac or as per manufacturer controller requirement
- THE HV terminal shall be adequately long from the bushing epoxy material such that the connecting lug shall not rest directly on the bushing epoxy
- Voltage transformer shall be provided for metering purpose and VA burden of Voltage transformer should be sufficient to provide auxiliary supply for battery charging and operation of MFT.

4.00 Housing:

- Enclosure Stainless steel enclosure suitable for IP67
- SF6 gas pressure low alarm
- Provision for SF6 gas pressure indication Manometer with non return valve
- Arc interruption method for SF6 breaker: Puffer type / rotating arc type

5.00 Earthing Arrangement:

All Sectionalizer should have a special earth bar with a sectional area of not less than 100 mm² run along the whole of metal enclosed switch structure, each end being connected to the main earthing system where metal cases are used on instruments these shall be connected to this bar by conductors of not less than 16 mm² section.

- It should be easily possible to test the cables by a simple earthing arrangement.
- Equipment earthing of GI / Copper strips of adequate size be provided.

6.00 Power Supplies:

The Sectionalizer system shall provide power for the electronics, operation of the Sectionalizer and Controller operation (Future FRTU and Modem) shall be capable of supplying at least 45VA or higher suitable for self-operation of Sectionalizer and Modem.

Primary supply: Preference will be given to the ability to obtain primary power directly from the HV power system requiring no additional primary supply connection.

Test supply: The LBS shall accept an external AC 230 V 50 Hz supply. Optional supply: the LBS shall accept an external DC 110 V supply.

Auxiliary supply: An auxiliary supply with the following minimum characteristics shall be provided One battery and constant voltage charger with current limiting shall be part of the Sectionalizer.

O. Identification of DDUGJY / IPDS Assets:

Sign Boards for Village electrification: The DDUGJY sign boards shall be provided in villages which have been electrified under the scheme. The board shall be erected at a suitable location preferably near the office of Sarpanch/Gram Panchayat/or any other prominent location.

Specification of sign board under DDUGJY:

S. No.	Components	Desired Specification
1	Iron sheet	MS sheet 14 Gauge (1.6mm thickness)
2	Size of Iron sheet	6 Feet x4 Feet (Lengh x Breadth)
4	Painting on Board	Enamel paint with red oxide base coat
5	Printing on Board	Colour printing by Screen printing method
6	Height of Board from ground level (Between ground level and bottom part of board)	6 feet
7	Support L type angle	3" X 3", 6 mm thickness
8	Length of angle to be buried in the ground	1.50 Feet with 1 Feet hole pass inside

- a. The name of village should be included on the sign board.
- b. The sample copy of signboard for Un-electrified villages is hereunder:

The boards are to be installed at prominent locations like public building, school, health center, Panchayat Bhawan etc. A photograph depicting installation of board shall be submitted to the Project

Manager while submission of claim for the completed village. The list of village wise photographs, in soft copy shall be maintained by the contractor and shall be submitted for review at the time of block wise reconciliation of works and associated payments.

Similar type of sign board should be provided for Power Substation, Distribution Transformer Substation and in Partially Electrified village. Design of sign board will be provided by Project Manager.

All Support Structures and Substations: Single Pole (SP), Double Pole (DP), DTRSS (Distribution Transformer Substation Structures) are to be provided with sign board for unique identification of the structure as per prevailing practices of state. The details of pre-painting preparations, painting and writing shall be as per scope of work.

The grid substation / distribution transformer substation sign board should indicate the name of the scheme, name of implementation agency and capacity of substation. The sign board should be put up immediately when the substation is commissioned.

P. Testing during pre-commissioning and post commissioning

1.00 Type Test, Routine and Acceptance Tests:

All equipment with their terminal connectors, control cabinets, main protective relays, etc. as well as insulators, insulator strings with hardware, clamps and connectors, marshalling boxes, etc., shall conform to type tests and shall be subjected to routine and acceptance tests in accordance with the requirements stipulated under respective equipment sections.

Contractor shall submit all type test reports/certificates according to the relevant standards and/or specifications for all the equipment/material for Owner's review as a proof of their conformity to type tests along with a certificate regarding conformity of equipment to be supplied with the type test.

The test certificates submitted shall be of the tests conducted within 5 years prior to the date of bid opening. In case the test reports are of the tests conducted earlier than 5 years prior to the date of bid opening, or they do not meet the requirements of the specifications/relevant standards, or they are not available, the Contractor shall conduct these type test(s) under this contract at no extra cost to the Owner.

The Owner will have the right of getting any test of reasonable nature carried out on any component or completely assembled equipment at Contractor's premises or at site or in any other place in addition to the aforesaid type and routine tests, to satisfy that the materials/equipment comply with the specifications.

Failure of any equipment to meet the specified requirements of tests carried out at works or at site shall be sufficient cause for rejection of that equipment lot. Rejection of any equipment lot will not be held as a valid reason for delay in the completion of the works as per schedule. Contractor shall be responsible for removing all deficiencies, and supplying the equipment that meet the requirement.

Test results / Test reports of various tests performed under this contract shall be furnished by the agency in two copies signed jointly by agency and representative of Project Manager along with a soft copy in excel file in the office of Employer.

2.00 General Checks:

- i. Check for physical damages.
- ii. Visual examination of zinc coating/ painting.
- iii. Check from name plate that all items are as per order/ specification.
- iv. Check tightness of all bolts, clamp and connecting terminals using torque wrenches.
- v. For oil filled equipment check for oil leakage, if any. Also check oil level and top up.
- vi. Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanized surfaces.
- vii. Check cleanliness of insulator and bushings.
- viii. All checks and tests specified by the manufacturers in their drawings and manuals as well as tests specified in the relevant code of erection.
- ix. Visual examination of labelling, danger board, anti-climbing device, muffing, painting, tension on stay wires, straightening of poles, alignment of line/supports etc

Equipment test records, commissioning test records and drawings:

Factory test certificates of equipment, test certificates at the time of pre-dispatch inspections, pre-dispatch inspection reports, pre-commissioning check results and post commissioning check results shall be compiled and provided in three sets to Project Manager for his approval and records.

A copy of such test record shall be offered to electrical inspector and other inspecting officials during his/her visit to substation for inspection.

3.00 Power Transformer:

- i. Check for Vector group.
- ii. Checking for transformation ratio.
- iii. Checks for winding resistances,
- iv. Insulation resistance of windings, live parts, transformer oil,
- v. Operation of WTI, OTI, Buchholtz relays,
- vi. Calibration of OTI & WTI,
- vii. Functional checking for tripping of transformer on field inputs,
- viii. Transformer oil testing - BDV
- ix. Visual examination of statutory clearances
- x. Visual examination of earthing connections
- xi. Measurement of earth resistance of individual earth pit
- xii. Visual examination of termination of wires and cables
- xiii. Visual examination of Oil leakage in power transformer
- xiv. Visual examination of breather, filling of oil and silica gel in breather of power transformer
- xv. Visual examination of two separate earth connection to neutral bushing of power transformer
- xvi. Visual examination of valves between transformer tank and breathers
- xvii. Checking of transformer oil in conservator tank
- xviii. Visual examination of explosion vent

4.00 Circuit Breakers:

- i. Insulation resistance of each pole.
- ii. Check adjustment, if any, suggested by manufacturer.
- iii. Breaker closing and tripping time.
- iv. Slow and power closing operation and opening.
- v. Trip free and anti-pumping operation.
- vi. Minimum pick up volts of coils
- vii. Contact resistance.
- viii. Interlock with other breakers/circuits,
- ix. Functional checking of all accessories.
- x. Functional checking of control circuits, interlocks, tripping through protective relays and auto-reclose operation.
- xi. Insulation resistance of control circuits, motor etc.
- xii. Resistance of closing and tripping coils.

5.00 Isolators:

- i. Alignment,
- ii. Insulation resistance of each pole.
- iii. Manual and electrical operation on interlocks.
- iv. Insulation resistance of control circuit and motors.
- v. Ground connections
- vi. Contact resistance
- vii. Proper alignment to minimize the vibration to the extreme possible during operation.
- viii. Measurement of operating torque for isolator and earth switch
- ix. Resistance of operating and interlocking coils.

- 6.00 Current Transformers:
- i. Insulation Resistance Test
 - ii. Polarity test.
 - iii. Ratio identification test-checking of all ratios on all cores by primary injection of current.
 - iv. Dielectric test of oil (Wherever applicable)
 - v. Magnetizing characteristics test.

- 7.00 Voltage Transformers:
- i. Insulation resistance test
 - ii. Polarity test.
 - iii. Ratio test
 - iv. Dielectric test of oil (if applicable)

- 8.00 Surge Arrester
- i. Grading leakage current
 - ii. Resistance of ground connection

9.00 Phasing Out

The phasing out of all supplies in the Sub-station system shall be carried out.

- 10.00 Station Earthing
- i. Check soil Resistivity
 - ii. Check continuity of grid wires
 - iii. Check earth resistance of the entire grid as well as various sections of the same.
 - iv. Check for weld joint and application of zinc rich paint on galvanized surface.
 - v. Dip test on earth conductor prior to use.

- 11.00 Conductor Stringing and Power Connectors
- i. Physical check for finish
 - ii. Electrical clearance check
 - iii. Testing of torque by torque wrenches on all bus power connectors and other accessories.
 - iv. Milli volt drop test on all power connectors
 - v. Sag and tension check on conductors.

- 12.00 Insulators
- i. Visual examination for finish damage, creepage distance, etc.
 - ii. Insulation resistance

- 13.00 33 kV & 11 kV Line testing
- i. Visual examination of statutory clearances
 - ii. Visual examination of earthing connections
 - iii. Measurement of earth resistance of individual earth pit
 - iv. Checking of sag chart
 - v. Visual examination of tensioning of wires, evenness of sag
 - vi. Visual examination of straightening of individual pole
 - vii. Visual examination of painting of support and fabricated items

- viii. Insulation resistance of line conductor
- ix. Visual examination of labelling, danger board, anti-climbing device, muffing
- x. Visual examination of unguarded road/line crossings
- xi. Visual examination of alignment of lines
- xii. Visual examination of position correctness of pre-fabricated items
- xiii. Visual examination of tightness and tidiness of stays

14.00 Distribution Transformer substation testing

- i. Visual examination of statutory clearances
- ii. Visual examination of earthing connections for tightness and tidyness
- iii. Measurement of earth resistance of individual earth pit
- iv. Visual examination of termination of wires and cables
- v. Visual examination of operation of AB switch and DO fuse units
- vi. Visual examination of straightening of individual substation pole, composite DP structure
- vii. Visual examination of painting of support and fabricated items
- viii. Insulation resistance of transformer and distribution board
- ix. BDV test of transformer oil
- x. Visual examination of Oil and silica gel leakage in distribution transformer
- xi. Visual examination of breather, filling of oil& silica gel in breather of distribution transformer
- xii. Visual examination of two separate earth connection to neutral bushing of distribution transformer
- xiii. Testing and recording of LV voltages (Ph-Ph and Ph-N) after commissioning of distribution transformer
- xiv. Testing and recording of neutral current after commissioning of distribution transformer
- xv. Checking of transformer oil in conservator tank
- xvi. Visual examination of valves between transformer tank and breathers
- xvii. Visual examination of labelling, danger board, anti-climbing device, muffing
- xviii. Visual examination of tightness and tidiness of stays

15.00 LT Line testing

- i. Visual examination of statutory clearances
- ii. Visual examination of earthing connections for tightness and tidyness
- iii. Measurement of earth resistance of individual earth pit
- iv. Checking of sag for evenness of sag
- v. Visual examination of tensioning of cables and wires
- vi. Visual examination of straightening of individual pole
- vii. Visual examination of painting of support and fabricated items
- viii. Insulation resistance of line conductor/ABC conductor
- ix. Visual examination of labelling, danger board, anti-climbing device, muffing
- x. Visual examination of alignment of line
- xi. Visual examination of tightness and tidiness of stay sets

Q. CIVIL WORKS AND SOIL INVESTIGATION

1.00 General

The provisions of this section of specification shall only be applicable to the extent of scope of works indicated in Bid Proposal Sheet (BPS). The intent of specification covers the following:

Design, engineering, and construction of all civil works at power sub-station, 66 kV line, 33 kV line, 11 kV line, DTR substation, LT line, metering, HVDS, augmentation/renovation of system etc. All civil works shall also satisfy the general technical requirements specified in other Sections of this 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 National/ International Standards.

All civil works shall be carried out as per applicable Indian Laws, Standards and Codes. All materials shall be of best quality conforming to relevant Indian Standards and Codes.

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 Employer.

The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the Project Manager based on Tender Drawings Supplied to the Contractor by the Project Manager and Original Equipment Manufacturer recommendation. 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 based on the input provided by the Project Manager. Certain minimum requirements are indicated in this specification for guidance purposes only.

In case of R&M of existing substations, Contractor shall visit site to ascertain the amount of repair and strengthening of structures and foundations, dismantling and new construction of structures and foundations works are to be done before quoting. Contractor must furnish the design and drawings in support of the activities mentioned above that are to be carried out in the R&M of existing substation site.

The rate quoted by the bidder for all type of civil work shall be firm irrespective of the type of terrain and depth of filling.

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 Project Manager.

All the work shall be carried out as per latest edition of the corresponding Indian Standard Codes.

a. Geotechnical Investigation

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. So that the foundation of the various structures can be designed and constructed safely and rationally.

A report to the effect will be submitted by the Contractor for Project Manager's specific approval giving details regarding data proposed to be utilised for civil structures design.

The Contractor should visit the site to ascertain the soil parameters before submitting the bid. The topography is uneven steeply sloping at few places requiring cutting and filling operations including slope stability and protection measures (if slopes encountered). Any variation in soil data shall not constitute a valid reason for any additional cost & shall not affect the terms & condition of the Contract. Tests must be conducted under all the critical locations i.e. Control Room Building, Tower locations, transformer etc.

b. Bore Holes

Drilling of bore holes of 150 mm dia. in accordance with the provisions of IS: upto 10 m depth or to refusal whichever ever occur earlier. (By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration). For a new substation, minimum three (3) bore holes shall be done to find out the geological profile of the area. If any unconformity encountered then more bore holes shall be drilled with the approval of Project Manager for the new projects. However in case deep pile foundations are envisaged the depths have to be regulated as per codal provisions. In cases where rock is encountered, coring in one borehole per bay shall be carried out to 1.5 M in bedrock and continuous core recovery is achieved.

Performing Standard Penetration Tests at approximately 1.5 m interval in the borehole starting from 1.5 m below ground level onwards and at every change of stratum. The disturbed samples from the standard penetrometer shall also be collected for necessary tests.

Collecting undisturbed samples of 100/75 mm diameter 450 mm long from the boreholes at intervals of 2.5 m and every change of stratum starting from 1.0 m below ground level onwards in clayey strata.

The depth of Water table shall be recorded in each borehole.

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 Project Manager.

c. Electrical Resistivity Test

This test shall be conducted to determine the Electrical resistivity of soil required for designing safe grounding system for the entire station area. The specifications for the equipments and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall conform to IS: 3043. The test shall be conducted using Wagner's four electrode method as specified in IS: 1892, Appendix-B2. 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 0.5 m upto a distance of 10.0 m.

d. Water Sample

Representative samples of ground water shall be taken when ground water is first encountered before the addition of water to aid drilling of boreholes. The samples shall be of sufficient quantity for chemical analysis to be carried out and shall be stored in airtight containers.

e. Back Filling of Bore Holes

On completion of each hole, the Contractor shall backfill all bore holes as directed by the Project Manager. The backfill material can be the excavated material and shall be compacted properly.

f. Laboratory Test

1. The laboratory tests shall be carried out progressively during the field work after sufficient number of samples have 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.
2. 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 I.S. Codes.

The following laboratory tests shall be carried out

- a) Visual and Engineering Classification
- b) Liquid limit, plastic limit and shrinkage limit for C- soils.
- c) Natural moisture content, bulk density and specific gravity.
- d) Grain size distribution.
- e) Swell pressure and free swell index determination for expansive soil only.
- f) Consolidated un-drained test with pore pressure measurement.
- g) 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.
- h) C.B.R value
- i) Rock quality designation (RQD), RMR in case of rock is encountered

g. Test Results and Reports

1. The Contractor shall submit the detailed report in two (2) 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. Initially the report shall be submitted by the Contractor in draft form and after the draft report is approved, the final report in two (3) copies shall be submitted. The test data shall bear the signatures of the Investigation Agency, Vendor and also site representative of XXXX (Name of Employer).
2. The report shall include but not limited to the following:
 - i. A plan showing the locations of the exploration work i.e. bore holes, dynamic cone penetration tests etc.

- ii. 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 summarised 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.

- h. 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 Project Manager. The observations and recommendations shall include but not limited to the following:
 - i. 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. Slope stability characteristics and landslide history of the area shall be specifically highlighted. Remedial measures to be adopted shall also be given.
 - ii. 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.
 - iii. 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 shall be provided.
 - iv. Recommendations regarding slope of excavations and dewatering schemes, if required. Required protection measures for slope stability for cut & fill slopes of switchyard and approach road with stone pitching/retaining walls shall be clearly spelt out. Calculation shall also be provided for stability adequacy.
 - v. 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.
 - vi. If expansive soil is met with, recommendations on removal or retaining the same under the structure, road, drains, etc. shall be given. In the latter case detailed specification of any special treatment required including specification or materials to be used, construction method, equipment to be deployed etc. shall be furnished. Illustrative diagram of a symbolic foundation showing details shall be furnished.
 - vii. Recommendations for additional investigations beyond the scope of the present work, if considered such investigation as necessary.

2.00 Site Preparation

The Employer shall be responsible for proper leveling of switchyard site as per layout and levels of switchyard finalised during detailed engineering stage. The Employer at his own cost shall make the layout and levels of all structure etc from the general grids of the plot and benchmarks set and approved by the Project Manager. The Contractor shall give all help in instruments, materials and personnel to the Project Manager for checking the detailed layout and shall be solely responsible for

the correctness of the layout and levels. Site leveling shall be in the scope of the Employer. Bidder may decide the level of the sites. However, the level shall be such that it is 300 mm higher than the highest flood level (HFL) of the site. If HFL is not available, then nearby road level shall be assumed as HFL.

Whenever for bay extension works the existing substation are to be modified or strengthen, contractor should keep same as EGL of existing sub-station so that FFL shall be same for both and all the necessary arrangements are to be carried out in this regard by the contractor.

This clause covers the design and execution of the work for site preparation, such as clearing of the site, the supply and compaction of fill material, slope protection by stone pitching/retaining walls depending on the site location & condition, excavation and compaction of backfill for foundation, road construction, drainage, trenches and final topping by brick soling/stone filling.

- 1) The Employer shall develop the site area to meet the requirement of the intended purpose. The site preparation shall conform to the requirements of relevant sections of this specification or as per stipulations of standard specifications. Employer shall also carry out necessary protection of slope of switchyard area and approach road.
 - 2) The fill material if required shall be suitable for the above requirement. The fill shall be such material and the site so designed as to prevent the erosion by wind and water of material from its final compacted position or the in-site position of undisturbed soil.
 - 3) Material unsuitable for founding of foundations shall be removed and replaced by suitable fill material and to be approved by the Project Manager.
 - 4) Backfill material around foundations or other works shall be suitable for the purpose for which it is used and compacted to the density described under Compaction. Excavated material not suitable or not required for backfill shall be disposed off in areas as directed by Project Manager upto a maximum lead of 1 km.
- a. Excavation and backfill
1. Excavation and backfill for foundations shall be in accordance with the relevant code.
 2. Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling.
 3. When embankments are to be constructed on slopes of 15% or greater, benches or steps with horizontal and vertical faces shall be cut in the original slope prior to placement of embankment material. Vertical faces shall measure not more than 1 m in height.
 4. Embankments adjacent to abutments, culverts, retaining walls and similar structures shall be constructed by compacting the material in successive uniform horizontal layers not exceeding 20 cm in thickness (of loose material before compaction). Each layer shall be compacted as required by means of mechanical tampers approved by the Project Manager. Rocks larger than 10 cm in any direction shall not be placed in embankment adjacent to structures.
 5. Earth embankments of roadways and site areas adjacent to buildings shall be placed in successive uniform horizontal layers not exceeding 20 cm in thickness in loose stage measurement and compacted to the full width specified. The upper surface of the embankment shall be shaped so as to provide complete drainage of surface water at all times.

6. The land required for borrowing earth shall be arranged & selected by contractor. The identified land shall be got approved by Project Manager. The quoted rates shall include cost of earth, taxes, duties, royalty, compensation for the land identified for borrow earth. The rate shall also be inclusive of all leads, lifts, ascent, descent and testing required for completion of work in all respect.
7. The ground levels for all measurements shall be taken at every 5 meter distance in uniformly sloping ground and at closer distance where pits/undulations are met with. In fairly leveled area, levels shall be taken at 15 mt. apart at the discretion of Project Manager. The ground levels shall be recorded and plotted on plans. The same shall be recorded by Project Manager before the earth work is started. All labor, material, tool, equipment etc required for the above work shall be arranged by the Employer at his own cost.

b. Compaction

1. The density to which fill materials shall be compacted shall be as per relevant IS and as per direction of Project Manager. All compacted sand filling shall be confined as far as practicable. Backfilled earth shall be compacted to minimum 95% of the Standard Proctor's density at OMC. The sub-grade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC. Cohesion less material sub grade shall be compacted to 70% relative density (minimum).
2. At all times unfinished construction shall have adequate drainage. Upon completion of the road's surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.
3. Each layer of earth embankment when compacted shall be as close to optimum moisture content as practicable. Embankment material, which does not contain sufficient moisture to obtain proper compaction, shall be wetted. If the material contains any excess moisture, then it shall be allowed to dry before rolling. The rolling shall begin at the edges overlapping half the width of the roller each time and progress to the center of the road or towards the building as applicable. Rolling will also be required on rock fills. No compaction shall be carried out in rainy weather.

c. Requirement for fill material under foundation

All foundations shall rest below virgin ground level and the minimum depth of foundation below the virgin ground level shall be at least 500 mm. For small equipment and minor foundations like marshalling kiosk, Switch board stand, earth switch and main box support etc. may be reduced to 300 mm with specific approval of the Project Manager.

3.00 Stone Filling & Antiweed Treatment

The Contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification and direction of the Project Manager.

Stone filling shall be done in the areas of the switchyard wherever equipment and or structures are to be provided under present scope of work covering entire fencing area.

Prevailing practice of stone filling is to be adopted for the bay extension works of existing substations. Contractor shall verify the existing practice prevailing at site before quoting.

Before taking up stone rolling, antiweed treatment shall be applied in the switchyard area where stone filling is to be done and the area shall be thoroughly de-weeded including removal of the roots. The recommendation of local agriculture/horticulture department shall be sought where ever feasible while choosing the type of chemical to be used. Nevertheless the effectiveness of chemical shall be demonstrated by the contractor in a test area of size 10 meterx 10 meter (approx..). The final approval based on the result shall be given by Project Manager. Antiweed treatment shall be procured from reputed manufacturer. The dosage and application of chemical shall be strictly as per the manufacturer's recommendation. The contractor shall be requested to maintain the area free of weed for a period of one year from the date of application of the first dose of the chemical.

4.00 General Requirement

- a. The material required for site surfacing shall be free from all types of organic materials and shall be of standard quality, and as approved by the Project Manager.

The material to be used for stone filling/ site surfacing shall be uncrushed/ crushed/ broken stone of 20 mm nominal size (single sized) conforming to table 2 of IS: 383- 1970. Hardness, flakiness shall be as required for wearing courses are given below.

(a) Sieve analysis limits/Gradation

Sieve size	% passing by weight
40mm	100
20mm	85-100
10mm	0-20
4.75mm	0-5

(b) Hardness

Abrasion value (IS: 2386 part-IV) not more than 40%
 Impact value (IS: 2386 part-IV) not more than 30%

(c) Flakiness Index

As per (IS: 2386 part-IV) and maximum value is 25.

- b. After all the structures/equipment are erected, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by Project Manager. De-weeding including removal of roots shall be done before rolling is commenced. Project Manager shall decide final formation level so as to ensure that the site appears uniform. The final formation level shall however be very close to the formation level indicated in the drawing using half-ton roller with suitable water sprinkling arrangement to form a smooth and compact surface.
- c. A base layer of uncrushed/crushed/broken stone of 20 mm nominal size (single sized) shall be spread and rolled/compacted by using half ton roller with 4 to 5 passes and water sprinkling to form a minimum 50 mm layer on the finished ground level of the specified switchyard area excluding roads, drains, cable trench and tower and equipment foundations as indicated in the drawing.
- d. Over the base layer of site surfacing material, a final surface course of minimum 50 mm thickness of 20 mm nominal size (single sized) broken stone as specified above shall be spread and compacted by light roller using half tones steel roller (width 30" and 24" dia meter) with water sprinkling as directed by the Project Manager. The water shall be sprinkled in such a way that bulking does not take place.

- e. In areas that are considered by the Project Manager to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipment, 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.

5.00 Site Drainage

- a. Adequate site drainage system shall be provided by the Contractor in new and existing substation. In case of bay extension of existing substation, drainage layout shall be prepared by the contractor in such away that it should satisfy the technical parameters stated below while designing the drainage system so that flow of water of the existing part of substation remain uninterrupted and the same should be approved by the Project Manager. The technical parameters stated below also to be taken into account while designing the drainage system for new substation as well.

The Contractor shall obtain rainfall data and design the storm water drainage system, (culverts, ditches, drains etc.) to accommodate run off due to the most intense rainfall that is likely to occur over the catchments area in one hour period on an average of once in ten years. The surface of the site shall be sloped to prevent the ponding of water.

- b. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8m/sec respectively. However, minimum non-silting velocity of 0.6m/sec shall be ensured. Longitudinal bed slope shall not be milder than 1 in 1000.
- c. The drains shall be constructed using Brick masonry except at road crossings etc. where RCC pipe shall be used. The RCC pipe for drains and culverts shall be as per IS:456 and IS:783.
- d. The Contractor shall ensure that water drains are away from the site area and shall prevent damage to adjacent property by this water. Adequate protection shall be given to site surfaces, roads, ditches, culverts, etc. to prevent erosion of material by water.
- e. The drainage system shall be adequate without the use of cable/pipe trenches. (Pipe drains shall be provided in areas of switchyard where movement of crane will be necessary in operating phase of the substation).
- f. For pipe drains, concrete pipe of class NP2 shall be used. However, for road crossings etc. higher strength pipe of class NP3 shall be provided. For rail crossings, pipes conforming to railway loading standards or at least NP4 class shall be provided. Manholes shall be provided at every 30m interval, at connection points and at every change of alignment.
- g. Open surface drains for new s/s shall be provided with brick masonry in 1:6 (1 cement: 6 coarse sand) cement mortar with 12 mm thick, 1:4 (1 cement: 4 sand) cement plaster inside and exposed surface of drains as per approved drawing. For bay extension at existing substations, prevailing practice of the respective substation shall be adopted.
- h. Pipe drains shall be connected through manholes at an interval of max. 30m. Effluents shall be suitably treated by the Contractor to meet all the prevalent statutory requirements and local pollution control norms and treated effluents shall be conveyed to the storm water drainage system at a suitable location for its final disposal.
- i. Invert of the drainage system shall be decided in such a way that the water can easily be discharged above the High Flood Level (HFL) outside substation boundary at suitable location upto a maximum 50M beyond boundary wall of substation or actual whichever occurs earlier and approved by Project Manager.

- j. All internal site drainage system, including the final connection/disposal to Project Manager acceptance points shall be part of Supplier's scope including all required civil works. The Contractor shall connect his drain(s) at one or more points to outfall points as feasible at site.
- k. The drainage scheme and associated drawings shall be got approved and constructed as per enclosed tender drawing.

6.00 Roads and Culverts inside substation premises

- a. The main approach road including modification of existing road to meet the site conditions, roads for access to equipment and buildings with in substations (including bay extension in existing substations) are in the scope of the contractor. Layout of the roads shall be based on General detail & Arrangement drawing for the substation. If extra road is required for functional point of view, which has not been mentioned in the layout drawing, Contractor should provide the same without extra cost to the Project Manager.
- b. All substation roads shall be constructed so as to permit transportation of all heavy equipment. The roads shall have min. 3.0 m wide RCC road as per enclosed tender drawing.
- c. Road construction shall be as per IRC standards.
- d. Adequate provision shall be made for road drainage. Protection of cut and embankment slopes of roads as per slope stability requirement shall be made.
- e. All the culverts and its allied structure (required for road/rail, drain trench crossings etc.) shall be designed for class A loading as per IRC standard / IS code and should be checked for loading.
- f. All roads shall be designed for class 'D' of traffic as per IRC-37 Guide-lines for the design of rigid pavements.

7.00 Transformer Foundation

The Contractor shall provide a road system integrated with the transformer foundation to enable installation and the replacement of any failed unit by the spare unit located at the site. This system shall enable the removal of any failed unit from its foundation to the nearest road.

If existing/failed transformer is required to be replaced by new one in augmentation/bay extension works of existing substations then the foundation supporting that equipment shall be strengthened by modifying the foundation itself or the foundation shall be dismantle and recast new foundation as per site conditions. However, contractor must furnish the design calculation incorporating all those changes so that safety of the structure and foundation remain adequate.

Similarly all types of equipment foundations with /without supporting structures shall be treated in similar manner as stated for transformer foundations.

Contractor must access the amount of work involve for augmentation/bay extension of existing substations while quoting.

8.00 Cable & Pipe Trenches

- a. The cable trenches and precast removable RCC cover (with lifting arrangement) shall be constructed using RCC of M20 grade for new substation whereas for bay extension of existing substation size and material of cable trenches shall be same as the existing one and pre-cast

removable RCC cover (with lifting arrangement) shall be constructed using RCC of M20 grade. Cable trenches must be designed for the design criteria stated below, whether it is of concrete or brick for both new substations and bay extension works in existing substations.

- b. The cable trench walls shall be designed for the following loads.
 - (i) Dead load of 100 kg/m length of cable support + 75 Kg on one tier at the end.
 - (ii) Triangular earth pressure + uniform surcharge pressure of 1T/m².
- c. Cable trench covers shall be designed for self-weight of top slab + concentrated load of 200 kg at center of span on each panel.
- d. Cable trench crossing the road/rails shall be designed for class A. Loading of IRC/relevant IS Code and should be checked for transformer loading.
- e. Trenches shall be drained. Necessary sumps be constructed and sump pumps if necessary shall be supplied. Cable trenches shall not be used as storm water drains.
- f. The top of trenches shall be kept at least 100 mm above the finished ground level for the new substation. The top of cable trench shall be such that the surface rainwater does not enter the trench.
- g. The top of trench shall be kept same as existing one to maintain uniformity of the cable trenches structure in case of bay extension works of existing substations.
- h. All metal parts inside the trench shall be connected to the earthing system.
- i. Cables from trench to equipment shall run in hard conduit pipes.
- j. Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.
- k. The trench bed shall have a slope of 1/500 along the run & 1/250 perpendicular to the run.
- l. Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12mm thick 1:6 cement sand mortar.
- m. Cable trench contains cable tray that shall be supported on ISA. The size and spacing of angle section shall be as per design criteria mentioned above.
- n. Cable trench shall be constructed as per enclosed tender drawing.

9.00 Foundation /RCC Construction

1. Work covered under this Clause of the Specification comprises the design and construction of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, drains, control cubicles, bus supports, transformer, marshalling kiosks, auxiliary equipment & systems, buildings, tanks, boundary wall or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to the other RCC constructions.

However, for the augmentation/bay extension works of existing substation, type of RCC structures and foundations etc. shall be similar to one already existing at the existing substation and for which design shall be furnished in support of safety of those RCC structures and foundations etc. Contractor must assess the amount of work involved for the construction of switchyard structures, equipment supports, trenches, drains, control cubicles,

bus supports, transformer, marshalling kiosks, auxiliary equipment & systems, buildings, tanks, boundary wall or for any other equipment or service and any other foundation required to complete the work for the existing substations.

2. Concrete shall conform to the requirements mentioned in IS: 456 and all the tests shall be conducted as per relevant Indian Standard Codes as mentioned in Standard field quality plan appended with the specification

A minimum grade for PCC and RCC shall be used for all structural/load-bearing members as per latest IS 456.

3. If the site is sloppy, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate such slopes.
4. The switchyard foundation's plinths and building plinths shall be minimum 300mm and 500 mm above finished ground level respectively.
5. Minimum 75mm thick lean concrete shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.
6. Concrete made with Portland slag cement shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering.
7. The design and detailing of foundations shall be done based on the approved soil data and sub-soil conditions as well as for all possible critical loads and the combinations thereof. The Spread footings foundation or pile foundation as may be required based on soil/sub-soil conditions and superimposed loads shall be provided.
8. If pile foundations are adopted, the same shall be cast-in-situ driven/bored or precast or under reamed type as per relevant parts of IS Code 2911. Only RCC piles shall be provided. Suitability of the adopted pile foundations shall be justified by way of full design calculations. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used. Necessary initial load test shall also be carried out by the bidder at their cost to establish the piles design capacity. Only after the design capacity of piles has been established, the Contractor shall take up the job of piling. Routine tests for the piles shall also be conducted. All the work (design & testing) shall be planned in such a way that these shall not cause any delay in project completion.

a. Design

1. Foundations shall be of reinforced cement concrete for new substation but for the augmentation / bay extension works of existing substation it could be of RCC/ PCC depending on type of structures and materials used for the similar type of structures in those bay extension works of existing substation. Design requirement shall be fulfilled by the contractor and furnished for approval for both new substation and existing substation (for bay extension works) as specified in the scope of work. The design and construction of RCC/ PCC / Masonry structures shall be carried out as per IS: 456 and relevant IS code/CBIP manual/NBC etc and minimum grade of concrete shall be as per relevant IS code. Higher grade of concrete than specified above may be used at the discretion of Contractor without any additional financial implication to the Project Manager.
2. Limit state method of design shall be adopted unless specified otherwise in the specification.

3. For detailing of reinforcement IS: 2502 and SP: 34 shall be followed. Cold twisted deformed bars ($F_e=415 \text{ N/mm}^2$) conforming to IS: 1786 shall be used as reinforcement. However, in specific areas, mild steel (Grade I) conforming to IS: 432 can also be used. Two layers of reinforcement (on inner and outer face) shall be provided for wall & slab sections having thickness more than 150 mm. Clear cover to reinforcement towards the earth face shall be minimum 40 mm.
4. RCC water retaining structures like storage tanks, etc. shall be designed as un-cracked section in accordance with IS: 3370 (Part I to IV) by working stress method. However, water channels shall be designed as cracked section with limited steel stresses as per IS: 3370 (Part I to IV) by working stress method.
5. The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and or equipment and/or superstructure and other conditions, which produces the maximum stresses in the foundation or the foundation component and as per the relevant IS Codes of foundation design. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups or isolated /combined footings proposed to be used.
6. Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.
7. Necessary protection to the foundation work, if required shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental/harmful to the concrete/masonry foundations.
8. RCC columns /pedestals shall be provided with rigid connection at the base.
9. All sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be taken as mentioned in relevant IS Codes or as stipulated elsewhere in the Specifications. For checking against overturning, weight of soil vertically above footing shall be taken and inverted frustum of pyramid of earth on the foundation should not be considered.
10. Earth pressure for all underground structures shall be calculated using co-efficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable).
11. In addition to earth pressure and ground water pressure etc., a surcharge load of 1T/Sq.m shall also be considered for the design of all underground structures including channels, sumps, tanks, trenches, substructure of any underground hollow enclosure etc., for the vehicular traffic in the vicinity of the structure.
12. Following conditions shall be considered for the design of water tank in pumps house, channels, sumps, trenches and other underground structures:
 - i. Full water pressure from inside and no earth pressure & ground water pressure & surcharge pressure from outside (application only to structures, which are liable to be filled up with water or any other liquid).
 - ii. Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

- iii. Design shall also be checked against buoyancy due to the ground water during construction and maintenance stages. Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the superimposed loadings.
13. The foundations shall be proportioned so that the estimated total and differential movements of the foundations are not greater than the movements that the structure or equipment is designed to accommodate.
 14. The foundations of transformer and circuit breaker shall be of block type foundation. Minimum reinforcement shall be governed by IS: 2974 and IS: 456.
 15. The tower and equipment foundations shall be checked for a factor of safety of 2.0 for normal condition and 1.5 for short circuit condition against sliding, overturning and pullout.
- b. Admixtures & additives
1. Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own batch and added to the mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labeled containers to enable identification.
 2. Admixtures in concrete shall conform to IS: 9103. The water proofing cement additives shall conform to IS: 2645. Project Manager shall approve concrete Admixtures/ Additives.
 3. The Contractor may propose and the Project Manager may approve the use of a water-reducing set-retarding admixture in some of the concrete. The use of such an admixture will not be approved to overcome problems associated with inadequate concrete plant capacity or improperly planned placing operations and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.
 4. The water-reducing set-retarding admixture shall be an approved brand of Ligno-sulphonate type admixture.
 5. The waterproofing cement additives shall be used as required / advised by the Project Manager.
- c. Gates and Boundary Wall
1. The Gate frame shall be made of medium duty MS pipe conforming to relevant IS with welded joints.
 2. The gates shall be fabricated with welded joints to achieve rigid connections. The gate frames shall be painted with one coat of approved steel primer and two coats of synthetic enamel paint.
 3. Gates shall be fitted with approved quality iron hinges, latch and latch catch. Latch and latch catch shall be suitable for attachment and operation of pad lock from either side of gates. Hinges shall permit gates to swing through 180 degree back against fence. Gates shall be earthed by G I wire.
 4. Gates shall be fitted with galvanized chain hook or gate hold back to hold gates open. Double gates shall be fitted with centre rest and drop bolt to secure gates in closed position.

5. Gates shall be installed in locations shown on drawings. Next to the main gate, a men gate (1.25 m wide, single leaf) shall also be provided.
6. Bottom of gates shall be set approximately 40mm above ground surface and necessary guiding mechanism shall be fitted.
7. The Contractor shall design and construct boundary wall around substation area as per requirements. The boundary wall shall be of height 2.0M and shall be made of RCC frame construction with RCC column and plinth beam arrangement and panels filled with one brick thick wall in cement sand mortar 1:6. The boundary wall shall be plastered on both external and internal faces with cement and sand plaster 1:6 of thickness 18 mm and 12 mm respectively. An additional barbed Y-shaped arm of MS angle 50x50x6 with 3-rows (6 nos) barbed wire A-4 IS: 278. Expansion joints shall be provided as per codal requirements. MS grating shall be provided at required locations for drainage purposes. The boundary wall shall be painted with minimum two coats of color wash over a base coat of white wash with lime. The front portion of boundary wall shall however be with a RC jail and 12 mm square MS bar top above brick work and pebble dash plaster finish with colour pigment. The steel work shall be given two coats of synthetic enamel paint of approved make over one coat of primer. Boundary wall and gate shall be constructed as per enclosed tender drawing.

10.00 Buildings - General Requirements

The scope for new control room building includes the design, engineering and construction including anti-termite treatment, plinth protection, DPC of Building including sanitary, water supply, electrification, false ceiling etc. of control room building. The buildings shall be of RCC framed structure of concrete of M20 grade (Min.). Following design criteria shall be adopted for design purposes for new substation.

If any extension of the Control Room building is required in augmentation / bay extension works of existing substation then extension part shall be compatible to existing one structurally and architecturally but following design criteria shall be adopted for design purposes for R&M of existing substation.

a. Control room Building

Minimum floor area requirements shall be 10000×12000 mm excluding space for wash room which may be increased at the time of detailed engineering to suit project requirements. The layout of the control room shall be finalised as per detailed engineering to suit project requirements. The minimum dimension of different rooms required for C.R. building shall be as per drawing. The CR building shall consist of the following:

- a. Control room
- b. S/s In-charge room
- c. Battery room
- d. Store room
- e. Toilet

An open space of 1 m minimum shall be provided on the periphery of the rows of panel and equipment generally in order to allow easy operator movement and access as well as maintenance.

Any future possibility of annexe building shall be taken care of while finalizing the layout of the control room building.

Minimum headroom of 3 M below soffit of beams/false ceiling shall be considered for rooms. The roof shall have four side sloping roof or flat roof as finalised during detailed engineering.

i. Design

a) The buildings shall be designed:

1. To the requirements of the National Building Code of India, and the standards quoted therein.
2. For the specified climatic & loading conditions.
3. To adequately suit the requirements of the equipment and apparatus contained in the buildings and in all respects to be compatible with the intended use and occupancy.
4. With a functional and economical space arrangement.
5. For a life expectancy of structure, systems and components not less than that of the equipment, which is contained in the building, provided regular maintenance is carried out.
6. Be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design.
7. To allow for easy access to equipment and maintenance of the equipment.
8. With, wherever required, fire retarding materials for walls, ceilings and doors, which would prevent supporting or spreading of fire.
9. Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.
10. Individual members of the buildings frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion etc.
11. Permissible stresses for different load combinations shall be taken as per relevant IS Codes.
12. The building lighting shall be designed in accordance with the requirements of relevant section.
13. Sismic considerations as applicable.

ii. Design loads

Building structures shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, wind loads, seismic loads, and temperature loads.

Dead loads shall include the weight of structures complete with finishes, fixtures and partitions and should be taken as per IS: 1911.

Super-imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks/hangers and erection, operation and maintenance loads. Equipment

loads shall constitute, if applicable, all load of equipments to be supported on the building frame.

The wind loads shall be computed as per IS 875, Seismic Coefficient method shall be used for the seismic analysis as per IS 1893 with importance factor 1.5.

Wind and Seismic forces shall not be considered to act simultaneously.

Floors/slabs shall be designed to carry loads imposed by equipment, cables piping, equipment and other loads associated with building. Floors shall be designed for live loads as per relevant IS. Cable and piping loads shall also be considered additionally for floors where these loads are expected.

For consideration of loads on structures, IS: 875 shall strictly adhere to. Any other load coming in the structure, not mentioned in IS 875 shall be calculated as per relevant IS code and NBC.

iii. Submission

The following information shall be submitted for review and approval to the Project Manager:

1. Design criteria shall comprise the codes and standards used, applicable climatic data including wind loads, earthquake factors maximum and minimum temperatures applicable to the building locations, assumptions of dead and live loads, including equipment loads, impact factors, safety factors and other relevant information.
2. Structural design calculations and drawing (including construction/fabrication) for all reinforced concrete and structural steel structures.
3. Fully, dimensioned concept plan including floor plans, cross sections, longitudinal sections, elevations and perspective view of each building. These drawings shall be drawn at a scale not smaller than 1:75 and shall identify the major building components.
4. Fully dimensioned drawings showing details and sections drawn to scales of sufficient size to clearly show sizes and configuration of the building components and the relationship between them.
5. Product information of building components and materials, including walls partitions flooring ceiling, roofing, door and windows and building finishes.
6. A detailed schedule of building finishes including colour schemes.
7. A door & window schedule showing door types and locations, door lock sets and latch sets and other door hardware.

Approval of the above information shall be obtained before ordering materials or starting fabrication or construction as applicable.

iv. Finish Schedule

1. The finishing schedule is given in subsequent clauses.
2. M.S. Ladder should be provided to access the control room roof from outside. Ladder shall be made up of ISMC 75x40 which will run as beam one meter apart and intermediate

steps will be made up of 45x45x5 angle with rise of 300 mm. Red oxide primer shall be applied initially, then two coats of rich zinc paint shall be applied to avoid corrosion.

v. Flooring

Flooring in various rooms of control room building shall be as for detailed schedules given in Table -1

vi. Walls

Control room buildings shall be of framed superstructure. All walls shall be non-load bearing walls. Min. thickness of external walls shall be 230 mm (one brick) with 1:6 cement sand mortar.

vii. Plastering

All internal walls shall have minimum 12mm and 15 mm thick 1:6 cement sand plaster on either side of wall. The ceiling shall have 6mm thick 1:4 cement sand plaster.

viii. Finishing

All external surfaces shall have 18 mm cement plaster in two coats, under layer 12 mm thick cement plaster 1:5 and finished with a top layer 6 mm thick cement plaster 1:6 (DSR 13.19) with water proofing compound. The paint shall be antifungal quality of reputed brand suitable for masonry surfaces for high rainfall zone. White cement primer shall be used as per manufacturer's recommendation.

Internal finish Schedule is given Table - 1 below:

TABLE-1

Sl.No.	Location	Flooring & Skirting 150mm high	Wall Internal	Ceiling	Doors, Windows, Ventilators
1.	Control Room, Relay Room	Precast Terrazo tiles (DSR'02, item no. 11.29A.2 & 11.31.2	Oil bound washable distemper on smooth surface applied with 2mm thick Plaster of Paris putty. (DSR'02 – 13.40 A & 13.77.2)	White Wash (DSR'02 – 13.70.1)	1) Standard steel rolled section frames with 5 mm glass. DSR'02 – 10.12, 10.13 & 10.14 2) Flush door shutters - DSR'02 – 9.25.2
2.	Sub-station Incharge, Office, corridor, staff room.	Precast Terrazo tiles (DSR'02, item no. 11.29A.2 & 11.31.2	Oil bound washable distemper on smooth surface applied with POP putty. (DSR'02 – 13.40 A & 13.77.2)	White Wash (DSR'02 – 13.70.1)	1) Standard steel rolled section frames with 5 mm glass. DSR'02 – 10.12, 10.13 & 10.14 2) Flush door shutters - DSR'02 – 9.25.2
3.	Battery room	Acid and Alkali Resistant tiles. DSR'02 – 11.36 C. 1 & 11.36 C.1.1	Dado of acid resistant tile 1.2 M high & Paint above 1.2 M to ceiling. DSR'02 – 11.36 C. 2.1, 11.36C.2 & 13.96.1	Acid resistant Paint. DSR'02 – 13.96.1	1) Standard steel rolled section frames with 5 mm glass. DSR'02 – 10.12, 10.13 & 10.14 2) Flush door shutters - DSR'02 – 9.25.2

					Painted with acid resistant Paint. DSR'02 –13.96.1
4.	Toilet	Ceramic glazed tiles in flooring DSR'02 – 11.74	DADO glazed tile 2.1M high for toilet (DSR 02 - 11.73)	White Wash (DSR'02 – 13.70.1)	1) Standard steel rolled section frames with 5 mm glass. DSR'02 – 10.12, 10.13 & 10.14 2) Flush door shutters - DSR'02 – 9.25.2
5.	Other areas not specified	Terrazo tiles (DSR'02 - 11.29A.2 & 11.31.20)	Oil bound distemper, DSR'02 - 13.40A & 13.77	White Wash (DSR'02 – 13.70.1)	

Note: DSR item references (DSR-2002) to be read with CPWD specifications are only for material and workmanship guidance of the Contractors.

ix. Roof

Roof of the C.R. Building shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be an integral cement based treatment conforming to CPWD specification (item no. 25.8 of DSR 2002). The water proofing treatment shall be of following operations:

- i. Applying and grouting a slurry coat of neat cement using 2.75 kg/m² of cement admixed with proprietary water proofing compounds conforming to IS: 2645 over the RCC slab including cleaning the surface before treatment.
- ii. Laying cement concrete using broken bricks/brick bats 25mm to 100mm size with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 over 20mm thick layer of cement mortar of min 1:5 (Cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 to required slope and treating similarly the adjoining walls upto 300mm height including rounding of junctions of walls and slabs.
- iii. After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to IS: 2645.
- iv. Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement: 4 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.
- v. The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Project Manager.

With average thickness of 120 mm and minimum thickness at khurra at 65 mm.

x. Glazing

Minimum thickness of glazing shall be 5.0 mm. as per IS: 2835.

xi. Doors and Windows

The details of doors and windows of the control room building shall be as per finish schedule Table-1 and tender drawing with the relevant IS code. Rolling steel shutters and rolling steel grills shall be provided as per layout and requirement of buildings. Paints used in the work shall be of best quality specified in CPWD specification.

xii. Plumbing & Sanitation

1. All plumbing and sanitation shall be executed to comply with the requirements of the appropriate byelaws, rules and regulations of the Local Authority having jurisdiction over such matters. The Contractor shall arrange for all necessary formalities to be met in regard to inspection, testing, obtaining approval and giving notices etc.
2. PVC syntax or equivalent make Roof water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided. Minimum 1 Nos. 500 liters capacity shall be provided.
3. Galvanized MS pipe of medium class conforming to IS: 1239 shall be used for internal & external piping work for potable water supply.
4. Sand CI pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.
5. Each toilet shall have the following minimum fittings.
 - (a) WC (Western type) 390 mm high with toilet paper roll holder and all fittings
Or
WC (Indian Type) Orissa Pattern (580 x 440 mm) with all fittings
(both types of WCs shall be provided at alternate locations).
 - (b) Urinal (430 x 260 x 350 mm size) with all fittings.
 - (c) Wash basin (550 x 400 mm) with all fittings.
 - (d) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing
 - (e) CP brass towel rail (600 x 20 mm) with C.P. brass brackets
 - (f) Soap holder and liquid soap dispenser.
6. All fittings, fastener, grating shall be chromium plated.
7. All sanitary fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to site must bear identification marks of the type of the Manufacturer.
8. Soil, waste and drain pipes, for underground works shall be stoneware for areas not subject to traffic load. Heavy-duty cast iron pipes shall be used otherwise.
9. In case of Augmentation/R&M of existing substation, amount of work shall be envisaged by contract for lump sum quotation.

11.00 Miscellaneous General Requirements

1. Dense concrete with controlled water cement ratio as per IS-code shall be used for all underground concrete structures such as pump-house, tanks, water retaining structures, cable and pipe trenches etc. for achieving water-tightness.
2. All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops shall be used for the base slab and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm.
3. All steel sections and fabricated structures that are required to be transported on sea shall be provided with anti corrosive paint to take care of sea worthiness.
4. All mild steel parts used in the water retaining structures shall be hot-double dip galvanised. The minimum coating of the zinc shall be 750 gm/sq. m. for galvanised structures and shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS: 3416.
5. A screed concrete layer not less than 100 mm thick and of grade not weaker than M10 conforming to IS: 456-1978 shall be provided below all water retaining structures. A sliding layer of bitumen paper or craft paper shall be provided over the screed layer to destroy the bond between the screed and the base slab concrete of the water retaining structures.
6. Bricks having minimum 75kg/cm² compressive strength can only be used for masonry work. Contractor shall ascertain himself at site regarding the availability of bricks of minimum 75kg/cm² compressive strength before submitting his offer.
7. Doors and windows on external walls of the buildings (other than areas provided, with insulated metal claddings) shall be provided with RCC sunshade over the openings with 300 mm projection on either side of the openings. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings.
8. Service ladder shall be provided for access to all roofs.
9. Angles 45x45x5 mm (minimum) with lugs shall be provided for edge protection all round cut outs/openings in floor slab, edges of drains supporting grating covers, edges of RCC cable/pipe trenches supporting covers, edges of manholes supporting covers, supporting edges of manhole precast cover and any other place where breakage of corners of concrete is expected.
10. Anti termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS: 6313 and other relevant Indian Standards.
11. All rungs for ladder shall also be galvanised as per IS: 277 medium classes.
12. For all civil works covered under this specification, nominal mix by volume batching as per CPWD specification is intended. The relationship of grade of concrete and ratio of ingredients shall be as below:

Sl.No.	Mix	Cement	Sand	Coarse aggregate of 20 mm down grade as per IS 383
1.	M 10	1	3	6
2.	M 15	1	2	4
3.	M 20	1	1.5	3

The material specification, workmanship and acceptance criteria shall be as per relevant clauses of CPWD specification and approved standard Field Quality Plan.

13. The details given in tender drawings shall be considered along with details available in this section of the specification while deciding various components of the building.

14. Items/components of buildings not explicitly covered in the specification but required for completion of the project shall be deemed to be included in the scope.

12.00 Interfacing

The proper coordination & execution of all interfacing civil works activities like fixing of conduits in roofs/walls/floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports/embedment, provision of cutouts etc. shall be the sole responsibility of the Contractor. He shall plan all such activities in advance and execute in such a manner that interfacing activities do not become bottlenecks and dismantling, breakage etc. is reduced to minimum.

13.00 Water Supply

- (i) Contractor shall make its own arrangement for construction water.
- (ii) The contractor shall carry out all the plumbing/erection works required for supply of water in control room building.
- (iii) The details of tanks, pipes, fittings, fixtures etc for water supply are given elsewhere in the specification under respective sections.
- (iv) A scheme shall be prepared by the contractor indicating the layout and details of water supply which shall be got approved by the Project Manager before actual start of work including all other incidental items not shown or specified but as may be required for complete performance of the works.
- (v) Bore wells and pumps for water supply are in the scope of contractor meeting the day-to-day requirement of the water supply.
- (vi) If the water is supplied by Municipal Corporation then bore well for water supply purposes is not required to be carried out by contractor. Contractor shall also make necessary arrangement /formalities to receive water connection from corporation.

14.00 Sewerage System

- (i) Sewerage system shall be provided for control room building.
- (ii) The Contractor shall construct septic tank and soak pit suitable for 5 users if outside of Municipal Corporation zone. Otherwise, all necessary arrangement for the disposal of sewerage to the Municipal Corporation's end shall be arranged by the contractor at his own cost for regularizing the disposal activity.
- (iii) The septic tank and soak pit shall be constructed as per enclosed tender drawing.

15.00 Statutory Rules

- a. Contractor shall comply with all the applicable statutory rules pertaining to factories act (as applicable for the State). Fire Safety Rules of Tariff Advisory Committee, Water Act for pollution control etc.
- b. Provisions for fire proof doors, no. of staircases, fire separation wall, plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Tariff Advisory Committee.
- c. Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.
- d. Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation to be carried out by the Bidder.
- e. Foundation system adopted by Bidder shall ensure that relative settlement and other criteria shall be as per provision in IS: 1904 and other Indian Standards
- f. All water retaining structures designed as un-cracked section shall also be tested for water tightness at full water level in accordance with clause no. 10 of IS: 3370 (Part-I).
- g. Construction joints shall be as per IS: 456.
- h. All underground concrete structures like water retaining structures etc. shall have plasticizer cum water proofing cement additive conforming to IS: 9103. In addition, limit on permeability as given in IS: 2645 shall also be met with. The concrete surface of these structures in contact with earth shall also be provided with two coat of bituminous painting for water/damp proofing. In case of water leakage in the above structures, Injection Method shall be applied for repairing the leakage.
- i. All building/construction materials shall conform to the best quality specified in CPWD specifications if not otherwise mentioned in this specification.
- j. All tests as required in the standard field quality plans have to be carried out.

16.00 Fencing

- a. Product materials for fencing

The minimum requirements are as follows:

i. Chain Link fence fabric in accordance to IS-2721

- | | | | |
|----|----------------------------|---|------------|
| 1. | Size of mesh | : | 75 mm |
| 2. | Nominal wire size | : | 4.0 mm dia |
| 3. | Width of chain link | : | 2000 mm |
| 4. | Class of zinc coating | : | medium |
| 5. | Zinc coated after weaving. | | |

ii. Posts

Angle Section

- | | | |
|-----------------|---|---------------|
| Intermediate | : | L 65 x 65 x 6 |
| Straining posts | : | L 65 x 65 x 6 |
| Stay post | : | L 65 x 65 x 6 |

1. All structural steel shall conform to IS: 2062 and shall be painted with a coat of approved steel primer and two coats of synthetic enamel paint.
2. The Chain Link fabric shall be fixed to the post at the top and bottom of the fence by welding/fixing 50 mm MS flat all through its length.
3. Fencing top shall be either of galvanised barbed wire or tape. Barbed wire shall conform to IS: 278.
4. The barbed wire may consist of not more than two splices per reel. The barbed wire shall be formed by twisting two line wires, one containing the barbs. The barbed wire shall be designated as A-4 IS: 278 and shall be galvanized.
5. Above chain link, 3-rows (6 nos) of barbed tape/wire shall be provided in each arm of the Y shaped barbed arm at top.
6. With barbed tape/wire above the chain link fence, the total fence height shall be minimum 2500 mm above finished gravel level.
7. Barbed tape/wire arms shall be same as intermediate and straining post.
8. Tension wire: single strand, high tensile, galvanised steel wire, 4 mm diameter.
9. Fittings and hardware: cast aluminum alloy or galvanized steel, malleable or ductile cast iron turnbuckles to be drop forged.
10. GI chain link mesh shall be as per IS: 2721. Mesh size 75 mm and nominal wire size shall be 4.0 mm diameter.

On the results of these additional tests, the whole or portion of the barbed wire/tape shall be accepted or discarded by the Purchaser, as the case may be.

b. Installation

1. Contractor shall submit the fencing drawing Fence shall be installed along lines shown on approved drawings.
2. Post holes shall be excavated by approved methods.
3. Intermediate posts shall be spaced 2.5 m apart measured parallel to ground surface.
4. Straining posts shall be installed at equal intervals not exceeding 25.0 m.
5. Straining posts shall be installed at sharp changes in grade, at corners, at change of direction and where directed.
6. All corner post will have two-stay post and every tenth post will have a transverse stay post.
7. Posts shall be set in 1:2:4 plain cement concrete Blocks of minimum dimension 400 mm x 400 mm x 1000 mm deep Concrete work shall conform to relevant clause. Post shall be braced and held in plumb position and true alignment and elevation until concrete has set.
8. Fence fabric shall not be installed until concrete has cured a minimum of 7 days.
9. Bottom and top of the fence fabric shall be fixed with MS flats of 50 mm x 6mm (min).
10. Fence fabric shall be laid out with barbed edge on top, stretched tightly and shall be fastened to intermediate, post gate and straining post with 50 x 6 flats.
11. Fabric shall be secured to tension wires with tie wires at 400 mm intervals. Tie wires shall be given not less than two twists.
12. Barbed tape shall be spliced with standard wire splices.
13. Barbed tape shall be stretched to have uniform tension.
14. Barbed tape shall be attached to barbed wire arms with approved metal clips.
15. Toe wall of one Brick/Random Rubble masonry, with notches over 75 mm thick PCC (1:4:8) shall be provided below all fencing and shall be minimum 200 mm above and 200 mm below finished ground level. All exposed surfaces of brick toe wall shall be provided with 1:6 cement sand plaster and coated with two coats of colour wash with a base coat of white wash with lime. Rubble masonry toe wall shall be with raised & cut pointing and 50 mm PCC (1:2:4) band coping.
16. Proper earthing shall be done for fencing also.

Annexure-A to
VOLUME – I : Section-VII

General Technical Instructions

(This document is meant for the exclusive purpose of bidding against this Package and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued.)

Technical Specification of DDUGJY/IPDS

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General Technical Instructions

Following CEA regulations shall be applicable during execution of work:

- a. Construction Regulation – Central Electricity Authority (Technical Standards for construction of electrical plants and electric lines) Regulation, 2010 (as amended time to time)
- b. Safety Regulation for construction and O&M - Central Electricity Authority (Safety requirements for construction, Operation and Maintenance of electrical plants and electric lines) Regulation, 2011 (as amended time to time)
- c. Connectivity Regulation – Technical Standard for connectivity to the grid (Amendment) Regulation 2013; Technical Standards for connectivity of the Distributed Generation resources, 2013; Central Electricity Authority (Grid Standard) Regulation, 2010 (as amended time to time)
- d. Metering Regulations – Central Electricity Authority (Installation and Operation of meters) Regulations, 2006; Central Electricity Authority (Installation and Operation of meters) (Amendment) Regulations, 2010 and 2015 (as amended time to time)
- e. Central Electricity Authority (Measures relating to safety and Electric supply regulations), 2010 and amendment regulation 2015 (as amended time to time)

1.1 33 KV Line support

1.1.1. 9.1 meter long PCC Pole or 11 KV long PCC pole (or PCC Pole as per state practice shall be used for 33 KV line support). 152x152mm H-Beam (37.1kg/m)¹ can also be used as support in urban/forest area and or Steel Tubular Poles may be used in hilly area where head load shifting is the only option. Cement concreting shall be used for 33 KV support foundations in mixture 1:3:6 (1: cement, 3: coarse sand and 6 Stone ballast 40mm sizes). Each support shall be concrete (0.5mx0.5mx2m) = 0.5 cmt. 0.014 cmt shall also be used in muffing of the support. PCC pole shall not be provided with muffing.

1.1.2. Pole base plates as per specifications shall be used.

1.1.3. Pole earthing shall be performed through earthing coil duly connected with 8 SWG wire. The GI wires between pole structure and the earthing coil should not be used in cut length. Wherever, cut is evitable, proper nut bolt, washer and binding should be made as per REC specifications. The GI wire between support and earth coil should be placed 1 meter below the ground level.

1.1.4. Earth coil should be inserted 1200 mm away from pole.

¹ In hilly and difficult terrain, steel tubular support may be accepted, they shall be concreted as per speculations,

1.2 11 KV line Support and DTR Substation support

- 1.2.1. 8.0 meters or equivalent PCC Poles² as per prevailing practices of the state shall be used for 11 KV line and substation support. 152x152mm H-Beam (37.1kg/m)³ can also be used as support in urban/forest area and or Steel Tubular Poles may be used in hilly area where head load shifting is the only option.

The single PCC pole supports shall be erected with Stone bolder/stone ballast mixed with excavated earth in normal soil. PCC poles in Double Pole structures, turning point structure, Distribution Transformer Substation structures shall be grouted in cement concrete mixture of 1:3:6 (1: cement, 3: coarse sand and 6 Stone ballast 40mm sizes). Single pole supports in water logging area shall also be grouted in cement concrete mixture of 1:3:6 (1: cement, 3: coarse sand and 6 Stone ballast 40mm sizes). PCC pole shall be grouted with concrete (0.6mx0.6mx1.35m)= 0.486 cmt.. In special location, wherever, Project Manager specifically decides, to enhance additional strength, concreting may be used as support foundation.

In forest, wherever special care is to be made for elephant corridors, 13m long, 152x152mm RS Joist (37.1kg/m) may be used for 11 KV line support.

152x152mm H-Beam (37.1kg/m)⁴ and Steel Tubular Poles shall be grouted in cement concrete mixture of 1:3:6 (1: cement, 3: coarse sand and 6 Stone ballast 40mm sizes) in all the formation.

- 1.2.2. Pole base plates as per specifications shall be used.
- 1.2.3. Pole earthing shall be performed through earthing coil duly connected with 8 SWG wire. The GI wires between pole structure and the earthing coil should not be used in cut length. Wherever, cut is evitable, proper nut bolt, washer and binding should be made as per REC specifications. The GI wire between support and earth coil should be placed 1 meter below the ground level.
- 1.2.4. Earth coil should be inserted 1200 mm away from pole.

1.3 Route And Terrain

- 1.3.1. The scope of HT/LT length of feeder are enclosed with the tender documents. On award of the contract, contractor shall perform foot survey to access the route, pole location and thus Single Line Diagram of the line works. The survey shall be approved by Project Manager. Accordingly requirements of materials shall be finalized by the turnkey contractor in association with Project Manager.

1.4 Detailed Survey

- 1.4.1. The detailed survey shall be carried out for the approved feeders/spur lines by the contractor and submitted for owner approval.

²In hilly and difficult terrain, steel tubular support may be accepted, they shall be concreted as per speculations,

³ In hilly and difficult terrain, steel tubular support may be accepted, they shall be concreted as per speculations,

⁴ In hilly and difficult terrain, steel tubular support may be accepted, they shall be concreted as per speculations,

1.5 Profile Plotting

- 1.5.1. Span: The number of consecutive spans between the section points shall not exceed design length considering wind pressure, type of poles and size of conductor.
- 1.5.2. Extension: An individual span shall be as near to the normal design span as possible. In case an individual span becomes too short with normal supports on account of undulation in ground profile, one or both the supports of the span may be extended by inserting standard body extension designed for the purpose according to technical specification.
- 1.5.3. Loading: There shall not be any upward force on poles under normal working conditions and the suspension poles shall support at least the minimum weight span as provided in the design. In case uplift is unavoidable, it shall be examined if the same can be overcome by adding standard body extensions to the poles failing which tension poles designed for the purpose shall be employed at such positions.
- 1.5.4. Horizontal Tensions on pin insulators are to be avoided by proper alignment of the line. In case where installation of DP structure is not possible to erect for turning the line, "two pins" arrangement with suitable jumpering shall be provided at all those locations where pins are subjected to horizontal tension. Bridling type V Cross arms for such installations shall be used by the agency accordingly.

1.6 Road Crossing

At all road crossings, the poles shall be fitted with horizontally aligned disc type tension insulator string(s) or bridling V-cross armsupports using double pin insulator per phase depending on the type of poles and line but the ground clearance at the roads under maximum temperature and in still air shall be such that it should not fall below 6.1m in case of 33 KV and 11 KV lines. Also, cradle guarding is to be used at all the road crossing locations as per drawings / specifications enclosed.

1.7 Railways Crossings

Railway Crossings at pre-planned locality shall be selected in such a way that minimum feeder length shall be re-routed. The line crossing should be executed as per prevailing practices and approved drawings of railways. Railways crossing shall preferably be executed through underground cabling. Horizontal drill machine shall be used for this purpose. Required permission to block the Railways traffic and approval for railway crossing shall be arranged by the owner at his own cost. All liaison works shall be performed by turnkey contractor.

1.8 Telecommunication, LT or HT Line Crossing

The angle of crossing shall be as near 90 degrees as possible. However, deviation to the extent of 30 degree may be permitted under exceptionally difficult situations. Cradle guarding is to be used at all such crossing locations as per drawings / specifications enclosed.

1.9 Details En-route

All topographical details, permanent features, such as well, trees, building etc. 75 m on either side of the alignment shall be detailed on the profile plan.

1.10 Clearances - General

For the purpose of computing the vertical clearance of an over-head line, the maximum sag of any conductor shall be calculated on the basis of the maximum sag in still air and the maximum design temperature. Similarly, for the purpose of computing any horizontal clearance of an over-head line, the maximum deflection of any conductor shall be calculated on the basis of the wind pressure specified by the State Government under rule 76 (2) (a) [or may be taken as 35°, whichever is greater]. Following clearances shall be maintained by the contractor while executing the work:

- 1.10.1. CLEARANCE ABOVE GROUND OF THE LOWEST CONDUCTOR: No conductor of an over-head line, including service lines, erected across a street shall at any part thereof be at a height less than
- (a) For low and medium voltage lines 5.8 metres
 - (b) For high voltage lines 6.1 metres
- 1.10.2. No conductor of an over-head line, including service, lines, erected along any street shall at any part thereof be at a height less than

a.	For low, medium and high voltage lines upto and including 11,000 volts, if bare -	4.6 metres
b.	For low, medium and high voltage lines Upto and including 11,000 volts, if insulated -	4.0 metres
c.	For high voltage lines above 11,000 volts - 5.2 metres	

For extra-high voltage lines the clearance above ground shall not be less than 5.2 meters plus 0.3 meter for every 33,000 volts or part thereof by which the voltage of the line exceeds 33,000 volts:

Provided that the minimum clearance along or across any street shall not be less than 6.1 meters.

- 1.10.3. CLEARANCE FROM BUILDINGS OF LOW AND MEDIUM VOLTAGE LINES AND SERVICE LINES:

Where line is to cross over another line of the same voltage or lower voltage, pole with suitable extensions shall be used. Provisions to prevent the possibility of its coming into contact with other overhead lines shall be made in accordance with the latest CEA regulations (as amended from time to time). The contractor will required to under cross higher voltage lines by erecting gantries/suitable Rail Pole structures.

Where a low or medium voltage over-head line passes above or adjacent to or terminates on any building, the following minimum clearances from any accessible point, on the basis of maximum sag, shall be observed:-

- a) For any flat roof, open balcony, verandah roof and lean-to-roof
 - i. When the line passes above the building a vertical clearance of 2.5 meters from the highest point; and
 - ii. When he line passes adjacent to the building a horizontal clearance of 1.2 meters from the nearest point, and
- b) For pitched roof

- i. When the line passes above the building a vertical clearance of 2.5 meters immediately under the lines, and
- ii. When the line passes adjacent to the building a horizontal clearance of 1.2 meters.

The horizontal clearance shall be measured when the line is at a maximum deflection from the vertical due to wind pressure.

1.10.4. CLEARANCE FROM BUILDINGS OF HIGH AND EXTRA-HIGH VOLTAGE LINES:

Where a high or extra-high voltage over-head line passes above or adjacent to any building or part of building it shall have on the basis of maximum sag a vertical clearance above the highest part of a building immediately under such line, of not less than

(a)	For High Voltage Lines up to and including 33,000 volts	3.7 m
(b)	For Extra High Voltage Lines	3.7 m plus 0.3 m for every additional 33 KV or part thereof.

1.11 Electrical System Data

	<u>33 KV</u>	11KV
Nominal voltage	33 kV	11KV
Maximum system voltage	36 kV	12KV
BIL (Impulse)	170 kVp	75KV
Power frequency withstand voltage (wet)	75 kV (rms)	28KV
Minimum corona extinction voltage for condition (rms) phase to earth	Not less than 27 kV, 50 Hz ac system under Dry	
Radio interference voltage at one MHz for 27 kV (dry condition)	Not exceeding 1000 micro-volts	

1.12 Pole Location

In locating poles on lines, the following general principles should be kept in mind:-

1. Keep spans uniform in length as far as possible.
2. Locate to give horizontal grade.
3. By locating the poles on high places short poles can be used and will maintain proper ground clearance at the middle of the span. In extremely hilly or mountainous country, poles are located on ridges there by greatly increasing the spans without greatly increasing the pull on the conductor. This is possible because the sag can be made very large and will maintain the required ground clearance. Special attention should be given to the locations of poles, where the ground washes badly. Poles should not be placed along the edges of cuts at or embankment or along the banks of creeks of streams.

1.13 Construction

The construction of overhead-lines may be divided into the following parts:-

- (1) Pit marking, pit digging.
- (2) Erection of supports and concreting.

- (3) Providing of guys to supports.
- (4) Mounting cross-arms, pin and insulators, and pin binding.
- (5) Paying and stringing of the conductor.
- (6) Sagging and Tensioning of Conductors.
- (7) Crossings.
- (8) Guarding.
- (9) Earthing.
- (10) Testing and Commissioning.

1.14 Erection of DP Structure for Angle Locations

For angles of deviations more than 10 degree, DP structure may be erected. The pit digging should be done along the bisection of angle of deviation.

After the poles are erected, the horizontal/cross bracings should be fitted and the supports held in a vertical position with the help of temporary guys of Manila rope 20/25 mm dia.

Wherever space is not found sufficient to install double Pole structure, single pole cut point may be installed. The support so erected must be grouted.

1.15 Concreting

The concreting mixture of one cum 1:3:6 ratios would mean 1 part cement, 3 parts coarse sand and 6 part 40 mm aggregate size stones. It may be noted that while preparing the concrete mixture, large quantities of water should not be used as this would wash away cement and sand.

1.16 Providing Of Guys To Supports

Guys are installed at locations where terminal poles are erected at sectional cut points. These cut points may be in same alignment or at turn points. Guys are installed to nullify tension on supports resulted due to conductors tension. In spite of careful planning and alignment of line route, certain situations arise where the conductor tries to tilt the pole from its normal position due to abnormal wind pressure and deviation of alignment, etc. When these cases of strain arise, the pole is strengthened and kept in position by guys. One or more guys will have to be provided for all supports where there is unbalanced strain acting on the support, which may result in tilting/uprooting or breaking of the support.

Guys are braces fastened to the pole. In this work anchor type guy sets are to be used. These guys are provided at (i) angle locations (ii) dead end locations (iii) T - off points (iv) Steep gradient locations and (v) where the wind pressure is more than 50 kg / Sq.m.

The fixing of guys stays will involve (i) pit digging and fixing stay rod (ii) fastening guy wire to the support (iii) Tightening guy wire and fastening to the anchor. The marking of guy pit, digging and setting of anchor rod must be carefully carried out. The stay rod should be placed in a position so that the angle of rod with the vertical face of the pit is 30°/45° as the case may be.

Before start of erection of Stay sets, required concreting materials like Cement, Sand, Stone Chips and Construction water need to be made available near the pit.

G.I. stay wires of size 7/3.15 mm (10 SWG) & 7/4.00 mm (8 SWG), for 16 mm/20 mm stay rods respectively, are to be provided. 8.5 Kg. Stay Wire (7/4.00 mm) per Stay with 20 mm Stay rod for 33 KV line and 5.5 Kg. Stay Wire (7/ 3.15 mm) per Stay with 16 mm

Stay rod for 11 KV lines are to be used. For double pole structure (DP), four stays along the line, two in each direction and two stays along the bisection of the angle of deviation (or more) as required depending on the angle of deviation are to be provided. Hot dip galvanized stay sets are to be used. One stay to counter the angular deformation force shall be used.

After concreting, back filling and ramming must be done well and allowed 7 days to set. The free end of the guy wire/stay wire is passed through the eye of the anchor rod, bent back parallel to the main portion of the stay/guy and bound after inserting the G.I. thimble, where it bears on the anchor rod. If the guy wire proves to be hazardous, it should be protected with suitable asbestos pipe filled with concrete of about 2 m length above the ground level, painted with white and black strips so that, it may be visible at night. The turn buckle shall be mounted at the pole end of the stay and guy wire so fixed that the turn buckle is half way in the working position, thus giving the maximum movement for tightening or loosening.

1.17 Guy Strain Insulators

Guy insulators are placed to prevent the lower part of the Guy from becoming electrically energized by a contact of the upper part of the guy when the conductor snaps and falls on them or due to leakage. No guy insulator shall be located less than 2.6 m from the ground. Guy insulators are to be used in stay wires only. All stay conductors are to be provided with guy insulators as per following specifications.

11 KV line stay	Type C guy insulator (1 No)
33 KV line stay	Type C guy insulators (2Nos)

1.18 Fixing Of Cross-Arms

After the erection of supports and providing guys, the cross-arms are to be mounted on the support with necessary clamps, bolts and nuts. The practice of fixing the cross arms before the pole erection is also there. In case, the cross-arm is to be mounted after the pole is erected, the lineman should climb the pole with necessary tools. The cross-arm is then tied to a hand line and pulled up by the ground man through a pulley, till the cross-arm reaches the line man. The ground man should station himself on one side, so that if any material drops from the top of the pole, it may not strike him. All the materials should be lifted or lowered through the hand line, and should not be dropped.

1.19 Insulators And Bindings

Line conductors are electrically insulated from each other as well as from the pole by 'Insulators'. Following two type of insulators shall be used for the line insulation:

- (1) Pin type
- (2) Strain type

The pin type insulators will be used for straight stretch of line. The insulator and its pin should be mechanically strong enough to withstand the resultant force due to combined effect of wind pressure and weight of the conductor in the span.

The strain insulators are intended for use at terminal locations or dead end locations and where the angle of deviation of line is more than 10°. Strain insulators are also intending to use at major road crossing locations.

The pins for insulators are fixed in the holes provided in the cross-arms and the pole top brackets. The insulators are mounted in their places over the pins and tightened. In the case of strain or angle supports, where strain fittings are provided for this purpose, one

strap of the strain fittings is placed over the cross-arm before placing the bolt in the hole of cross-arms. The nut of the straps is so tightened that the strap can move freely in horizontal direction.

All HT/LT insulators shall be tested for insulation tests before installation on line. They shall be dipped into water for 24 hrs and then tested for insulation resistance tests at the stores. The insulators found fit in IR testing shall be sent to site for erection. 11KV na d33 KV insulators shall be tested by at-least 1 KV megger whereas LT insulators shall be tested by 500 Volts megger.

1.20 Conductor Erection

The main operations are:-

- (a) Transportation of Conductor to works site.
- (b) Paying and Stringing of Conductor
- (c) Jointing of Conductor
- (d) Tensioning and Sagging of Conductor

While transporting conductors drums to site, precautions are to be taken so that the conductor does not get damaged/injured. The drum could be mounted on cable drum support, which generally is made from crow-bar and wooden slippers for small size conductor drums. The direction of rotation of the drum has to be according to the mark in the drum so that the conductor could be drawn. While drawing the conductor, it should not rub causing damage. The conductor could be passed over poles on wooden or aluminum snatch block (pulley) mounted on the poles for this purpose.

When approaching the end of a drum length at least three coils shall be left in place when the stringing operations are stopped. These coils are to be removed carefully and if another length is required to be run out a joint shall be made as per the recommendations of the accessories manufacturer.

The mid span jointing is done through compressions or if helical fittings are used the jointing could be done manually. After completing the jointing, tensioning operation could be commenced. The conductor is pulled through come-along clamps to stringing the conductor between the tension locations.

Conductor splices shall not crack or otherwise be susceptible to damage in the stringing operation. The Contractor shall use only such equipment / methods during conductor stringing which ensures complete compliance in this regard.

All the joints on the conductor and earth-wire shall be of the compression type, in accordance with the recommendations of the manufacturer, for which all necessary tools and equipment like compressors, dies, etc., shall be obtained by the Contractor. Each part of the joint shall be cleaned by wire brush till it is free of rust or dirt, etc., and be properly greased with anti-corrosive compound. If required and as recommended by the manufacturer, before the final compression is carried out with the compressors.

All the joints or splices shall be made at least 15 meters away from the pole. No joints or splices shall be made in spans crossing over main roads, railways and small river spans. Not more than one joint per sub-conductor per span shall be allowed. The compression type fittings shall be of the self-centering type or care shall be taken to mark the conductors to indicate when the fitting is centered properly. During compression or splicing operation, the conductor shall be handled in such a manner as to prevent lateral or vertical bearing against the dies. After compressing the joint, the aluminum sleeve shall have all corners rounded; burrs and sharp edges removed and smoothed.

During stringing of conductor to avoid any damage to the joint, the contractor shall use a suitable protector for mid span compression joints in case they are to be passed over pulley blocks / aerrail rollers. The pulley groove size shall be such that the joint along with protection can be passed over it smoothly.

1.21 Tensioning and Sagging Operations

The tensioning and sagging shall be done in accordance with the approved stringing charts or sag tables. The "initial" stringing chart shall be used for the conductor and "final" stringing chart for the earth-wire. The conductors shall be pulled up to the desired sag and left in running blocks for at least one hour after which the sag shall be rechecked and adjusted, if necessary, before transferring the conductors from the running blocks to the suspension clamps. The conductor shall be clamped within 36 hours of sagging in.

The sag will be checked in the first and the last section span for sections up to eight spans and in one additional intermediate span for sections with more than eight spans. The sag shall also be checked when the conductors have been drawn up and transferred from running blocks to the insulator clamps.

At sharp vertical angles, conductor and earth-wire sags and tensions shall be checked for equality on both sides of the angle and running block. The suspension insulator assemblies will normally assume verticality when the conductor is clamped.

Tensioning and sagging operations shall be carried out in calm weather when rapid changes in temperature are not likely to occur.

1.22 Clipping In

Clipping of the conductors into position shall be done in accordance with the manufacturer's recommendations. Jumpers at section and angle towers shall be formed to parabolic shape to ensure maximum clearance requirements. Fasteners in all fittings and accessories shall be secured in position. The security clip shall be properly opened and sprung into position.

1.23 Fixing of Conductors and Earthwire Accessories

Conductor and earth-wire accessories supplied by the Contractor shall be installed by the Contractor as per the design requirements and manufacturer's instruction within 24hours of the conductor / earth-wire clamping. While installing the conductor and earth-wire accessories, proper care shall be taken to ensure that the surfaces are clean and smooth and that no damage occurs to any part of the accessories or of the conductors.

1.24 Replacement

If any replacements are to be effected after stringing and tensioning or during maintenance e.g. replacement of cross arms, the conductor shall be suitably tied to the pole at tension points or transferred to suitable roller pulleys at suspension points.

Sagging of conductor has to be in accordance to the Sag Tension chart. In order to achieve it, it is preferred to pull the conductor to a tension a little above the theoretical value so that while transferring it from the snatch blocks to the pit insulators and to take care of temperature variation. Proper sag could achieve. Sagging for 33/11 KV line is mostly done by "Sighting". A horizontal strip of wood is fixed below the cross-arm on the pole at the required sag. The lineman sees from other end and the sag is adjusted by increasing or decreasing the tension. The tension clamps could then be finally fixed and

conductor be fixed on pin-insulators. All fittings, accessories like guys, cross-arms, etc., could be checked as they should not have de-formalities.

The maximum permissible spans for all the lines of 33/11/0.4 KV are prescribed according to the design of the supports. Sag-tension charts for these conductors are to be followed.

1.25 Tying Of Conductor On Pin Insulators

Conductors should occupy such a position on the insulator as will produce minimum strain on the tie wire. The function of the wire is only to hold the conductor, in place on the insulator, leaving the insulator and pin to take the strain of the conductor.

In straight line, the best practice is to use a top groove insulator. These insulators will carry grooves on the side as well. When the conductor is placed on the top groove, the tie wire serves only to keep the conductor from slipping out.

On corners and angles (below 5 degree deviations) the conductors should be placed on the outside of the insulators. On the far side of the pole, this pulls the conductor against the insulator instead of away from the insulator.

1.26 Kind And Size Of Tie Wire To Be Used

Helically formed fittings are to be used for tying the insulators, end terminal connectors etc.. The tie should always be made of soft annealed wire so that it may not be brittle and injure the line conductor. A tie wire should never be used for second time. Specifications of helically formed fittings are given in this section.

1.27 Rules Of Good Tying Practice

- a. Use only helically formed fittings.
- b. Use of size of tie wire which can be readily handled yet one which will provide adequate strength.
- c. Use length of tie wire sufficient for making the complete tie, including an allowance for gripping with the hands. The extra length should be cut from each end if the tie is completed.
- d. A good tie should
 - (a) Provide a secure binding between line wire insulator and tie wire.
 - (b) Have positive contacts between the line wire and the tie wire so as to avoid any chattering of the contacts.
 - (c) Re-enforce line wire in the vicinity of insulator.
- e. Apply without use of pliers.
- f. Do not use the wire which has been previously used.
- g. Do not use hard drawn wires for typing.

1.28 Conductors At Different Voltages On Same Supports

In urban area, lines are to be erected with provision for forming lines of two different gradients as under

- a) 11 KV Line and LT Lines
- b) 33 KV Line and LT Lines

Where conductors forming parts of systems at different voltages are erected on the same supports, the contractor shall make adequate provision to guard against danger to

linesmen and others from the lower voltage system being charged above its normal working voltage by leakage from or contact with the higher voltage system; and the methods of construction and the clearances between the conductors of the two systems shall be as described in the specifications.

The agency shall be intimated by the Project Manager in writing about the locations where such provisions is intended by him. At all such locations, the contractor shall make adequate provision to guard against danger to linesmen and others from the lower voltage system being charged above its normal working voltage by leakage from or contact with the higher voltage system.

1.29 Earthing

Earthing shall generally be carried out in accordance with the requirements of latest CEA regulations (as amended from time to time) and the relevant regulations of the Electricity Supply Authority concerned and as indicated below:

- a) All metallic supports shall be earthed.
- b) For PCC poles the metal cross-arms and insulator pins shall be bonded and earthed at every pole for HT lines.
- c) All special structures on which switches, transformers, fuses, etc., are mounted / likely to mount should be earthed.
- d) The supports on either side of the road, railway or river crossing should be earthed.
- e) All supports (Steel & PCC) HT lines passing through inhabited areas, road crossings and along such other places, where Earthing of all poles is considered desirable from safety considerations should be earthed.
- f) In special locations and special structures, road crossings etc., pipe/rod Earthing should be done on either side of the construction.
- g) At other locations the coil Earthing may be adopted. The coil Earthing consists of 10 m length of 8 SWG. G.I. wire compressed into a coil 450 mm length and 50 mm dia and buried 1500 mm deep as per REC standard J-1.

Following shall be the earthing requirements:

No	Description	Type of Earthing
1	Single Pole - PCC/RS Joist/steel tubular	1 No. Coil/Spike Earthing at each SP
2	Double pole - PCC/RS Joist/steel tubular	2 Nos. Coil/Spike Earthing at each DP
3	Substation Poles structure - PCC/RS Joist/steel tubular	GI Pipe Earthing 3 Nos
4	Road crossing	GI Pipe earthing on either side one each
5	Telephone line crossing	GI Pipe earthing on either side one each
6	DP with Isolating switch	Coil/Spike earthing 2 Nos and GI Pipe earthing 1 No

1.30 Anti-Climbing Devices

In order to prevent unauthorized persons from climbing any of the supports of HT lines without the aid of a ladder or special appliance, certain anti-climbing devices are provided

to the supports. Barbed wire binding is to be adopted for this purpose at a distance of 30 to 40 cm at a height of 3.5 to 4 m from ground level. The barbed wire shall conform to IS – 278 (Grade A1). The barbed wire shall be given chromatin dip as per procedure laid down in IS: 1340. At-least 3.5 kgs barbed wire is to be used per pole for the purpose.

1.31 Testing And Commissioning

When the line is ready for energisation, it should be thoroughly inspected in respect of the following:-

- a) Poles-Proper alignment, concerting and muffing.
- b) Cross-arms – Proper alignment.
- c) Finishing of fabricated steel items used.
- d) Insulators – Proper finish, cleanliness, insulation resistance.
- e) Binding, clamps and jumpers – To check whether these are in reach.
- f) Conductor and earth wire – Proper sag to check whether there are any cuts, etc.
- g) Guys: To check whether the Guy wire is tight and whether the Guy insulators are in tact.
- h) Earthing System: To check whether the earthing connections of supports and fittings are intact. Measure earth resistance with earth tester.

After the visual inspection is over and satisfied, the conductor is tested for continuity/ground, by means of megger. At the time of testing through megger person should not climb on the pole or touch the guarding, conductor, guy wire etc.

- a. Before charging any new line, it should be ensured that the required inspection fee for the new line is paid to the Electrical Inspector and approval obtained from him for charging the line.
- b. The line should be energized before the officer who has been authorized by the Project Manager in this regard.
- c. Before energizing any new line, the contractor of the line shall notify to the workmen that the line is being energized and that it will no longer be safe to work on line. Acknowledgement of all the workmen in writing should be taken in token of having intimated them.
- d. Wide publicity by Tom-toming should be arranged in all the localities through which the line, that is to be energized passes, intimating the time and date of energizing and warning public against the risk in meddling with the line.
- e. The Officer-in-charge of the line shall personally satisfy himself that the same is in a fit state to be energized.

1.32 River Crossing

No special structures are to be erected for this work. River crossing more than normal span of poles are not considered under the package. For small rivers etc., data for the highest flood-level should be obtained for previous years. The structures should be located at such places that they should be approached under flood condition. Normal DP structures are to be used for such crossings on approval of Project Manager.

In case of river crossing with longer span, special designed structures are to be used for the purpose.

1.33 Guarding

Guarding is to be provided for the lines, so that a live conductor, when accidentally broken, is prevented to come in contact with other electric lines, telephone or telegraph lines, roads, and persons or animals and carriages moving along the road, by providing a sort of cradle below the main electric line.

Guarding is not required for crossings of 66 KV and higher voltage lines where the transmission line is protected by fast acting relay operated circuit breaker of modern design with a tripping time of the order of 0.25 sec. from occurrence of fault to its clearance. For all other crossings, guarding is essential for all telecommunication lines and major road crossing.

The guarding shall consist of GI guard cross arm of length 2.5 mtrs made out of 65x65x6 mm angle & shall be hot dipped galvanized generally conforming to IS : 2633/72. The clamps shall also be hot dipped galvanized generally conforming to IS: 2633/72 & suitable for 13 m 52 kgs/m rail pole & for 8.0 meters long RCC poles. Guarding shall be erected with ground & line clearances as per the I.E. rules. Cradle guard wire should be of 8 SWG GI Wire provided with lashing of 10 SWG GI wire at a distance of 2 m along the length of the guarding. Tension clamps, threaded eye bolts, turn buckles, thimble, tying wires and hardware are as per specified in the specifications. A sketch showing arrangement of guarding at road crossing is enclosed with tender drawing.

The minimum height between any guard wires and live crossing conductor shall not be less than 1.5 m in case of a railway crossing.

1.34 Repair to conductors

The conductor shall be continuously observed for loose or broken strands or any other damage during the running out operations. Repair to conductors, if necessary, shall be carried out with repair sleeves. Repairing of the conductor surface shall be carried out only in case of minor damage, scuff marks, etc. The final conductor surface shall be clean, smooth and free from projections, sharp points, cuts, abrasions, etc. The Contractor shall be entirely responsible for any damage to the poles during stringing.

1.35 LT Lines and Service connection

1.35.1. The LT line shall be erected of single phase or three phase arrangements through AB Cable depending on site requirements. Every 6th pole of LT line shall be earthed with GI spike/GI Coil as per specifications.

1.35.2. In all those locations where LT AB cable is to be erected on the same support in which 11KV or 33KV line is also erected, proper isolation is to be maintained.

1.35.3. All single phase service connections released under the DDUGJY/IPDS schemes shall be provided with one earth point near the energy meter. This point is connected with the proper earthing system through GI wires. 10mm diameter earth knob in form of bolt and nut is to be installed on energy meter board. This earth point is to be maintained by service providing Distribution Company after installation and energisation. In up-stream network, this earth point is to be connected with earth point.

1.35.4. Service connection is to be issued on proper surveying of the location so that excessive erection of LT line or 11 KV line may be avoided. The service wire is to be hanged on supportive GI wire between pole support and the house. Before installing service wires and GI wire, GI pipe on the consumer premises is to be erected using clamps/ nails/proper

binding etc. In case of hut or poor structure at consumer premises, GI pipe is to clamp on wooden planks/wooden structure existing in the house. The GI pipe should be supported for neutralizing tension by means of GI tie wire support. In pukka/brickwork/cement concrete foundations, house, GI support pipe is to be clamped by means of MS clips.

- 1.35.5. The consumer meter shall be installed at the premises of consumers at suitable height and at place which is not in direct approach of sun-light and rain water. Meters should be installed under the covering shade.

STANDARD BIDDING DOCUMENT

(PARTIAL TURNKEY CONTRACT)

FOR

**RURAL/URBAN ELECTRIFICATION WORKS OF ~~XXXX~~
(NAME OF DISTRICT) DISTRICT OF ~~XXXX~~ (NAME OF
STATE) UNDER DEENDAYAL UPADHYAYA GRAM
JYOTI YOJANA/INTEGRATED POWER DEVELOPMENT
SCHEME**

VOLUME-III

(TECHNICAL SPECIFICATONS & DRAWINGS)

Section-I : Technical Specifications

Section-II : Tender Drawings

SPECIFICATION No.:.....

DOCUMENT NO.:.....

VOLUME-II: SECTION – I

PROJECT MANAGEMENT SYSTEM
(PMS),

QUALITY ASSURANCE &
EVALUATION MECHANISM (QAM),

DOCUMENTATION & PMA

PROJECT MANAGEMENT SYSTEM, QUALITY ASSURANCE AND DOCUMENTATION

This section describes the project management system, quality assurance and documentation requirements for the project.

1. Project Management System

1.1. General

The Contractor shall assign a project manager with the authority to make commitments and decisions that are binding on the Contractor. Employer will designate a project manager to coordinate all employer project related activities. All communications between employer and the Contractor shall be coordinated through the project managers. The project managers shall also be assisting employer in communicating project related information to other stake holders.

Bidder shall submit the manpower deployment plan along with the bids, describing the key roles of each person.

The role and responsibilities of contractor shall be as follows:

- a) To prepare, maintain and update project detailed Work Execution Plan for successful implementation of project like approval of GTP, approval of sub-contractor, approval of drawings, supply of materials, mobilization of men, material and equipment etc. at site for successful completion of works, Compile and up-load physical as well as financial progresses, compile the progress of works at Employer level and to assist in forwarding it to all stake holders.
- b) To actively participate with employer in resolving all issues relating to project implementation including ROW, Forest Clearances, Railway Crossings, and Payments to contractors/vendors and policy matters.
- c) To actively participate in monitoring, reviewing and analysing the physical, financial and quality assurances works' progress of DDUGJY/IPDS works and also to take suitable measures on compliance of observations being raised during monitoring/review meetings with employer.
- d) To implement and maintain a dedicated centralized bank account for the project, upload and up-date project wise physical progress in DDUGJY/IPDS web portal. Physical as well as financial progresses shall be uploaded in standard Bill of Material format of the contract. Also, to submit claims as per release DDUGJY/IPDS guidelines to Employer for release of payments/funds.
- e) To oversee the progress and compliance of the Quality Assurance Mechanism as per DDUGJY/IPDS guidelines.

1.2. Project Schedule

As per the schedule the bidder shall submit a preliminary implementation plan along with the bid. The detailed project implementation schedule shall be submitted by the contractor after the award for employer's approval, which shall include at least the following activities:

- (a) Surveying of site.
- (b) Documents submission and approval schedule
- (c) Type Testing Schedule
- (d) Dispatch Schedule
- (e) Installation & commissioning schedule
- (f) Training schedule, if any.

The project schedule shall include the estimated period for completion of project and its linkage with other activities.

1.3. Progress Report

A progress report shall be prepared by the Contractor each month against the activities listed in the project schedule. The report shall be made available to employer on a monthly basis, e.g., the 10th of each month. The progress report shall include all the completed, ongoing and scheduled activities.

1.4. Transmittals

Every document, letter, progress report, change order, and any other written transmissions exchanged between the Contractor and employer shall be assigned a unique transmittal number. The Contractor shall maintain a correspondence index and assign transmittal numbers consecutively for all Contractor documents. Employer will maintain a similar correspondence numbering scheme identifying documents and correspondence that employer initiates.

2. Quality Assurance and Evaluation Mechanism

The Project Implementation Agency (PIA) shall be solely responsible & accountable for assuring quality in Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) works. Project Implementing Agency (PIA) shall formulate a detailed comprehensive Quality Assurance (QA) plan for the works to be carried out under DDUGJY scheme with an objective to create quality infrastructure works. The QA and Inspection Plan shall be integral part of the contract agreement with turnkey contractor or equipment supplier and erection agency as the case may be in case of turnkey/ or departmental execution of works. PIA has to ensure that the quality of materials/equipment supplied at site and execution of works carried out at field under DDUGJY scheme is in accordance to Manufacturing Quality Plan (MQP)/Guaranteed Technical Particulars (GTP) and Field Quality Plan (FQP)/Approved Drawings/Data Sheets respectively.

2.1. Quality checks to be ensured by PIA/Turnkey Contractor:

PIA & Turnkey Contractor shall strictly ensure QA checks during the day to day course of project execution, which are as follows:

- a. 100% pre-dispatch inspections of all materials viz. as per MQP/ Approved Drawings/ Technical Specifications/Datasheet/GTP/applicable national & international standards.
- b. 100% villages with all infrastructures are to be verified for quality as per MQP/Datasheet/GTP/ Approved Drawings/Technical Specifications and FQP.
- c. 100% of all 66/11 or 33/11 kV sub stations (New & Augmented) for quality of material as per MQP/Approved Drawings/Technical Specifications/Datasheet/GTP and erection works in the field as per FQP/approved survey drawings/layout.
- d. 100% verification of BPL HHs connections released.
- e. 100% verifications feeders created under the scheme.
- f. 100% verification of materials utilised under the scheme.
- g. 100% verification of works done in Metering, SAGY & System Strengthening.

Also, PIA & Turnkey Contractor have to carry out quality assurance of village electrification and substation works as per the checklist provided at Annexure-A.

- 2.1.1. Vendor approval: All the materials procured for DDUGJY works shall be purchased from the authorised vendors approved by their Quality Assurance Department of PIA. Approved vendors list is to be uploaded periodically (monthly) on the PIA web portal.

New vendors/suppliers may be approved by PIAs, provided capability of manufacturer's is assessed suitably by visiting the factory premises and checking the testing facility available before accepting it as approved vendor. If required, State Electricity Board/Power Department/ Distribution Companies may adopt vendors already approved by CPSUs.

2.1.2. Material Inspection: All six materials of 33/11kV or 66/11kV substations and materials required for Village Electrification shall be inspected at manufacturer works/premises before dispatch at site. The materials to be used under the scheme shall be as per Technical Specification attached with Standard Bidding Document of DDUGJY scheme or as per latest relevant Indian Standards/approved Datasheet/drawings/GTP/MQP.

Note: PIA to perform one stage inspection of Power/Distribution transformer for each manufacturer.

2.1.3. FQP for Civil works: PIA shall prepare a separate FQP for civil works supported with drawings which shall be approved by their competent authority which shall be uploaded at web portal. The turnkey contractor shall adhere to this FQP while carrying out physical works.

2.1.4. FQP for testing & commissioning: PIA shall prepare a comprehensive FQP for testing & commissioning of 33/11kV or 66/11kV substation, Distribution transformer Substation etc. as well as infrastructure created during electrification of villages/habitations. The electrical system shall be energized only after performing all tests as described in the FQP. Proper records in this regard, including tests on earth resistance, insulation resistance of 11 kV line & Distribution Transformer etc. shall be maintained, jointly signed by PIA and turnkey contractor representatives.

2.1.5. QA documentation: All the quality assurance checks shall be conducted in the field as per approved Field Quality Plan(FQP) and shall be documented properly and signed by the quality engineer of the turnkey contractor & countersigned by PIA's representative and shall be kept for future reference. These documents shall be maintained by PIAs in proper order and shall be made available at site for verification by Quality Monitors during inspection.

2.2. Quality Assurance Mechanism to be envisaged by REC/MoP for DDUGJY Projects

DDUGJY Projects shall have a single tier Quality Assurance Mechanism (QAM). The single tier QAM shall exclude the in-house process quality checks followed by the Project Implementation Agency (PIA) during the physical execution of the project.

Rural Electrification Corporation (REC), the nodal agency for the DDUGJY scheme shall operate for Quality Assurance Mechanism. REC shall designate a senior officer (ZM/CPM of the state) as REC State Quality Assurance Coordinator (RSQAC) at its State level Zonal/Project office. REC corporate office shall designate a senior officer not below the level of AGM/GM as RQAC.

Under this mechanism, RQM shall oversee the compliance of DDUGJY guidelines, adherence to system procedures etc. shall be verified by an independent inspecting agency.

REC shall outsource independent agency(ies) designated as REC Quality Monitors (RQM) to ensure quality of materials procured and shall also verify quality of works carried out under the DDUGJY scheme. RQM shall carry out pre-dispatch inspection of six materials randomly in a single lot containing minimum 10% materials at manufacturer works. RQM shall also verify quality of works carried out in the Project, which are as follows:

- 100% of the Un-electrified and 10% of Intensive Electrified villages where electrification works has been carried out excluding SAGY villages, (Note: Villages includes Habitations/Dhani/Majra/Tolas/Thandas etc.)
- 10% of Feeders created under Feeder Separation,
- 1% Consumer Meters & 10% of Industrial/Commercial Meters or 3-Phase Distribution Transformer Meters,
- 100% works carried out in Sansad Adarsh Gram Yojana (SAGY) ,
- 100% of new substations (66/11 or 33/11kV),
- 25% of augmented substations (66/11 or 33/11kV),

2.2.1. Material Inspection: Six important materials of 33/11kV or 66/11kV substation including materials to be used for village electrification shall be inspected at manufacturer premises before dispatch.

2.2.1.1. Inspection of substation materials: Following materials have been identified as important materials for 33/11 or 66/11kV Substation:

- i. Power Transformer,
- ii. Circuit Breaker,
- iii. Insulators,
- iv. Cables
- v. Conductor
- vi. Control & Relay Panel,

2.2.1.2. Inspection of Village Electrification Materials: The materials which have been identified for pre-dispatch inspection at manufacture premises is as follows:

- i. Distribution Transformer,
- ii. Overhead Conductor,
- iii. Energy Meter,
- iv. Pole,
- v. Insulators,
- vi. Cables,

At least one type from each of the aforesaid 6 (six) materials to be utilized in substations and villages' electrification shall be inspected by the RQM as per MQP. The inspection/testing/witnessing of acceptance tests shall be as per approved Drawings/Technical Specifications/Datasheet/GTP/ and applicable national & international standard.

2.2.1.3. Sampling from field: Any material, including materials listed below, may be picked from site for testing at test laboratory chosen by inspecting official.

- i. Distribution Transformer,
- ii. Overhead Conductor,
- iii. Energy Meter,
- iv. Pole,
- v. Insulators,
- vi. Cables,
- vii. Circuit Breaker

All expenditures that shall incurred towards packing, transport, inspection, testing charges etc. are to be borne by the PIA.

2.2.2. Villages' inspections are to be done as per approved FQP/Drawings/Technical Specifications/Datasheet/survey report. The villages inspection that shall be carried out by REC Quality Monitors, which are as hereunder:

2.2.2.1. 100% Un-Electrified (UE) and 10% of Intensive Electrified (IE) villages are to be inspected in 2 (two) stages including SAGY villages. Stage-I & Stage-II inspections shall cover 50%UE & 5% of IE villages respectively.

2.2.2.2. Stage-I inspection of RQM shall commence in a project when 50% of UE & 30% of IE villages are completed in all respect. Five (5) nos. of villages in a project are to be thoroughly inspected at the very beginning when the same is completed in a project. These villages after rectification of defects will become modal quality village. The findings of inspection of these five villages shall be used as training resource and necessary improvement in Quality Assurance.

2.2.2.3. Stage-II inspection of RQM shall commence and end in a project when 100 % of UE & 70% of IE villages are completed in all respect.

2.2.2.4. (a) Inspection of 100% new (33/11 or 66/11 kV) substation for quality works as per FQP.

(b) Inspection of 25% augmented (33/11 or 66/11 kV) substation for quality works as per FQP.

2.2.3. Inspection of 100% works carried out in Sansad Adarsh Gram Yojana(SAGY) including HT Lines, LT lines, Distribution Transformer Substation, BPL HHS connection released or any other works not stated herein but have been carried out under the scheme in that village(s).

2.2.4. In 100% UE & 10% IE villages of the project; 100% verification of BPL connections, 100% of Distribution Transformer Substations, 1km(for hilly areas)/2km (for plain areas) of 33kV Lines, 100% verification of LT Lines and 100% of the 11KV lines attributed to the village (emanating from cut-point/grid substation) as well as the 11 KV line laid within the village, verification of village energisation & BPL beneficiaries, installation of service connections in public places, hours of supply in the village, time taken by DISCOM to raise first energy bill in favor of beneficiaries.

2.2.5. REC Quality Monitor shall also oversee the Contract Management Part of PIA like adherence to Standard Bidding Document, PMA appointment, adherence to Quality Assurance Mechanism of DDUGJY scheme, Contractual provisions pertaining to defects identification and rectification, resolution of project related issues and action on delayed project. In their visit, RQM would give thrust on adherence on systems and procedures of DDUGJY schemes by PIA and turnkey contractors during project implementation. Also, RQM would ensure availability and awareness of project specific drawings, documents, quality assurance plans among all stake holders in PIA contractor staff/workers.

2.2.6. REC Quality Monitors shall oversee the progress of up-loading of monitoring observations raised by inspectors during inspection and submission of compliance by PIA with supporting site photographs details in DDUGJY web portal.

2.3. GENERAL

2.3.1. 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 programme to control such activities at all points necessary. Such programme shall be broadly outlined by the contractor and finalized after discussions before the award of contract. The detailed programme shall be submitted by contractor after the award of contract and finally accepted by the Employer after discussions. A quality assurance programme of the contractor shall generally cover the following:

- a) His organization structure for the management and implementation of the proposed quality assurance programme :
- b) Documentation control system;
- c) Qualification data for 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 Employer.

- l) System for maintenance of records;
- m) System for handling storage and delivery; and
- n) A manufacturing 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.
- o) A Field quality Plan covering field activities

2.3.2. The manufacturing & Field quality Plans shall be mutually discussed and approved by the Employer after incorporating necessary corrections by the Contractor as may be required.

2.3.3. 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.

2.3.4. 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.

2.4. TYPE & ACCEPTANCE TESTS

The following type, acceptance and routine tests and tests during manufacture shall be carried-out on the material. For the purpose of this clause:

2.4.1. Contractor shall supply the materials of type & design which has already been Type Tested. Contractor shall provide copy of such tests at site in support of type-tested materials supplied under the contract. No extra payment or time shall be granted for type testing of materials. In exceptional case to case basis, employer will decide to permit type testing of material at contractor's cost.

2.4.1.1. Acceptance Tests shall mean those tests which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purposes of acceptance of that lot.

2.4.1.2. Routine Tests shall mean those tests, which are to be carried out on the material/equipment to check requirements which are likely to vary during production.

2.4.1.3. Tests during Manufacture shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the Contractor to ensure the desired quality of the end product to be supplied by him.

2.4.1.4. The norms and procedure of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to by the Contractor and the Owner.

2.4.1.5. The standards and norms to which these tests will be carried out are listed against them. Where a particular test is a specific requirement of this Specification, the norms and procedure of the tests shall be as per IS/IEC Standard this specification or as mutually agreed to between the Contractor and the Owner in the Quality Assurance Programme.

2.4.1.6. For all type test and acceptance tests, the acceptance values shall be the values specified in this Specification, Approved Quality Plan or guaranteed by the Bidder, as applicable.

2.5. TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

2.5.1. All equipment being supplied shall conform to type tests including additional type tests, if any as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Employer reserves the right to witness any or all the type tests. The Contractor shall intimate the Employer the detailed program about the tests at least three (3) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

- 2.5.2. The reports for all type tests and additional type tests as per technical specification shall be furnished by the Contractor alongwith equipment/material drawings. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO/IEC Guide 25/17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by the representative(s) of Employer or Utility. The test-reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to the Employer
- 2.5.3. In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Employer.
- 2.5.4. 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.
- 2.5.5. The Contractor shall give the Employer/Inspector ten (10) days written notice of any 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 thirty (30) 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.
- 2.5.6. 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. 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. If any modification is made on the equipment on the basis of test results not in conformity with the contract, the modified equipment shall be subject to same sequence of test again without any additional cost to Employer.
- 2.5.7. 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 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, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of dispatch instruction by the Employer.
- 2.5.8. 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 labour, 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.

- 2.5.9. The inspection by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.
- 2.5.10. 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 comply with the specification.
- 2.5.11. The Employer reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Employer.
- 2.5.12. The Employer intends that type tests and additional type tests are conducted on Power/Distribution Transformers, Pin & Disc Insulators, 33 kV/11 kV LT AB cables, Conductors, 66 kV / 33 kV & 11 kV Vacuum circuit breaker, Battery Charger and energy meter. The price of conducting type tests and additional type tests shall be included in Bid price.
- 2.5.13. In case the contractor opts to procure these items from more than one manufacturer, the type test shall be conducted in respect of all the manufactures. No type test / repeat type test charges shall be paid by owner.
- 2.5.14. Purchaser reserves the right to witness any or all the type tests.

2.6. 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 pre-commissioning tests at Site. The list of pre-commissioning tests to be performed is given in respective chapters or as included in the Contractor's quality assurance programme.

2.7. COMMISSIONING TESTS

All required instrumentation and control equipment will be used during such tests and the contractor will use all such measuring equipment and devices duly calibrated as far as practicable. However, the Contractor, for the requirement of these tests, shall take immeasurable parameters into account in a reasonable manner. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions.

- 2.7.1. Any special equipment, tools and tackles required for the successful completion of the Commissioning tests shall be provided by the contractor, free of cost.
- 2.8. The specific tests to be conducted on equipment have been brought out in the respective chapters of the technical specification. However where the pre-commissioning tests have not been specified specifically they shall be as per relevant IS code of practice or as mutually agreed.
- 2.9. The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning and operation of the equipment including the Electrical Inspector. Necessary fee to perform these works shall be paid by Employer.

3. Documentation

3.1. GENERAL

- 3.1.1. To ensure that the proposed systems conform to the specific provisions and general intent of the Specification, the Contractor shall submit documentation describing the systems to employer for review and approval. The contractor shall obtain approval of employer for the relevant document at each stage before proceeding for manufacturing, system development, factory testing, site testing, training etc. The schedule for submission/approval of each document shall be finalised during the discussions before placement of the contract, this schedule shall be in line to overall project schedule.
- 3.1.2. Each document shall be identified by a Contractor document number, the employer document number, and the employer purchase order number. Where a document is revised for any reason, each revision shall be indicated by a number, date, and description in a revision block along with an indication of official approval by the Contractor's project manager. Each revision of a document shall highlight all changes made since the previous revision.
- 3.1.3. All technical description, specifications, literature, correspondence, prints, drawings, instruction manuals, test reports(both factory and at site), progress photographs, booklets, schedules and all supplementary data or documents furnished in compliance with the requirements of the Contract, shall become the property of the Employer and the costs shall be considered as included in the Contract price.
- 3.1.4. The Contractor shall be responsible for any time delay, misinterpretation, error and conflict during design, manufacturing, testing and erection of the Works resulting from non-compliance with the requirements of this Specification.
- 3.1.5. The Employer shall have the right to make copies of any documents, data, reports, information etc. supplied by the Contractor in connection with the Works. The Employer shall not impart the information of these documents to any other manufacturer or competitor but he shall be free to use these for preparation of technical papers, reports etc.
- 3.1.6. All documentation shall be in English language.

3.2. REQUIREMENTS FOR SUBMISSION OF DOCUMENTS, INFORMATION AND DATA BY THE CONTRACTOR

- 3.2.1. The Contractor shall submit to the Employer all documents in accordance with an approved schedule of submissions and shall submit any further information (in the form of drawings, documents, manuals, literature, reports etc.) when asked by the Employer while commenting/approving any drawings/documents etc.
- 3.2.2. The documents which are subject to the approval of the Employer shall be identified by the Contractor with the stamp "FOR APPROVAL". All other documents shall be submitted to the Employer for information and shall be identified by the Contractor with the stamp "FOR INFORMATION".
- 3.2.3. The sequence of submission of the documents shall be subject to the approval of the Employer. The sequence of submissions of all documents shall be such that the necessary information is available to enable the Employer to approve or comment the document.
- 3.2.4. The Contractor shall supply 4 hard copies of all drawings and documents.
- 3.2.5. In case a "SUBSEQUENT" revision of any document is made due to any reason whatsoever, a revision of the same, highlighting the changes shall be resubmitted for the Employer's specific approval/information.

3.3. DOCUMENTS FOR APPROVAL

3.3.1. The Employer shall be allowed fifteen (15) calendar days to approve the Contractor's submissions. The submissions for approval, shall be returned to the Contractor marked in one of the following ways :

Category I:	Approved
Category II:	Approved with Comments.
Category III:	Returned for correction.
Category IV :	For information

3.3.2. The first notations "I" or "II" shall be deemed to permit the Contractor to proceed with the work shown on the document, except in the case of notation "II" the work shall be done subject to the corrections indicated thereon and/or described in the letter of transmittal. The Contractor shall bear the full responsibility for proceeding with the Works prior to receipt of the release in notation "I" from the Employer.

3.3.3. In case of notation "II", the Contractor shall include the alterations required & resubmit the document within fifteen (15) days from date of Employer's letter of transmittal.

3.3.4. In case of notation "III", the Contractor shall include the alterations required and resubmit the document to the Employer, within fifteen (15) days, from date of letter of transmittal, so that such document can be returned with the notation "I" or "II".

3.3.5. It may also be noted that the approval/commenting by the Employer does not relieve the Contractor of any of his contractual obligations and his responsibilities for correctness of dimensions, materials, weights quantities or any other information contained therein, as well as the conformity of designs with Indian Statutory Laws and the Technical Specifications as may be applicable. The approval also does not limit the Employer's rights under the Contract.

3.3.6. The approved documents shall be considered as the working documents. However the Technical Specification and connected documents shall prevail over these documents in case a decision is required on interpretation.

3.4. DOCUMENTS FOR INFORMATION

The Contractor shall not delay the Works pending the receipt by the Contractor of the comments on documents submitted to the Employer for information. However, the Employer shall have the right to comment on all the documents submitted by the Contractor, when, in the opinion of the Employer the document does not comply with the Contract or otherwise. The Contractor shall satisfactorily demonstrate that the information contained in the aforesaid document does meet the requirements of the Contract or revise the document in order that the information shall comply with the requirements of the Contract.

3.5. BASICREFERENCE DRAWINGS

3.5.1. The reference drawings are enclosed with the bid document, which forms a part of the specification. The contractor shall develop a new layout in line with the specification and take the approval of the EMPLOYER. The contractor shall maintain the overall dimensions of the substation, buildings, bay length, bay width, phase to earth clearance, phase to phase clearance and sectional clearances, clearances between buses, bus heights but may alter the locations of equipment to obtain the statutory electrical clearances as required for the substation.

3.5.2. All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external

connections, fixing arrangement required and any other information specifically requested in the specifications.

- 3.5.3. Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.
- 3.5.4. Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer, if so required.
- 3.5.5. The review of these data by the Employer will cover only general conformance of the data to the specifications and documents interfaces with the equipment provided under the specifications. This review by the Employer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Employer shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.
- 3.5.6. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.
- 3.5.7. All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.6. PRE-DISPATCH INSPECTION:

Pre-dispatch inspection shall be performed on various materials at manufacturer's work place for which contractor shall be required to raise requisition giving at least 10-day time. Depending on requirement, inspection shall be witnessed by representatives of Employer, TPIA and/or REC/PFC/MoP.

The contractor shall ensure receipt of material at site within 21 days from date of receipt of dispatch instructions. In case materials are not received within 21 days from date of issue of dispatch instruction, the dispatch instruction shall stand cancelled. In the event of delay in receipt of materials beyond 21 days due to reasons not attributed to turnkey contractor/supplier, suitable time extension may be permitted by the Employer. All expenditure incurred by Employer in performance of dispatch instruction shall be recovered from turnkey contractor.

The turnkey contractor shall ensure that pre-dispatch inspection for materials are intimated only when the material is completely ready for inspection. On due date of inspection, if it is found that materials are not ready in required quantities or the inspection could not be carried out due to non-availability of requisite calibrated certificate of instruments with manufacturer, closing of works on scheduled date of inspection, non-availability of sufficient testing/material handling staff at manufacturer works etc, all expenditures incurred on deployment of various inspecting officials along with a fine of Rs 50,000/- shall be recovered from the bills of the agency and re-inspection shall be carried out on expense of contractor. 2nd such situation at same manufacturer/supplier shall result in rejection of name of manufacturer from list of approved vendors/sub-vendors. In case sub-standard materials (old component, re-cycled materials, re-used core material, re-used transformer coil material

etc) offered for inspection and are noticed during the inspection, materials shall be rejected and approval of sub-vendor shall also be cancelled for all DDUGJY/IPDS projects.

4. Project Management Agency (PMA)

Employer shall appoint a Project Management Agency (PMA) to assist them in Project Planning and Implementation of the project as under:

4.1. Project Planning and Implementation:

- 4.1.1. Assisting Employer in preparation of detailed work implementation schedule in association with turnkey contractor.
- 4.1.2. Coordination & monitoring of project implementation activities.
- 4.1.3. To monitor DPR wise monthly physical & financial progress of the scheme, prepare a consolidated report & submit to utility for onward submission to Nodal Agency.
- 4.1.4. Identification of anticipated bottlenecks in project implementation & preparation of remedial action plan in consultation with Employer&Contractor.
- 4.1.5. To assist Employer in addition of the created assets to their asset register.
- 4.1.6. Recommend the claim of utility for fund release from Nodal Agency. The recommendation is to be supported by a report on expenditure, progress and constraints if any for timely completion of project.
- 4.1.7. Submit a report to Nodal Agency, regarding Project Completion and expenditure incurred along with recommendation in accordance with the guidelines.
- 4.1.8. To assist utility in supervision of flow of funds in dedicated bank account of projects.

4.2. Quality Monitoring:

- 4.2.1. To prepare a Quality Assurance (QA) Plan
- 4.2.2. To carry out field quality inspection of ongoing/ completed works
- 4.2.3. Joint inspection of material at site on sample basis i.e. 10% of major materials (Poles, Conductor, Meters, Transformers, Cable etc).

Annexure-A

Checklist for Quality Assurance

Distribution Transformer Substation

S. No	Description	Status (Yes/No)	Observations	Location	Picture No.
1	Record capacity of DTR transformer used				
2	Record S. No., make and year of manufacturing of DTR transformer				
3	Safe and adequate access to distribution transformer (DTR) substation				
4	Availability of approved survey report				
5	Proper load survey is performed of the locality for perspective consumers while deciding capacity and location of DTR				
6	Expected loading of transformer using 5 years growth is performed in survey report				
7	Proper alignment of substation structure with 11 KV line				
8	Record type of poles/support used for DTR substation				
9	Record type of foundation used				
10	Proper muffing is provided on steel supports of DTR substation				
11	If DTR substation is in water logging area, its foundation is grouted in cement concrete				
12	Proper verticality of substation supports				
13	Proper pole to pole distance of substation supports.				
14	Proper erection of jumpers and connection to DTR transformers without any bent				
15	Proper binding of insulators				
16	Stay plates are properly grouted in cement concrete mixture to support DTR substation structure (if erected)				
17	Proper tensioning is there on stay set				
18	Proper alignment of stay wire with overhead conductor				
19	Proper erection of stay clamp using 12 mm dia nuts and bolts				
20	Proper galvanization of stay wire				
21	Thimble is provided on turn buckle of stay set				
22	Stay set installation is provided with guy insulator				
23	Proper phase to phase and phase to ground clearances maintained on the substation jumpers				
24	Steel overhead structure is properly earthed using 8 SWG wire/G.I. flat?				

S. No.	Description	Status (Y/N)	Observations	Location	Picture
25	Each 11 kV overhead equipment including transformer are individually earthed using 8 SWG Earth wire/ GI flat				
26	Danger plate is installed at appropriate height using proper size clamp. Record type and size of clamp				
27	Proper anti-climbing device (barbed wire/spike) installed at appropriate height on individual support. Record quality of wrapping of barbed wire				
28	Substation is numbered				
29	Individual substation pole is imposed/painted with the name of scheme				
30	Surface of the PCC poles is finished and there are no steel wire visible				
31	No physical damages appeared on PCC pole surface				
32	GI flat to GI flat connection using at least 2 sets of GI nut bolts and washers				
33	8 SWG GI wire/GI Flat is properly dressed with support				
34	GI wire to GI wire jointing is provided using 12 SWG GI nut bolts and washers				
35	GI wire connection to earth pit is using GI nut bolt and washer				
36	GI earth pipe is properly inserted inside earth without hammering				
37	Number of earth pit used for substation earthing.				
38	Pit to pit distance in meters. Is it adequate?				
39	Masonry enclosure is provided over individual earth pits				
40	Funnel is provided over earth pit				
41	Proper jumpering using binding practices/PG clamp				
42	Proper clearances to avoid bird fault on conductors of substation supports				
43	Type and size of overhead conductors used in the substation				
44	Cement-concrete grouting foundation of substation supports				
45	Measure quantum of cement concreting in any one sample support				
46	Measure cement concreting foundation in any one sample of stay set pit				
47	Proper painting/galvanizing done on steel structure				
48	Any sign of rusting found on substation structure/hardware				
49	Any broken insulator found in the substation				
50	Disc Insulators installed precariously (loose bolts/ missing cotter pins)				

S. No.	Description	Status (Y/N)	Observations	Location	Picture
51	Separate individual earth connection using GI wire/GI flat is used for neutral earthing with separate pit				
52	Dedicated transformer body earthing using GI wire/GI flat				
53	Bimetallic clamps are provided on 11 kV bushing				
54	No gap between busing seat and bimetallic clamp on LT as well as HT bushing while connecting conductor/cable				
55	Proper lugs are provided on termination of cables				
56	Oil is filled in cup of silica gel breather				
57	Silica gel is blue in colour				
58	Oil control valves are open between transformer tank and breather (wherever used)				
59	Oil leakage from the body/gasket of transformer and from conservator tank				
60	Record level of oil in conservator tank				
61	Transformer installed precariously (Nut / bolts / side bracing missing)				
62	Transformer is fitted with 12 mm dia nut bolts on its base channel				
63	Transformer belting is provided				
64	Dimension of transformer base channel				
65	Individual lightening arrestor are earthed with dedicated separate earth pit				
66	LA jumper connections is missing/ not proper				
67	LA is charged/ installed but not meggared				
68	Isolators/AB switch are properly aligned and its operation is smooth				
69	Operating handle (not missing eye bolt) of isolator/AB switch is earthed using flexible cable				
70	No joint in between entire length of operating pipe of isolator/AB switch				
71	Guiding hook is provided for isolator pipe movement				
72	Alignment of male and female contacts of isolators/AB switch and no spark during normal use				
73	Proper fuse wire is used in DO fuse/HG fuse				
74	Arching Horn is missing/ not aligned / not proper				
75	Proper size of LT cable are used between transformer and LTDB				
76	lockability and proper closing of door of LTDB				
77	Gland plate and glands are used for cable entry in LTDB				
76	No unused holes on gland plates				
77	Availability of LTDB equipment as per approved drawing and scope of work like isolator, fuse, switch, bus bar, MCCB, MCB etc.				

S. No.	Description	Status (Yes/No)	Observations	Location	Picture No.
78	Installation of DTR as per BIS specification				
79	LTDB earthing at different points using 8 SWG GI wire				
80	Proper painting and No physical damages on LTDB				
81	Suitable loop length of cables in LTDB				
82	3 Nos earthing pit and earth mat /risers using 50X6mm GI Flat are used as under:				
a	a) Earth Pit – 1 for Transformer Neutral,				
b	b) Earth pit - 2 for Lightning Arrester,				
c	c) Earth pit – 3 for Equipment body earthing				
83	Metering of DTR substation				
84	Type of meters used and its healthiness				
85	Quality of painting/galvanizing on substation structure				
86	DTR is newly supplied				
87	PG Clamps are used (wherever needed as per drwg- Jumper etc)				
88	Energy meters (@ 11 kV feeder , DT , BPL consumer) at installed at appropriate height				
89	Earthing Electrodes short/missing				
90	Commissioning Defect: DT charged/installed but not merged				
91	Fasterers (Nuts/ Bolt/ Clamps /Connector) size not as per drawing /specification				
92	Fasteners (Nuts / bolts/ Clamps / connectors) in precarious state				
93	Poles not erected properly (inadequate or missing brick bat/ foundation)				
94	Stay installation is not proper : guy insulator missing ;inadequate depth				
95	Earthing wire diameter undersize				
96	Danger plate missing/improper				
97	Earthing wire not secured / not dressed				
98	Barbed wire missing/improper				
99	DTR ground electrodes far too close				
100	Earth pit to earth pit clearance not maintained				
101	HT Fuse not provided				
102	HT fuse unit jumpering not connected properly				
103	MCCB of lower rating than specified in LOA				
104	MCCB not installed				
105	Inferior quality of Distribution Board used (makeshift, locally fabricated DBs)				
LT Line					
S. No.	Description	Status (Yes/No)	Observations	Location	Picture No.
1	Availability of approved survey report with Single line diagram				
2	Correct alignment of LT line				

S. No.	Description	Status	Observations	Location	Picture
3	Type of poles used as per scope of the work				
4	Type of foundation used as per scope of work				
5	If line is passing through water logging area and its foundation is grouted in cement concrete				
6	Proper verticality of poles				
7	Any deflecting tension on LT pin insulator				
8	Proper tensioning of overhead conductor/LT cable/ABC Cable				
9	Any knot/wrapping of overhead conductor /LT cable /ABC Cable is there during erection				
10	Proper binding of insulators cable both / tension work is done				
11	Stay plates are properly grouted in cement concrete mixture				
12	Proper tensioning is there on stay set				
13	Proper alignment of Stay wire and stay set with overhead conductor is there to nullify tension				
14	Proper erection of stay clamp using 12 mm dia nuts and bolts and 50x6 mm (or more) size clamp				
15	If every 6th pole in a section of line is provided with stay sets to avoid line deflection				
16	Proper galvanization of stay wire/stay set				
17	Thimble is provided on turn buckle of stay set				
18	Proper phase to phase clearances are maintained on the line				
19	Steel overhead structure is properly earthed using 8 SWG wire				
20	Each LT pole individually earthed using 8 SWG Earth wire and separate Earth pit/Earthing coil/Earth spike				
21	Quality and size of danger plates is as per scope of work				
22	Danger plate is installed at appropriate height using proper clamp as per scope of work				
23	Anti-climbing device (barbed wire/spike) are installed at appropriate height on individual support				
24	Individual pole is numbered				
25	Individual pole is imposed/painted with the name of scheme				
26	Surface of the PCC poles is finished and there are no steel wire visible				
27	No physical damages appeared on PCC pole surface				
28	Cradle guard earthing is provided on each road crossing or on each LT line crossing				
29	Proper tensioning of the cradle guard wires				
30	Separate earthing on both the sides of road/line for cradle guarding are there				

S. No.	Description	Status (Yes/No)	Observations	Location	Picture No.
31	8 SWG G.I. wire is properly dressed with support for V-Cross arm/Channel/Top clamp earthing				
32	GI wire to GI wire jointing is provided using 12 SWG GI nut bolts and washers				
33	GI wire connection to earth pit is using 12 mm GI nut bolt and washer				
34	Earth pipe is properly inserted inside earth without pipe hammering				
35	Masonry enclosure is provided over individual pipe earth pits				
36	Funnel is provided over pipe earth pit				
37	Jumpering using best binding practices/PG clamp				
38	Proper conductor clearances to ground is there to avoid bird fault on end sectionizer support where disc insulator are used				
39	Average pole to pole span length in the line. It should not be less than 50 m.				
40	If Pole to pole span is less than 50 m, record the reason with pole numbers				
41	Number of poles used per kilometre of the line				
42	Type and size of overhead conductors/ABC cable used in the line				
43	Shuttering is used during casting of cement concrete foundation				
44	Cement-concrete grouting foundation of end supports				
45	Quantum of cement concreting in any one sample support				
46	Cement concreting foundation in any one sample of stay set pit				
47	Proper painting is done on steel structure				
48	Any broken insulator found in the line				
49	Surface finish of painting on Steel tubular pole/RSJ/H Pole/Rail pole about 2 m from bottom and above 2 m				
50	Possible damage on ABC cable surface				
51	Piercing connections are used to take-off connection from ABC cable				
52	Muffing is used in steel steel tubular poles, rail pole, RS joint/H beam Supports				
53	Adequate tree cutting on either side of line done				
54	Pole to pole schedule enclosed with profarma				

11 KV Line

S. No	Description	Status (Yes/No)	Observations	Location	Picture No.
1	Availability of approved survey report with single line diagram				
2	Correct alignment of 11 kV line				
3	Type of poles used as per scope of the work				

S. No.	Description	Status (Y/N)	Observations	Location	Picture
4	Type of foundation used as per scope of work				
5	Record whether line is passing through water logging area and its foundation is grouted in cement concrete				
6	Proper verticality of poles				
7	Cross-bracing on Double poles are provided				
8	Conductors are passing through the top groove of the insulator (creepage distance compromised)				
9	More than one joint in one span				
10	Any deflecting tension on 11 KV pin insulator				
11	Proper tensioning of overhead conductor				
12	Any knot/wrapping of overhead conductor is there during erection				
13	Proper binding of insulators is done				
14	Stay plates are properly grouted in cement concrete mixture				
15	Proper tensioning is there on stay set				
16	Proper alignment of Stay wire with overhead conductor is there to nullify tension				
17	Guy insulator, anchor plate/ thimble/ hardware are provided with stay set				
18	Proper erection of stay clamp using 12 mm dia nuts and bolts and 50x6 mm (or more) size clamp				
19	If every 6th pole in a section of line is provided with stay sets to avoid line deflection				
20	Proper galvanization of stay wire and stay set				
21	Thimble is provided on turn buckle of stay set				
22	Proper phase to phase clearances are maintained on the line				
23	Steel overhead structure is properly earthed using 8 SWG wire				
24	Each 11 kV pole individually earthed using 8 SWG Earth wire and separate Earth pit/Earthing coil/Earth spike				
25	Quality and size of danger plates is as per scope of work				
26	Danger plate is installed at appropriate height using proper clamp as per scope of work				
27	Anti-climbing device (barbed wire/spike) are installed at appropriate height on individual support				
28	Individual pole is numbered				
29	Individual pole is imposed/painted with the name of scheme				
30	Surface of the PCC poles is finished and there are no steel wire visible				
31	No physical damages appeared on PCC pole surface				

S. No.	Description	Status	Observations	Location	Picture
32	Cradle guard earthing is provided on each road crossing or on each LT line crossing				
33	Proper tensioning of the cradle guard wires				
34	Proper Guard wires are provided in case of Road crossing as per drawing specification				
35	8 SWG G.I. wire is properly dressed with support for V-Cross arm/Channel/Top clamp earthing				
36	GI wire to GI wire jointing is provided using 12 SWG GI nut bolts and washers				
37	GI wire connection to earth pit is using 12 mm GI nut bolt and washer				
38	Earth pipe is properly inserted inside earth without pipe hammering				
39	Masonry enclosure is provided over individual pipe earth pits				
40	Funnel is provided over pipe earth pit				
41	Proper jumpering using binding practices/PG clamp				
42	If under sized conductor used				
43	Proper conductor clearances to ground is there to avoid bird fault on end sectionizer support where disc insulator are used				
44	Proper pole to pole span length in the line. It should not be less than 50 m.				
45	If Pole to pole span is less than 50 m, record the reason with pole numbers				
46	Number of poles used per kilometre of the line				
47	Record type and size of overhead conductors used in the line				
48	Shuttering is used during casting of cement concrete foundation				
49	Cement-concrete grouting foundation of end supports				
50	Measure quantum of cement concreting in any one sample support				
51	Measure cement concreting foundation in any one sample of stay set pit				
52	Proper painting is done on steel structure				
53	Disc Insulators are installed precariously (loose bolts/ missing cotter pins)				
54	D -shaped loop for jumpers are maintained				
55	Any broken insulator found in the line				
56	Surface finish and painting on Steel tubular pole/RSJ/H Pole/Rail pole				
57	Adequate tree cutting on either side of line done				
58	Pole to pole schedule enclosed with proforma				

S. No.	Description	Status (Yes/No)	Observations	Location	Picture No.
59	Pole numbering with "DDUGJY " inscription not done (properly)				
60	Engraving of poles (Name of Manufacturer, SL Nos etc.) not done				
61	Line Spacers not used				
62	Guy insulator not used in stay wire				
63	Inadequate length of barbed wire				

S. No	Description	Status (Yes/No)	Observations	Location	Picture No.
1	Approximate length of service line taken from nearby LT pole/Distribution Board/Distribution box				
2	Following materials are provided in the premises of consumer:				
A	Energy meter				
B	Metal meter box				
C	Double pole miniature circuit breaker				
D	Meter board				
E	Earthing point				
F	LED lamp				
3	The consumer meter has been tested at distribution licensee's test laboratory,				
4	The size of service cable is 2.5 mm ² twin core (unarmoured) PVC insulated cables with aluminium conductors				
5	Service cable is free of joints				
6	The size of the bearer wire is 3.15 mm (10 SWG) GI wire (55-95 kg. quality)				
7	Suitable meter board has been installed as per specification				
8	Suitable Switch Board has been installed (as per specification)				
9	Single phase Energy meter is installed as per specification with acrylic cover				
10	Type and size of PVC pipe/GI pipe support as per specification				
11	Proper ground clearance of service line as per the guidelines				
12	GI pipe/MS angle (35mmx35mmx5mm) clamped firmly using 40x3mm MS flat clamps at at-least two locations				
13	Use of GI Medium Class pipe as per specification				
14	Use of double pole miniature circuit breaker as per specification				
15	Meter box for single phase meter made provided for meter protection of the specified dimensions				

S. No.	Description	Status	Observations	Location	Picture
16	Reel Insulator are provided as per requirements				
17	Egg Insulator as per requirements				
18	Protection and Earthing as per specification and CEA regulations has been provided at consumer premises				
19	Each BPL Household has been provided with internal house wiring and accessories between switch board and Angle Holder as per specifications				
20	All the construction activities related to power supply in the households have been performed as per REC construction standards.				
21	Wattage of LED lamp provided at consumer premises				
22	Type of holder used for LED lamp				
23	Following ISI marked internal electrification material in consumer premises:				
a	5A socket				
b	5A 3 pin piano type switch				
c	5A pendant holders				
24	Type and size of following boards:				
a	Switch board				
b	Meter board				
25	Height of switch board in consumer premises				
26	Protection from direct sunlight and rain water to meter box at consumer premises				
27	Proper tensioning of service cable at consumer premises				

Checklist for inspection of REDB (Substation)

S.N.	Description	Status (Yes/No)	Observation	Picture No.	Location as per SLD
1	Major Materials (CT/PT/CB/X'mer/Battery/ Panels /Structures/Conductor) as per specifications				
2	Record S. No., make and year of manufacturing of Power transformer				
3	Major Materials dispatched without inspection				
4	Construction as per Approved Drawing				
5	Civil works FQP documentation maintained during construction				
6	Equipment (name it) provided in the BOQ/ drawing but not installed				
7	Verification of pre-commissioning and commissioning testes of substation equipment i.e. Circuit Breaker, CT, PT, transformer, Charger, Battery, Relays, Control Panels, Switchgear, 11 KV cable etc				
8	Present condition of main equipment				
9	Functional Status of Transformer: WTI, OTI etc, Relays, Battery Charger, Battery, CB, CT, PT, Energy Meter, Control & Relay panel				
10	Transformer oil tested				
11	Transformer Relays, CT, PT , CB , Switchgears, battery sets, etc charged after test				
12	Equipment charged after commissioning test				
13	Gravel size proper				
14	Earthing of main equipment, fence etc done properly				
15	Sub Station fencing provided				
16	Cable trench made with cable trays – or cables lying on trench floor				
17	Whether Cable trenches have suitable slope to ensure automatic draining of rainwater				
18	Proper storage of equipment				
19	Cables tied on cable trays				
20	Glands, lugs used (wherever need - at cable entries)				
21	Dead end marking for cables is done				
22	Earth mat provided				
23	Undersized conductor/ cables used				
24	Correct size of earthing conductor - flats, GI wires etc used				
25	Acid proof floor used in battery room				
26	Fasteners (nut, bolts, clamps connectors, hardwaresetc) as per specification				
27	Switchgear rubber mats, chequer plates not provided				
28	FQP for material receipt and storage maintained by PIA				
29	Name of Feeder on Control Panel.				
30	Name of Feeder on Outgoing DP structure				
31	Working platform on 33 KV and 11 KV outdoor VCB				
32	Name of Substation board on the entrances				

33	Painting of control room, water supply position in Substation				
34	General sanitation arrangement in the control room building				
35	Internal Lighting in the substation control room				
36	Closed fencing of the substation yard				
37	Approach road to Power Transformer foundation				
38	Water logging/ Earth filling in the yard trench				
39	Partition wall between two Power Transformers				
40	Availability of Earthing Rod in the substation				
41	Availability of Permit & Work Book				
42	Tracing of Earth connection of Power/ Distribution Transformer up to Earth Pit				
43	Connection at Earth Pit				
44	Jointing & Clamping of Earth Conductors				
45	All Terminal Blocks at CTs/PTs/Breaker/Panels/Junction Box				
46	Earthing & Fencing is as per specification				
47	Cable trench cover inside the control room and in the yard.				
48	Exhaust Fan in the Battery Room				
49	Inter Battery connections				
50	Battery Charger connection				
51	Earthing of Control Panel				
52	Termination of power cables at 11 KV sides/LT sides of Power and Station Transformer.				
53	Inside pic of distribution board of station transformer				
54	Take Overall picture of station transformer				
55	Connection of Lightning arrestor				
56	Approximate clearance of live part in the substation				
57	Oil leakage in Power/Station Transformer				
58	Area lighting in the substation				
59	Material diagram of substation in the control room				
60	List of authorized operational personnel in the substation				
61	Connection at the bus-bar jumpers				
62	Loop cables LT/HT/Control				
63	Tagging on cable terminals				
64	Work clearance on control panels and sufficient lightening on the control panel				

VOLUME-II : Section-II

Bid Forms (Bid Envelope)

the bid is binding upon us during the full period of its validity in accordance with the ITB Clause 14.

- (c) Attachment 3: The documentary evidence that we are eligible to bid in accordance with ITB Clause 2. Further, in terms of ITB Clause 9.3 (c) & (e), the qualification data has been furnished as per your format enclosed with the bidding documents [Attachment-3(QR)]. * Further, the required Joint Venture Agreement signed by us and our Partners has also been furnished as per your format [Attachment-3(JV)].
 * Delete if not applicable
- (d) Attachment 4: The documentary evidence establishing in accordance with ITB Clause 3, Vol.-I of the Bidding Documents that the facilities offered by us are eligible facilities and conform to the Bidding Documents has been furnished as Attachment 4. A list of Special Tools & Tackles to be used by us for erection, testing & Commissioning and to be handed over to Employer, the cost of which is included in our Bid Price, is also enclosed as per your format as Attachment 4A. A list of Special Tools & Tackles to be brought by the contractor for erection, testing & Commissioning and to be taken back after completion of work, whose cost is not included in our bid price, is enclosed as per your format as Attachment 4B.
- (e) Attachment 5: The details of all major items of services or supply which we propose subletting in case of award, giving details of the name and nationality of the proposed subcontractor/sub-vendor for each item.
- (f) Attachment 6: The variation and deviations from the requirements of the Conditions of Contract, Technical Specification and Drawings (excluding critical provisions as mentioned at clause 6.0 below) in your format enclosed with the Bidding Documents, including, inter alia, the cost of withdrawal of the variations and deviations indicated therein.
- (g) Attachment 7: ~~The details of Alternative Bids made by us indicating the complete Technical Specifications and the deviation to contractual and commercial conditions.~~ [Not Applicable]
- (h) Attachment 8: Manufacturer's Authorisation Forms - registered/notarized
- (i) Attachment 9: Work Completion Schedule.
- (j) Attachment 10: Guarantee Declaration.
- (k) Attachment 11: Information regarding ex-employees of Employer in our firm.

- (l) Attachment 12: Filled up information regarding Price Adjustment Data as per the format enclosed in the bidding documents
- (m) Attachment 13: ~~Declaration regarding Social Accountability~~
- (n) Attachment 14: Integrity Pact, in a separate envelope, duly signed on each page by the person signing the bid.
- (o) Attachment 15: Option for Interest bearing Initial Advance payment and Information for E-payment, PF details and declaration regarding Micro/Small & Medium Enterprises
- (p) Attachment 16: Additional Information
- (q) Attachment 17: Declaration for tax exemptions, reductions, allowances or benefits
- (r) Attachment 18: Declaration
- (s) Attachment 19: Bank Guarantee verification checklist

- 3.0 We are aware that, in line with Clause No. 27.1 (ITB), our online price bid is liable to be rejected in case the same contains any deviation/omission from the contractual and commercial conditions and technical Specifications other than those identified in this Bid Envelope.
- 3.1 We are aware that the Price Schedules do not generally give a full description of the Work to be performed under each item and we shall be deemed to have read the technical specifications, scope of works and other sections of the Bidding Documents and Drawings to ascertain the full scope of Work included in each item while filling-in the rates and prices in price schedule quoted and uploaded in e-procurement web-portal.
- 3.2 We declare that as specified in Clause 11.5, Section –II:ITB, Vol.-I of the Bidding Documents, prices quoted by us in the Price Schedules shall be fixed and firm during the execution of Contract except for the permitted items for which Price Adjustment is applicable, as mentioned in Appendix-2 (Price Adjustment) to the Contract Agreement of Volume-I : Section-VI (Sample Forms and Procedures).
- 4.0 We confirm that except as otherwise specifically provided our Bid Prices quoted and uploaded in e-procurement web portal include all taxes, duties, levies and charges as may be assessed on us, our Sub-Contractor/Sub-Vendor or their employees by all municipal, state or national government authorities in connection with the Facilities, in and outside of India.

- 4.1 100% of applicable Taxes and Duties(for direct transaction between Employer and us), which are payable by the Employer under the Contract, shall be reimbursed by the Employer after dispatch of equipment on production of satisfactory documentary evidence by the Contractor in accordance with the provisions of the Bidding Documents.
- 4.2 We further understand that notwithstanding 4.0 above, in case of award on us, you shall also bear and pay/reimburse to us, Excise Duty, Sales Tax/VAT (but not the surcharge in lieu of Sales Tax/VAT), local tax and other levies in respect of direct transaction between you and us, imposed on the Plant & Equipment including Mandatory Spare Parts specified in Schedule No. 1 of our Price Schedule quoted and uploaded on e-procurement web portal, to be incorporated into the Facilities; by the Indian Laws.
- 4.3 We also understand that, in case of award on us, you shall reimburse to us octroi/entry tax as applicable for destination site/state on all items of supply including bought-out finished items, which shall be dispatched directly from the sub-vendor's works to the Employer's site (sale-in-transit). Further, Service Tax, if applicable, for the services to be rendered by us, the same is included in our bid price quoted and uploaded on e-procurement web portal.
- 4.4 We confirm that we shall also get registered with the concerned Sales Tax Authorities, in all the states where the project is located.
- 4.5 We confirm that no Sales Tax/VAT in any form shall be payable by you for the bought out items which shall be dispatched directly by us under the First Contract (as referred in para 5.1 below) to the project site. However, you will issue requisite Sales Tax declaration/Vatable forms in respect of such bought out items, on production of documentary evidence of registration with the concerned Sales Tax Authorities.
- 5.0 Construction of the Contract
- 5.1 We declare that we have studied Clause GCC 2.1 relating to mode of contracting for Domestic Bidders and we are making this proposal with a stipulation that you shall award us two separate Contracts viz 'First Contract' for supply of all equipment and materials including mandatory spares and 'Second Contract' for providing all the services i.e. inland transportation for delivery at site, insurance, unloading, storage, handling at site, installation, testing and commissioning including Trial operation in respect of all the equipment supplied under the 'First Contract' and other services specified in the Contract Documents. We declare that the award of two contracts, will not, in any way, dilute our responsibility for successful operation of plant/equipment and fulfillment of all obligations as per Bidding Documents and that both the Contracts will have a cross-fall breach clause i.e. a breach in one Contract will automatically be classified as a breach of the other contract which will confer on you the right to terminate the other contract at our risk and cost.
- 6.0 We have read the provisions of following clauses and confirm that the specified stipulations of these clauses are acceptable to us:

(a) ITB 13

Bid Security

(b)	GCC 2.14	Governing Law
(c)	GCC 8	Terms of Payment
(d)	GCC 9.3	Performance Security
(e)	GCC 10	Taxes and Duties
(f)	GCC 21.2	Completion Time Guarantee
(g)	GCC 22	Defect Liability
(h)	GCC 23	Functional Guarantee
(i)	GCC 25	Patent Indemnity
(j)	GCC 26	Limitation of Liability
(k)	GCC 38	Settlement of Disputes
(l)	GCC 39	Arbitration
(m)	Appendix 2 to Form of Contract Agreement	Price Adjustment

Further we understand that deviation taken in any of the above clauses by us may make our bid non-responsive as per provision of bidding documents and be rejected by you.

- 7.0 We undertake, if our bid is accepted, to commence the work immediately upon your Notification of Award to us, and to achieve the delivery of goods and related services within the time stated in the Bidding Documents.
- 8.0 If our bid is accepted, we undertake to provide a Performance Security(ies) in the form and amounts, and within the times specified in the Bidding Documents.
- 9.0 We agree to abide by this bid for a period of six (06) months from the date fixed for opening of bids as stipulated in the Bidding Documents, and it shall remain binding upon us and may be accepted by you at any time before the expiration of that period.
- 10.0 Until a formal Contract is prepared and executed between us, this bid, together with your written acceptance thereof in the form of your Notification of Award shall constitute a binding contract between us.
- 11.0 We understand that you are not bound to accept the lowest or any bid you may receive.
- *12.0 (For Joint Venture only) We, the partners of Joint Venture submitting this bid, do agree and confirm that in case of Award of Contract on the Joint Venture, we shall be jointly and severally liable and responsible for the execution of the Contract in accordance with Contract terms and conditions.
- 13.0 We, hereby, declare that only the persons or firms interested in this proposal as principals are named here and that no other persons or firms other than those mentioned herein have any interest in this proposal or in the Contract to be entered into, if the award is made on us, that this proposal is made without any connection with any other person, firm or party likewise submitting a proposal is in all respects for and in good faith, without collusion or fraud.

Dated this ____ day of _____20__

Thanking you, we remain,

Yours Sincerely,
For and on behalf of the [Name of the Bidder#]

(Signature).....

(Printed Name).....

(Designation).....

(Common Seal).....

Date:

Place:

Business Address:

Country of Incorporation:
(State or Province to be indicated)

Name of the Principal Officer:

Address of the Principal Officer:

*Applicable in case of a bid from Joint Venture of firms.
#In case the bid is submitted by a Joint Venture, the name of the Joint Venture should be indicated

Note: Bidders may note that no prescribed proforma has been enclosed for:

(a) Attachment 2: Power of Attorney.

(For Attachments 2 Bidders may use their own proforma for furnishing the required information with the bid).

List of Attachments

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Attachment-3(JV)

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Joint Venture Agreement and Power of Attorney for Joint Venture*)

Bidder's Name and Address:

To: <Name and Address of Employer>

Dear Sir,

The Joint Venture Agreement (as per the proforma attached at no. 15 in Section-VI, Sample Forms and Procedures, Conditions of Contract, Vol.-I of the Bidding Documents) and Power of Attorney for Joint Venture (as per the proforma attached at no. 14 in Section-VI, Sample Forms and Procedures, Conditions of Contract, Vol.-I of the Bidding Documents) are enclosed herewith.

* Applicable for Joint Venture.

Date:.....

(Signature).....

Place:.....

(Printed Name).....

(Designation).....

(Common Seal).....

Attachment-3 (QR)

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Qualifying Requirement Data)

Bidders Name & Address:

To

<Name and Address of the Employer>

Dear Ladies and/or Gentlemen,

In support of the Qualification Requirements (QR) for bidders, stipulated in Annexure-A (BDS) of the Section - III (BDS), Volume-I & additional information required as per **ITB clause 9.3(c)** of the Bidding Documents, we furnish herewith our QR data/details/documents etc., alongwith other information, as follows (The QR stipulations have been reproduced in italics for ready reference, however, in case of any discrepancy the QR as given in BDS shall prevail).

* We have submitted bid as individual firm.

* We have submitted bid as joint venture of following firms:

(i)

(ii)

(iii)

(* Strike-off whichever is not applicable)

[For details regarding Qualification Requirements of a Joint Venture, please refer para 4.0 below.]

We are furnishing the following details/document in support of Qualifying requirement for the subject project.

A. Attached copies of original documents defining:

- a) The constitution or legal status;
- b) The principal place of business;
- c) The place of incorporation (for bidders who are corporations); or the place of registration and the nationality of the Owners (for applicants who are partnerships or individually-owned firms).

B. Attached original & copies of the following documents.

- a) Written power of attorney of the signatory of the Bid to commit the bidder.
- b)** Joint Venture Agreement

[** To be submitted only in case of Joint Ventures. Strike off in case of individual firms.]

1.0 Pre-qualification criteria – Part A:

1.01 Technical:

- (I) Part I: Supply, Erection, Testing & Commissioning of New/Augmentation of existing 66/11 KV or 33/11KV substation¹ and new/Augmentation of its incoming 33 or 66 KV Lines

The detailed criteria is mentioned at 1.01 (I) of Annexure-A to BDS at Volume-I : Section-III.

Format A: Format for the Bidder (Single Firm / Partner(s) in case of Joint Venture) for technical experience in compliance to para 1.01 (I) {(i) or (ii) or (iii)} of Annexure-A to BDS (Volume-I : Section-III) [In case of Joint Venture bidder, the QR data of each of the partner (in support of meeting the requirement of para 1.01 (I) (iv) of Annexure-A to BDS (Volume-I : Section-III))] is also is to furnished, as applicable, using this format. The bidder (Single Firm / Partner(s) in case of Joint Venture) who is willing to qualify in compliance to para 1.01 (I) {(ii) or (iii)} of para 1.01 (I) (iv) of Annexure-A to BDS (Volume-I : Section-III) shall fill below format for two or all three contracts.

A1.	Name of Bidder/Lead Partner of JV/other partner(s) of JV	
A2.	Name of Contract (executed during the last 7 years as on the originally scheduled date of bid opening):	
A3.	Contract Reference No. & Date of Award	
A4	Name and Address of the Employer/Utility by whom the Contract was awarded	
	e-mail ID	_____
	Telephone No.	_____
	Fax No.	_____

¹ Depending on the state practice to use 66 KV or 33 KV as sub-transmission voltage gradient

A1.	Name of Bidder/Lead Partner of JV/other partner(s) of JV	
A2.	Name of Contract (executed during the last 7 years as on the originally scheduled date of bid opening):	
A3.	Contract Reference No. & Date of Award	
A4	Name and Address of the Employer/Utility by whom the Contract was awarded <div style="text-align: right;"> e-mail ID _____ Telephone No. _____ Fax No. _____ </div>	
A5(i)	Name of electrical works of LT line or 11 KV or 22 KV class successfully erected, tested and commissioned	_____
(ii)	Distribution transformer capacity successfully erected, tested and commissioned for s/s of 33/11 KV or 66/11 KV (in KVA)	_____
(iii)	% of Distribution transformer capacity executed w.r.t. Distribution transformer capacity proposed in bid (in %)	_____
(iv)	Length of LT line/11 KV/22 KV line successfully erected, tested and commissioned (in cKms)	_____
(v)	% of LT line/11 KV/22 KV line executed w.r.t. LT line/11 KV/22 KV line proposed in bid (in %)	_____
A6(i)	Date of successful execution of the Contract/Date of commissioning	_____
(ii)	No. of years the above referred electrical works is in successful operation as on the date of bid opening	_____ years
A7.	Capacity in which the Contract was undertaken (Check One)	Prime Contractor Partner of JV Subcontractor (Tick whichever is applicable)
A8.	Details/documentary evidence submitted in support of stated experience/Contract	

(Documentary evidence, such as copies of utility certificates etc., in support of its experience shall be attached with the filled-up format for each experience/Contract)

(III) Part III: Combined Part of Part-I & II above

The detailed criteria is mentioned at 1.01 (III) of Annexure-A to BDS at Volume-I : Section-III.

Format C: Format for the Bidder (Single Firm / Partner(s) in case of Joint Venture) for technical experience in compliance to para 1.01 (III) {(i) or (ii) or (iii)} of Annexure-A to BDS (Volume-I : Section-III) [In case of Joint Venture bidder, the QR data of each of the partner (in support of meeting the requirement of para 1.01 (III) (iv) of Annexure-A to BDS (Volume-I : Section-III))] is also is to furnished, as applicable, using this format. The bidder (Single Firm / Partner(s) in case of Joint Venture) who is willing to qualify in compliance to para 1.01 (III) {(ii) or (iii)} above shall fill below format for two or all three contracts.

A1.	Name of Bidder/Lead Partner of JV/other partner(s) of JV	
A2.	Name of Contract (executed during the last 7 years as on the originally scheduled date of bid opening):	
A3.	Contract Reference No. & Date of Award	
A4	Name and Address of the Employer/Utility by whom the Contract was awarded	
	e-mail ID	_____
	Telephone No.	_____
	Fax No.	_____
A5(i)	Name of electrical works of 33/11 KV or 66/11 KV class substation and its associated 33 KV/66 KV lines successfully erected, tested and commissioned	_____
(ii)	Transformer capacity successfully erected, tested and commissioned for 33/11 KV or 66/11 KV s/s(in KVA)	_____
(iii)	% of Transformer capacity executed w.r.t. transformer capacity proposed in bid (in %)	_____
(iv)	Length of 33 KV/66KV line successfully erected, tested and commissioned (in cKms)	_____
(v)	% of 33 KV/66KV line executed w.r.t. 33 KV/66KV line proposed in bid (in %)	_____

A6(i)	Name of electrical works of LT line or 11 KV or 22 KV class successfully erected, tested and commissioned	_____
(ii)	Distribution transformer capacity successfully erected, tested and commissioned (in KVA)	_____
(iii)	% of Distribution transformer capacity executed w.r.t. Distribution transformer capacity proposed in bid (in %)	_____
(iv)	Length of LT line/11 KV/22 KV line successfully erected, tested and commissioned (in Kms)	_____
(v)	% of LT line/11 KV/22 KV line executed w.r.t. 11 KV/22 KV line proposed in bid (in %)	_____
A7(i)	Date of successful execution of the Contract/Date of commissioning	_____
(ii)	No. of years the above referred electrical works is in successful operation as on the date of bid opening	_____ years
A8.	Capacity in which the Contract was undertaken (Check One)	Prime Contractor Partner of JV Subcontractor (Tick whichever is applicable)
A9.	Details/documentary evidence submitted in support of stated experience/Contract	

(Documentary evidence, such as copies of utility certificates etc., in support of its experience shall be attached with the filled-up format for each experience/Contract)

1.01.1 For Bidder to qualify for more than one projects, the technical requirements of bidder shall be as per following:

S. No.	Description	Unit	Project1	Project2	Project3	QR for technical requirement of a bidder participating in all 3 projects
Part-I						
1	66 KV + 33 KV+ higher voltage	Km	500	200	150	500
2	sum of 33/11 KV and 66/11 KV substation	MVA	50	20	80	80
Part-II						
3	sum of 22 KV+11 KV+ LT line length	Km	1000	2000	3000	3000
4	sum of DTR transformation	MVA	2000	8000	5000	8000
Part-III						
1	66 KV + 33 KV+ higher voltage	Km	500	200	150	500

2	sum of 33/11 KV and 66/11 KV substation	MVA	50	20	80	80
3	sum of 22 KV+11 KV+ LT line length	Km	1000	2000	3000	3000
4	sum of DTR transformation	MVA	2000	8000	5000	8000

1.01.2 The bidder should possess "A" Class license issued by the Electrical inspectorate of Govt of (...)² /Central Inspectorial organization of Govt. of India/ other state Govt. In case bid submitted joint venture firm, any of partner should possess "A" class electrical license as stated above.

1.02 Commercial

The detailed criteria is mentioned at 1.02 of Annexure-A to BDS at Volume-I : Section-III.

Format C: Format for the Bidder (Single Firm / Partner(s) in case of Joint Venture) for commercial experience in compliance to para 1.02.1 (i) of Annexure-A to BDS at Volume-I : Section-III [In case of Joint Venture bidder, the QR data of each of the partner (in support of meeting the requirement of para 1.02.5 of Annexure-A to BDS at Volume-I : Section-III) is also is to furnished, as applicable, using this format. The bidder (Single Firm / Partner(s) in case of Joint Venture) who is willing to qualify in compliance to para 1.02.1 {(ii) or (iii)} of Annexure-A to BDS at Volume-I : Section-III shall fill below format for two or all three contracts.

A1.	Name of Bidder/Lead Partner of JV/other partner(s) of JV	
A2.	Name of Contract (executed during the last 5 years up to 31.03.2013):	
A3.	Contract Reference No. & Date of Award	
A4	Name and Address of the Employer/Utility by whom the Contract was awarded	
	e-mail ID	_____
	Telephone No.	_____
	Fax No.	_____

² Name of state where work is to be executed.

A5(i)	Name of completed work of project execution in electrical Transmission or sub-transmission & distribution sector	_____
	Cost of the project	
(ii)	% of cost w.r.t. estimated cost of this bid (in %)	_____
(iii)		
A6(i)	Date of successful execution of the Contract/Date of commissioning	_____
A7.	Capacity in which the Contract was undertaken (Check One)	Prime Contractor Partner of JV Subcontractor (Tick whichever is applicable)
A8.	Details/documentary evidence submitted in support of stated experience/Contract	

(Documentary evidence, such as copies of utility certificates etc., in support of its experience shall be attached with the filled-up format for each experience/Contract)

Format D: Format for the Bidder (Single Firm / Partner(s) in case of Joint Venture) for commercial experience in compliance to para 1.02.2, 1.02.3 & 1.02.4 of Annexure-A to BDS at Volume-I : Section-III [In case of Joint Venture bidder, the QR data of each of the partner (in support of meeting the requirement of para 1.02.5 of Annexure-A to BDS at Volume-I : Section-III) is also to furnished, as applicable, using this format.

A1.	Name of Bidder/Lead Partner of JV/other partner(s) of JV	
A2.	Net-worth in last three years	
	1. Financial Year 2012-13	: Rs. ----- lakhs
	2. Financial Year 2013-14	: Rs. ----- lakhs
	3. Financial Year 2014-15	: Rs. ----- lakhs
A3.	Minimum Average Annual Turnover (MAAT)	
	1. Financial Year 2010-11	: Rs. ----- lakhs
	2. Financial Year 2011-12	: Rs. ----- lakhs
	3. Financial Year 2012-13	: Rs. ----- lakhs
	4. Financial Year 2013-14	: Rs. ----- lakhs
	5. Financial Year 2014-15	: Rs. ----- lakhs
A4	liquid assets (LA) and/ or evidence of access to or availability of credit facilities	: Rs. ----- lakhs

A4.	Details/documentary evidence submitted in support of stated experience/Contract	
-----	---	--

(Documentary evidence, such as copies of utility certificates etc., in support of its experience shall be attached with the filled-up format for each experience/Contract)

1.02.1 Failure to comply with this requirement will result in rejection of the joint venture's bid. Sub contractors' experience and resources shall not be taken into account in determining the bidder's compliance with qualifying criteria.

1.02.2 One of the partners shall be nominated as lead partner, and the lead partner shall be authorized to incur liabilities and receive instruction for and on behalf of any and all partners of the joint venture and the entire execution of the contract including receipt of payment shall be done exclusively through the lead partner. This authorization shall be evidenced by submitting a power of attorney signed by legally authorized signatories of all the partners as per proforma in section "Annexure" of Special Conditions of Contract-Vol.-IA.

1.02.3 All partner of the joint venture shall be liable jointly and severally for the execution of the contract in accordance with the contract terms and a copy of the agreement entered into by the joint venture partners having such a provision shall be submitted with the bid.

2.0 Pre-qualification criteria – Part B:

The Bidder shall also furnish following documents/details with its bid:

2.01.1 A certificate from banker (as per format) indicating various fund based/non fund based limits sanctioned to the bidder and the extent of utilization as on date Such certificate should have been issued not earlier than three months prior to the date of bid opening. Wherever necessary Employer may make queries with the Bidders' bankers.

2.01.2 The complete annual reports together with Audited statement of accounts of the company for last five years of its own (separate) immediately preceding the date of submission of bid.

2.01.3 Note:

2.01.3.1 In the event the bidder is not able to furnish the information of its own (i.e. separate), being a subsidiary company and its accounts are being consolidated with its group/holding/parent company, the bidder should submit the audited balance sheets, income statements, other information pertaining to it only (not of its group/Holding/Parent Company) duly certified by any one of the authority [(i) Statutory Auditor of the bidder /(ii) Company Secretary of the bidder or (iii) A

certified Public Accountant] certifying that such information/documents are based on the audited accounts as the case may be.

2.01.3.2 Similarly, if the bidder happens to be a Group/Holding/Parent Company, the bidder should submit the above documents/information of its own (i.e. exclusive of its subsidiaries) duly certified by any one of the authority mentioned in Note - 2.01.3.1 above certifying that these information/ documents are based on the audited accounts, as the case may be.

2.01.4 Litigation History:

2.01.4.1 The bidder should provide detailed information on any litigation or arbitration arising out of contracts completed or under execution by it over the last five years. A consistent history of awards involving litigation against the Bidder or any partner of JV may result in rejection of Bid.

2.01.4.2 Notwithstanding anything stated hereinabove, the Employer reserves the right to assess the capacity and capability of the bidder, should the circumstances warrant such assessment in an overall interest of the Employer. The Employer reserves the right to waive minor deviations if they do not materially affect the capability of the Bidder to perform the contract.

Attachment-4

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Form of Certificate of Origin and Eligibility)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

We hereby certify that equipment and materials to be supplied are produced in , an eligible source country.

We hereby certify that our company is incorporated and registered in , an eligible source country.

Date:..... (Signature).....

Place:..... (Printed Name).....

(Designation).....

(Common Seal).....

Attachment-4A

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(List of Special Maintenance Tools & Tackles)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

Dear Sir,

We are furnishing below the list of special maintenance tools & tackles for various equipment under the subject project. The prices for these tools & tackles are included in our lumpsum bid price. We further confirm that the list of special maintenance tools & tackles includes all the items specifically identified in your bidding documents as brought out below:

S.No.	For Equipment	Item Description	Unit	Quantity
-------	---------------	------------------	------	----------

Notwithstanding what is stated above, we further confirm that any additional special maintenance tools and tackles, required for the equipment under this project shall be furnished by us at no extra cost to the employer.

Date:.....

(Signature).....

Place:.....

(Printed Name).....

(Designation).....

(Common Seal).....

Attachment-4B

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(List of Special Maintenance Tools & Tackles)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

Dear Sir,

We are furnishing below the list of special maintenance tools & tackles for various equipment under the subject Project. The prices for these tools & tackles which are to be taken back after the completion of the work by us are not included in our lumpsum bid price. We further confirm that the list of special maintenance tools & tackles includes all the items specifically identified in your bidding documents as brought out below:

(a)

(b)

Date:.....

(Signature).....

Place:.....

(Printed Name).....

(Designation).....

(Common Seal).....

Attachment-5

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)
 (Bought-out & Sub-contracted Items)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

Dear Sir,

1.0 We hereby furnish the details of the items/ sub-assemblies, we propose to buy for the purpose of furnishing and installation of the subjectProject:

Sl. No.	Item Description	Quantity proposed to be bought/sub-contracted	Details of the proposed sub-contractor/sub-vendor	
			Name	Nationality
1.				
2.				
3.				
4.				
5.				
6.				

2.0 We hereby declare that, we would not subcontract the erection portion of the contract without the prior approval of Employer.

Date:.....

(Signature).....

Place:.....

(Printed Name).....

(Designation).....

(Common Seal).....

Attachment-6

Electrification works of XXXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Alternative, Deviations and Exceptions to the Provisions)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

Dear Sir,

The bidder shall itemize any deviation from the Specifications included in his bid. Each item shall be listed (separate sheets may be used and enclosed with this Attachment) with the following information:

Sl. No.	Reference clause in the Specifications	Deviation	Cost of withdrawal of the deviation

The above deviations and variations are exhaustive. We confirm that we shall withdraw the deviations proposed by us at the cost of withdrawal indicated in this attachment, failing which our bid may be rejected and Bid Security forfeited.

Except for the above deviations and variations, the entire work shall be performed as per your specifications and documents. Further, we agree that any deviations, conditionality or reservation introduced in this Attachment-6 and/or in the Bid form, Price schedules & Technical Data Sheets and covering letter, or in any other part of the bid will be reviewed to conduct a determination of the substantial responsiveness of the bid.

Date:.....

(Signature).....

Place:.....

(Printed Name).....

(Designation).....

(Common Seal).....

Attachment-8

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Manufacturer's Authorization Form)
(On Manufacturer's Letterhead, see Clause 9.3(c) of the ITB)

To: [Insert: name of Employer]

Dear Ladies and/or Gentlemen,

WE [insert: name of Manufacturer] who are established and reputable manufacturers of [insert: name and/or description of the plant & equipment] having production facilities at [insert: address of factory] do hereby authorize [insert: name & address of Bidder] (hereinafter, the "Bidder") to submit a bid, and subsequently negotiate and sign the Contract with you against IFB [insert: title and reference number of Invitation for Bids] including the above plant & equipment or other goods produced by us.

We hereby extend our full guarantee and warranty for the above specified plant & equipment materials or other goods offered supporting the supply, installation and achieving of Operational Acceptance of the plant by the Bidder against these Bidding Documents, and duly authorize said Bidder to act on our behalf in fulfilling these guarantee and warranty obligations. We also hereby declare that we and, [insert: name of the Bidder] have entered into a formal relationship in which, during the duration of the Contract (including warranty / defects liability) we, the Manufacturer or Producer, will make our technical and engineering staff fully available to the technical and engineering staff of the successful Bidder to assist that Bidder, on a reasonable and best effort basis, in the performance of all its obligations to the Purchaser under the Contract.

For and on behalf of the Manufacturer

Signed: _____

Date: _____

In the capacity of [insert: title of position or other appropriate designation] and this should be signed by a person having the power of attorney to legal bind the manufacturer.

Date:.....

Place:.....

(Signature).....

(Printed Name).....

(Designation).....

(Common Seal).....

- Note 1. The letter of Undertaking should be on the letterhead of the Manufacturer and should be signed by a person competent and having Power of Attorney to legally bind the Manufacturer. It shall be included by the bidder in its bid.
2. Above undertaking shall be registered or notarized so as to be legally enforceable.

Attachment-9

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Work Completion Schedule)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

Dear Sir,

We hereby declare that the following Work Completion Schedule shall be followed by us in furnishing and installation of the subject Project for the period commencing from the effective date of Contract to us:

Sl. No.	Description of Work	Period in months from the effective date of Contract
1.	Detailed Engineering and drawing submission a) commencement b) completion	
2.	Procurement of equipment/ components & assembly a) commencement b) completion	
3.	Type Tests a) commencement b) completion	
4.	Manufacturing a) commencement b) completion	
5.	Shipments & Delivery a) commencement b) completion	
6.	Establishment of site office	
7.	Installation at Site	

Sl. No.	Description of Work	Period in months from the effective date of Contract
	a) commencement b) completion	
8.	Testing & Pre-commissioning a) commencement b) completion	
9.	Trial Operation a) commencement b) completion	

Date:..... (Signature).....
 Place:..... (Printed Name).....
(Designation).....
(Common Seal).....

Note: Bidders to enclose a detailed network covering all the activities to be undertaken for completion of the project indicating key dates for various milestones for each phase constituent-wise.

Attachment-10

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Guarantee Declaration)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

Dear Sir,

We hereby declare that this Attachment of "Guarantee Declaration" is furnished by us in Packet-I of Inner Envelope-2 of bid envelope.

Date:.....

Place:.....

(Signature).....

(Printed Name).....

(Designation).....

(Common Seal).....

Attachment-11

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Information regarding Ex-employees of XXXXX (Name of Employer) in our Organisation)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

Dear Sir,

We hereby furnish the details of ex-employees of XXXXX (Name of Employer) who had retired/ resigned at the level of XXXXXXX (Define suitable post) from XXXXX (Name of Employer) and subsequently have been employed by us:

Sl. No.	Name of the person with designation in XXXXX (Name of Employer)	Date of Retirement/ resignation from XXXXX (Name of Employer)	Date of joining and designation in our Organisation
1.
2.
3.
4.
5.

Date:.....

(Signature).....

Place:.....

(Printed Name).....

(Designation).....

(Common Seal).....

Note: The information in similar format should be furnished for each partner of joint venture in case of joint venture bid.

Attachment-12

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Price Adjustment Data as per Appendix-2 of section-VI : Sample forms and procedures)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

Dear Sir,

We hereby furnish the details of Price Adjustments:

Name of Material	Price as on 30 days prior to date of bid opening*	Price as on 60 days prior to date of shipment*	Variation*
ACSR conductor			
Power / Station / Distribution Transformer (Copper / Aluminium wound)			
Cables			

*Detailed calculations as per appendix-2 of section-VI : sample forms and procedures to be enclosed

Date:.....

(Signature).....

Place:.....

(Printed Name).....

(Designation).....

(Common Seal).....

Attachment-14

(PRECONTRACT INTEGRITY PACT)

General

This pre-bid pre-contract Agreement (hereinafter called the Integrity Pact) is made on day of the month of 2010, between, on one hand, the (Name of Owner) acting through Shri..... (Name and designation of Project Manager) (hereinafter called the "BUYER", which expression shall mean and include, unless the context otherwise requires, his successors in office and assigns) of the First Part and M/s..... (Name of Bidder) represented by Shri____, Chief Executive Officer (hereinafter called the "BIDDER/Seller" which expression shall mean and include, unless the context otherwise requires, his successors and permitted assigns) of the Second Part.

WHEREAS the BUYER proposes to procure (Name of the Stores/Equipment/Item) and the BIDDER/Seller is willing to offer/has offered the stores and

WHEREAS the BIDDER is a private company/public company/Government undertaking/partnership/registered export agency, constituted in accordance with the relevant law in the matter and the BUYER is a PSU/Utility/Department of State Govt. performing its functions on behalf of the (Name of owner).

NOW, THEREFORE,

To avoid all forms of corruption by following a system that is fair, transparent and free from any influence/prejudiced dealings prior to, during and subsequent to the currency of the contract to be entered into with a view to:-

Enabling the BUYER to obtain the desired said stores/equipment at a competitive price in conformity with the defined specifications by avoiding the high cost and the distortionary impact of corruption on public procurement, and

Enabling BIDDERs to abstain from bribing or indulging in any corrupt practice in order to secure the contract by providing assurance to them that their competitors will also abstain from bribing and other corrupt practices and the BUYER will commit to prevent corruption, in any form, by its officials by following transparent procedures.

The parties hereto hereby agree to enter into this Integrity Pact and agree as follows:

Commitments of the BUYER

- 1.1 The BUYER undertakes that no official of the BUYER, connected directly or indirectly with the contract, will demand, take a promise for or accept, directly or through intermediaries, any bribe, consideration, gift,

reward, favour or any material or immaterial benefit or any other advantage from the BIDDER, either for themselves or for any person, organisation or third party related to the contract in exchange for an advantage in the bidding process, bid evaluation, contracting or implementation process related to the contract.

1.2 The BUYER will, during the pre-contract stage, treat all BIDDERS alike and will provide to all BIDDERS the same information and will not provide any such information to any particular BIDDER which could afford an advantage to that particular BIDDER in comparison to other BIDDERS.

1.3 All the officials of the BUYER will report to the appropriate Government office any attempted or completed breaches of the above commitments as well as any substantial suspicion of such a breach

2.0 In case any such preceding misconduct on the part of such official(s) is reported by the BIDDER to the BUYER with full and verifiable facts and the same is prima facie found to be correct by the BUYER, necessary disciplinary proceedings, or any other action as deemed fit, including criminal proceedings may be initiated by the BUYER and such persons shall be debarred from further dealings related to the contract process. In such a case while an enquiry is being conducted by the BUYER the proceedings under the contract would not be stalled.

Commitments of BIDDERS

3.0 The BIDDER commits itself to take all measures necessary to prevent corrupt practices, unfair means and illegal activities during any stage of its bid or during any pre-contract or post-contract stage in order to secure the contract or in furtherance to secure it and in particular commit itself to the following: -

3.1 The BIDDER will not offer, directly or through intermediaries, any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the BUYER, connected directly or indirectly with the bidding process, or to any person, organisation or third party related to the contract in exchange for any advantage in the bidding, evaluation, contracting and implementation of the contract.

3.2 The BIDDER further undertakes that it has not given, offered or promised to give, directly or indirectly any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the BUYER or otherwise in procuring the Contractor for bearing to do or having done any act in relation to the obtaining or execution of the contract or any other contract with the Government for showing or for bearing to show favour or disfavour to any person in relation to the contract or any other contract with Government.

3.3 BIDDERS shall disclose the name and address of agents and representatives and Indian BIDDERS shall disclose their foreign principals or associates.

3.4 BIDDERS shall disclose the payments to be made by them to agents/brokers or any other intermediary, in connection with this bid/contract.

3.5 The BIDDER further confirms and declares to the BUYER that the BIDDER is the original manufacturer/integrator/authorised government sponsored export entity of the defence stores and has not engaged any individual or firm or company whether Indian or foreign to intercede, facilitate or in any way to recommend to the BUYER or any of its functionaries, whether officially or unofficially to the award of the contract to the BIDDER, nor has any amount been paid, promised or intended to be paid to any such individual, firm or company in respect of any such intercession, facilitation or recommendation.

3.6 The BIDDER, either while presenting the bid or during pre-contract negotiations or before signing the contract, shall disclose any payments he has made, is committed to or intend to make to officials of the BUYER or their family members, agents, brokers or any other intermediaries in connection with the contract and the details of services agreed upon for such payments.

3.7 The BIDDER will not collude with other parties interested in the contract to impair the transparency, fairness and progress of the bidding process, bid evaluation, contracting and implementation of the contract.

3.8 The BIDDER will not accept any advantage in exchange for any corrupt practice, unfair means and illegal activities.

3.9 The BIDDER shall not use improperly, for purposes of competition or personal gain, or pass on to others, any information provided by the BUYER as part of the business relationship, regarding plans, technical proposals and business details, including information contained in any electronic data carrier. The BIDDER also undertakes to exercise due and adequate care lest any such information is divulged.

3.10 The BIDDER commits to refrain from giving any complaint directly or through any other manner without supporting it with full and verifiable facts.

3.11 The BIDDER shall not instigate or cause to instigate any third person to commit any of the actions mentioned above.

3.12 If the BIDDER or any employee of the BIDDER or any person acting on behalf of the BIDDER, either directly or indirectly, is a relative of any of the officers of the BUYER, or alternatively, if any relative of an officer of the BUYER has financial interest/stake in the BIDDER's firm, the same shall be disclosed by the BIDDER at the time of filing of tender.

The term 'relative' for this purpose would be as defined in Section 6 of the Companies Act 1956.

3.13 The BIDDER shall not lend to or borrow any money from or enter into any monetary dealings or transactions, directly or indirectly, with any employee of the BUYER.

4. Previous Transgression

4.1 The BIDDER declares that no previous transgression occurred in the last three years immediately before signing of this Integrity Pact, with any other company in any country in respect of any corrupt practices envisaged hereunder or with any Public Sector Enterprise in India or any Government Department in India that could justify BIDDER's exclusion from the tender process.

4.2 The BIDDER agrees that if it makes incorrect statement on this subject, BIDDER can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

5. Earnest Money (Security Deposit)

5.1 While submitting commercial bid, the BIDDER shall deposit an amount..... (to be specified in RFP) as Earnest Money/Security Deposit, with the BUYER through any of the following instruments:

(i) Bank Draft or a Pay Order in favour of

(ii) A confirmed guarantee by an Indian Nationalised Bank, promising payment of the guaranteed sum to the BUYER on demand within three working days without any demur whatsoever and without seeking any reasons whatsoever. The demand for payment by the BUYER shall be treated as conclusive proof of payment.

(iii) Any other mode or through any other instrument (to be specified in the RFP).

5.2 The Earnest Money/Security Deposit shall be valid upto a period of..... years or the complete conclusion of the contractual obligations to the complete satisfaction of both the BIDDER and the BUYER, including warranty period, whichever is later.

5.3 In case of the successful BIDDER a clause would also be incorporated in the Article pertaining to Performance Bond in the Purchase Contract that the provisions of Sanctions for Violation shall be applicable for forfeiture of Performance Bond in case of a decision by the BUYER to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

5.4 No interest shall be payable by the BUYER to the BIDDER on Earnest Money/Security Deposit for the period of its currency.

6. Sanctions for Violations

6.1 Any breach of the aforesaid provisions by the BIDDER or anyone employed by it acting on its behalf (whether with or without the knowledge of the BIDDER) shall entitle the BUYER to take all or any one of the following actions, wherever required:-

- (i) To immediately call off the pre contract negotiations without assigning any reason or giving any compensation to the BIDDER. However, the proceedings with the other BIDDER(s) would continue.
- (ii) The Earnest Money Deposit (in pre-contract stage) and/or Security Deposit/Performance Bond (after the contract is signed) shall stand forfeited either fully or partially, as decided by the BUYER and the BUYER shall not be required to assign any reason therefore.
- (iii) To immediately cancel the contract, if already signed, without giving any compensation to the BIDDER.
- (iv) To recover all sums already paid by the BUYER, and in case of an Indian BIDDER with interest thereon at 2% higher than the prevailing Prime Lending Rate of State Bank of India, while in case of a BIDDER from a country other than India with interest thereon at 2% higher than the UBOR. If any outstanding payment is due to the BIDDER from the BUYER in connection with any other contract for any other stores, such outstanding payment could also be utilized to recover the aforesaid sum and interest.
- (v) To encash the advance bank guarantee and performance bond/warranty bond, if furnished by the BIDDER, in order to recover the payments, already made by the BUYER, along with interest.
- (vi) To cancel all or any other Contracts with the BIDDER. The BIDDER shall be liable to pay compensation for any loss or damage to the BUYER resulting from such cancellation/rescission and the BUYER shall be entitled to deduct the amount so payable from the money(s) due to the BIDDER.
- (vii) To debar the BIDDER from participating in future bidding processes of the Government of India for a minimum period of five years, which may be further extended at the discretion of the BUYER.
- (viii) To recover all sums paid in violation of this Pact by BIDDER(s) to any middleman or agent or broker with a view to securing the contract.
- (ix) In cases where irrevocable Letters of Credit have been received in respect of any contract signed by the BUYER with the BIDDER, the same shall not be opened.
- (X) Forfeiture of Performance Bond in case of a decision by the BUYER to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

6.2 The BUYER will be entitled to take all or any of the actions mentioned at para 6.1(i) to (x) of this Pact also

on the Commission by the BIDDER or anyone employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER), of an offence as defined in Chapter IX of the Indian Penal code, 1860 or Prevention of Corruption Act, 1988 or any other statute enacted for prevention of corruption.

6.3 The decision of the BUYER to the effect that a breach of the provisions of this Pact has been committed by the BIDDER shall be final and conclusive on the BIDDER. However, the BIDDER can approach the Independent Monitor(s) appointed for the purposes of this Pact.

7. Fall Clause

7.1 The BIDDER undertakes that it has not supplied/is not supplying similar product/systems or subsystems at a price lower than that offered in the present bid in respect of any other Ministry/Department of the Government of India or PSU and if it is found at any stage that similar product/systems or sub systems was supplied by the BIDDER to any other Ministry/Department of the Government of India or a PSU at a lower price, then that very price, with due allowance for elapsed time, will be applicable to the present case and the difference in the cost would be refunded by the BIDDER to the BUYER, if the contract has already been concluded.

8. Independent Monitors

8.1 The BUYER has appointed Independent Monitors (hereinafter referred to as Monitors) for this Pact in consultation with the Central Vigilance to as Monitors) for this Pact in consultation with the Central Vigilance Commission (Names and Addresses of the Monitors to be given).

8.2 The task of the Monitors shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this Pact.

8.3 The Monitors shall not be subject to instructions by the representatives of the parties and perform their functions neutrally and independently.

8.4 Both the parties accept that the Monitors have the right to access all the documents relating to the project/procurement, including minutes of meetings.

8.5 As soon as the Monitor notices, or has reason to believe, a violation of this Pact, he will so inform the Authority designated by the BUYER.

8.6 The BIDDER(s) accepts that the Monitor has the right to access without restriction to all Project documentation of the BUYER including that provided by the BIDDER. The BIDDER will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor shall be under contractual obligation to treat the information and documents of the BIDDER/Subcontractor(s) with confidentiality.

8.7 The BUYER will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the parties.

The parties will offer to the Monitor the option to participate in such meetings.

8.8 The Monitor will submit a written report to the designated Authority of BUYER/Secretary in the Department/ within 8 to 10 weeks from the date of reference or intimation to him by the BUYER / BIDDER and, should the occasion arise, submit proposals for correcting problematic situations.

9. Facilitation of Investigation

In case of any allegation of violation of any provisions of this Pact or payment of commission, the BUYER or its agencies shall be entitled to examine all the documents including the Books of Accounts of the BIDDER and the BIDDER shall provide necessary information and documents in English and shall extend all possible help for the purpose of such examination.

10. Law and Place of Jurisdiction

This Pact is subject to Indian Law. The place of performance and jurisdiction is the seat of the BUYER.

11. Other Legal Actions

The actions stipulated in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings

12. Validity

12.1 The validity of this Integrity Pact shall be from date of its signing and extend upto 5 years or the complete execution of the contract to the satisfaction of both the BUYER and the BIDDER/Seller, including warranty period, whichever is later. In case BIDDER is unsuccessful, this Integrity Pact shall expire after six months from the date of the signing of the contract.

12.2 Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact shall remain valid. In this case, the parties will strive to come to an agreement to their original intentions.

13. The parties hereby sign this Integrity Pact aton.....

BUYER
Name of the Officer
Designation
Deptt./PSU

BIDDER
CHIEF EXECUTIVE OFFICER

Witness
1.....
2.....

Witness
2.....
3.....

* Provisions of these clauses would need to be amended/ deleted in line with the policy of the BUYER in regard to involvement of Indian agents of foreign suppliers

Attachment-15

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Option for Initial Advance (either Interest Bearing Initial Advance or No Initial Advance) and Information for E-payment, PF details and declaration regarding Micro/Small & Medium Enterprises)

Bidder's Name and Address: To: XXXXX (Name and Address of Employer)

Dear Sir,

I. We have read the provisions in the Bidding Documents regarding furnishing the option for advance payment. Accordingly, as per ITB Clause 9.3 as provided in Section BDS, Section III, Vol.-I of the Bidding Documents, we hereby confirm to opt the following:

Interest Bearing Initial Advance

Supply Portion : Yes* [] No* []

Installation Portion : Yes^ [] No^ []

(*^ tick ONLY ONE of the selected options)

II. We are furnishing the following details of Statutory Registration Numbers and details of Bank for electronic payment.

1.	Name of the Supplier/ Contractor in whose favour payment is to be made	
2.	Address with PIN Code and State	Registered Office: Branch Office: Correspondence Address:

3.	Status – Company/others [Declaration of Micro/ Small/ Medium Enterprise under Micro/ Small & Medium Enterprises Development Act 2006, if applicable]	
4.	Permanent Account (PAN) No.	
5.	Central Sales Tax (CST) No.	
6.	State Sales Tax No.	
7.	Work Contract Tax No.	
8.	Service Tax Registration No.	
9.	PF Registration No. of the Company	
10.	PF Regional Office covered (with Address)	
11.	Name of Contact Person	
12.	Telephone No(s). Email	Landline(s): Mobile(s): Email ID :
13.	Bank Details for Electronic Payment	Name of the Bank: Address of Branch: Account No.: Type of Account: [] Saving [] Current
14.	9 digit MICR code printed at bottom in middle, next to cheque no.	

15.	IFSC (for RTGS)/NEFT Code (to be obtained from the Bank) Sample Cancelled Cheque to be enclosed	

We hereby declare that the above information is true and correct and we agree that the payment on account of this Contract, in the event of award, be made in the above account maintained in the above mentioned Bank.

Date:.....

(Signature).....

Place:.....

(Printed Name).....

(Designation).....

(Common Seal).....

Attachment-16

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Additional Information)

Bidder's Name and Address: To: XXXXX (Name and Address of Employer)

Dear Sir,

In support of the additional information required as per ITB Sub-Clause 9.3 (p) of the Bidding Documents, we furnish herewith our data/details/documents etc., alongwith other information, as follows (the stipulations have been reproduced in italics for ready reference):

1.0 The Bidder shall furnish

A certificate from their Banker(s) (as per prescribed formats in Form 16, Volume-I:Section-VI: Sample Forms and Procedures) indicating various fund based/non fund based limits sanctioned to the Bidder and the extent of utilization as on date. Such certificate should have been issued not earlier than three months prior to the date of bid opening. Wherever necessary the Employer may make queries with the Bidders' Bankers.[Reference ITB clause 9.3(p)(i)]

1.1 In accordance with 1.0, certificate(s) from banker as per requisite format, indicating various fund based/non fund based limits sanctioned to the bidder or each member of the joint venture and the extent of utilization as on date is/are enclosed, as per the following details:

Name of the Bidder/partner of Joint Venture	
Name of the Banker by whom certificate issued	
Date of certificate (should not be earlier than 3 months prior to date of bid opening)	
Whether fund based/non fund based limits are indicated in the certificate	
Whether extent of utilization is indicated in the certificate	

1.2 The Bidder should accordingly also provide the following information/documents (In case of JV bidders, information should be provided separately for all the Partners of JV in the given format):

(i) Details of Banker:

Name of Banker	
Address of Banker	_____ _____ _____
Telephone No.	_____
Contact Name and Title	_____
Fax No.	_____
E-mail ID	_____

(ii) As per para 1.0, Authorization Letter(s) from the bidder (in case of JV bidder, from all the partners) addressed to the Banker(s), authorizing XXXXX (Name of Employer) to seek queries about the bidder with the Banker(s) and advising the Banker(s) to reply the same promptly, is/are enclosed as per following details:

Sl. No.	Letter Ref.	Date	Addressed to (name of the Bank)

2.0 Litigation History

The bidder should provide detailed information on any litigation or arbitration arising out of contracts completed or under execution by it over the last five years. A consistent history of awards involving litigation against the Bidder or any partner of JV may result in rejection of Bid. [Reference ITB clause 9.3(p)(ii)]

2.1 Details of litigation history resulting from Contracts completed or under execution by the bidder over the last five years

Year	Name of client, cause of litigation/arbitration and matter in dispute	Details of Contract and date	Award for or against the bidder	Disputed amount

3.0 OTHER INFORMATION

3.1 Current Contract Commitments of works in progress

Bidders (individual firms or each partners of 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.

Details of Contract	Value of outstanding work (Rs.)	Estimated completion date

3.2 Financial Data :

(In Rs. Millions)

	Actual					Projection for next five years				
	(previous five years)					years				
1. Total Assets										
2. Current Assets										
3. Total Liability										
4. Current Liability										
5. Profit before taxes										
6. Profit after taxes										

4. The information/documentation in support of Bidder's design infrastructure and erection facilities and capacity and procedures including quality control related to the work, are enclosed at _____ herewith.
5. The CV and experience details of a project manager with 15 years experience in executing such contract of comparable nature including not less than five years as manager and the CVs of other employees to be deputed for the subject work, are enclosed at ____ herewith.

Date:.....

(Signature)

Place:.....

(Printed Name)

(Designation)

(Common Seal)

Attachment- 17

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Declaration for tax exemptions, reductions, allowances or benefits)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

Dear Sirs,

1. We confirm that we are solely responsible for obtaining following tax exemptions, reductions, allowances or benefits in respect of supplies under the subject Project, in case of award. We further confirm that we have considered the same in our bid thereby passing on the benefit to XXXXX (Name of Employer) while quoting our prices. In case of our failure to receive such benefits, partly or fully, for any reason whatsoever, the Employer will not compensate us.
2. We are furnishing the following information required by the Employer for issue of requisite certificate if and as permitted in terms of the applicable Govt. of India policies/procedures(in case of award):

Applicable Notification Clause Ref. No.	Act, No. and	Sl. No.	Description of item on which applicable	Country of origin	Remarks, if any

(The requirements listed above are as per current Notification of Govt. of India indicated above. These may be modified, if necessary, in terms of the Notifications.)

Date:.....

Signature).....

Place:.....

(Printed Name).....

(Designation).....

(Common Seal).....

Attachment-18

Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Declaration)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

Dear Sir,

We confirm that Bid Form have been filled up by us as per the provisions of the Instruction to Bidders. We have also uploaded price bid electronically as per the provisions of the Instruction to Bidders. Further, we have noted that the same shall be evaluated as per the provisions of the Bidding Documents.

Further, we hereby confirm that except as mentioned in the Attachment – 6 (Alternative, Deviations and Exceptions to the Provisions) hereof and/or the Covering Letter, forming part of our Bid Envelope:

- (i) there are no discrepancies/inconsistencies and deviations/omissions/ reservations to the Bidding Documents, in the price bid;
- (ii) the description of items and the unit thereof in the price schedules are in conformity with those indicated in the price schedule of the Bidding Documents without any deviation to the specified scope of work.

We also confirm that in case any discrepancies/ inconsistencies and deviations/ omissions/ reservations, as referred to in para (i) and (ii) above, is observed in the online price bid, the same shall be deemed as withdrawn/rectified without any financial implication, whatsoever to XXXXX (Name of Employer). However, in case of any arithmetical errors, the same shall be governed as per the provision of ITB Sub-Clause 27.2 read in conjunction with BDS.

Date:.....

(Signature).....

Place:.....

(Printed Name).....

(Designation).....

(Common Seal).....

Attachment-19

Rural Electrification works of XXXXXXXX (name of district) district in XXXXX (Name of State) under Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) /Integrated Power Development Scheme (IPDS)

(Bank Guarantee verification Check list)

Bidder's Name and Address:

To: XXXXX (Name and Address of Employer)

S. No.	Checklist	Yes	No
1	Does the bank guarantee compare verbatim with standard proforma for BG?		
2(a)	Has the executing Officer of BG indicated his name designation & Power of Attorney No. / Signing power Number etc. on BG?		
2(b)	Is each page of BG duly Signed/ initialed by the executants and last page is signed with full particulars as required in the standard proforma of BG and under the seal of the bank?		
2(c)	Does the last page of the BG carry the signatures of two witnesses alongside the signature of the executing Bank Manager?		
3(a)	Is the BG on non-judicial stamp paper of appropriate value?		
3(b)	Is the date of sale of non-judicial stamp paper shown on the BG and the stamp paper is issued not more than Six months prior to the date of execution of BG?		
4(a)	Are the factual details such as Bid specification No., LOA No. contract price, etc, correct?		
4(b)	Whether Overwriting /cutting, if any on the BG, authenticated under signature & seal of executants?		
5	Is the amount and validity of BG is inline with contract provisions?		
6	Whether the BG has been issued by a Nationalized bank / Non-Nationalized Bank acceptable to Buyer /Scheduled Bank in India (the applicability of the bank should be in line with the provisions of bidding documents)?		

Date:.....

(Signature).....

Place:.....

(Printed Name).....

(Designation).....

(Common Seal).....

VOLUME-II: SECTION – III

Price Schedules

Price Schedule-1: Ex-works Supply of Materials

Price Schedule-2: Local Transportation, Insurance
and other incidental services

Price Schedule-3: Installation/Erection Charges

Price Schedule-4: Summary of Taxes and Duties

Price Schedule-5: Grand Summary

Ex-works supply of materials

Schedule-1 (6/8)

Rural Electrification works in XXXX (Name of Project) Project in XXXX (Name of State) under DDUGJY
(Schedule of rates and prices)

Ex-works supply of materials

Bidder's Name & Address:

All prices in Indian Rupees

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
F(1)	Augmentation & Renovation of 11/0.4 kV Distribution Transformer Substation					
1.00	Augmentation of Distribution Transformer Substation (ASSUMING 25 YEARS OF LIFE AND 10 YEARS IN SERVICE) using New Distribution Transformer (three star) as per technical specifications, approved drawings and scope of the work. Replaced material to be deposited in Employer's store:					
1.01	New 63 KVA (11/0.4 kV) Aluminium wound DTR (Replacing 25KVA old DTR),	No				
1.02	New 100 KVA (11/0.4 kV) Aluminium wound DTR (Replacing 63 KVA old DTR),	No				
1.03	New 200 KVA (11/0.4 kV) Aluminium wound DTR (Replacing 100 KVA old DTR),	No				
1.04	New 315 KVA (11/0.4 kV) Copper wound DTR (Replacing 200 KVA old DTR),	No				
2.00	Augmentation of DTR Substation by using new 1.1 KV XLPE Aluminium Conductor, Stranded, unarmoured cable for connection of transformer LV bushing to Distribution Box and Distribution box to overhead line as per Scope of work, technical specification and approved drawings. Replaced cables to be deposited in Employer's store.					
2.01	1Cx16 sqmm aluminium conductor cable	km				
2.02	1CX35 sqmm aluminium conductor cable	km				
2.03	1CX50 sqmm aluminium conductor cable	km				
2.04	1Cx70 sqmm aluminium conductor cable	km				
2.05	1Cx150 sqmm aluminium conductor cable	km				
2.06	1Cx300 sqmm aluminium conductor cable	km				
3.00	Augmentation of DTR Substation by using new outdoor mounting type Distribution box made of MS sheet of thickness not less than 1.8 mm, dust and moisture vermin, weather proof with degree of protection IP 33 as per IS 13947 with suitable bus bars, earthing bus, earthing terminals, box illumination, front door operated with proper locking arrangement, non magnetic 4 mm thick gland plate, double compression brass cable glands, lugs, mounting channel frame, internal wiring with FRLS cables, danger plate, numbering, back clamps, hardware as per scope of the work, technical specifications and approved drawings suitable for following transformer:					
3.01	1 Ph 10 KVA transformer 45 A SPN MCCB (incomer) and 2 Nos. 32 A SP MCCB (outgoing) with metering	No				
3.02	1 Ph 16 KVA transformer 80 A SPN MCCB (incomer) and 2 Nos. 50 A SP MCCB (outgoing) with metering	No				

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
3.03	3 Ph 16 KVA transformer 25 A TPN MCCB (incomer) and 6 Nos. 16 A SP MCCB (outgoing) with metering	No				
3.04	3 Ph 25 KVA transformer 40 A TPN MCCB (incomer) and 6 Nos. 25 A SP MCCB (outgoing) with metering	No				
3.05	3 Ph 63 KVA Transformer having 200 A TPN isolator, 100 A HRC fuse (incomer) and 6 Nos. 60 A SP MCCB (outgoing)	No				
3.06	3 Ph 100 KVA Transformer having 200 A TPN isolator, 160A HRC fuse (incomer) and 6 Nos. 90 A SP MCCB (outgoing)	No				
3.07	3 Ph 200 KVA Transformer having 600 A TPN isolator, 315 A HRC fuse (incomer) and 9 Nos. 120 A SP MCCB (outgoing)	No				
3.08	3 Ph 315 KVA Transformer having 600 A TPN isolator, 500 A HRC fuse (incomer) and 12 Nos. 120 A SP MCCB (outgoing)	No				
4.00	Renovation of DTR substation Earthing as per technical specification, approved drawings and scope of work:					
4.01	Revamping of Distribution Transformer substation earthing by using 40 mm dia 3 meter long GI pipe earthing, using 50x6 mm GS flat for earth mat and riser and 25x3mm GS flat for connecting equipment, using 200 kg bentonite powder of substation in normal soil	No				
4.02	Revamping of Distribution Transformer substation earthing by using 3 Nos. chemical rod earthing including electrode & chemical, 50x6 mm GS flat for earth mat and riser and 25x3mm GS flat for connecting equipment in hard rock soil	No				
5.00	Augmentation of DTR substation by new Pre-fabricated steel items like DC cross arm (100x50x6 mm), back clamps (65x8 mm), pole clamp (65x8 mm), DO mounting channel (100x50x6 mm), transformer mounting channel (100x50x6 mm), transformer clamping set (50x50x6 mm), transformer belting set (50x50x6 mm) as per technical specification, approved drawings and scope of work.	MT				
6.00	Augmentation of DTR substation by new MS Nuts, Bolts with Washers as per technical specification, approved drawings and scope of work.	MT				
7.00	Augmentation of DTR substation by new Polymer/ Porcelain Insulators with hardware fittings, hardware etc as required as per technical specification, approved drawings and scope of work.					
7.01	11 KV, Disc Insulator with suitable hardware fittings	Set				
7.02	11 KV, Post Insulators / Pin Insulators with hardware fittings	Set				
8.00	Augmentation of DTR substation by new 9KV, 11 KA Distribution Class Lightning Arrester for DT as per technical specification, approved drawings and scope of work.	Set				

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
9.00	Augmentation of DTR substation by new 11 kV, 3-ph, 200 A, 3 Pin type, Vertical Mounting type, Gang Operated, AB Switch along with Support Insulators, Base Channel, down Pipe, Arcing Horns etc. complete as per technical specifications, scope of works and approved drawings	Sets				
10.00	11kV, 200 A, 3-ph Drop Out fuse assembly including insulators and mounting arrangements, jumpering from bus bar, hardware, etc as required as per technical specifications, approved drawings and scope of the works	Set				
F(11) Augmentation of 33 KV lines						
1.00	Augmentation of 3 phase 33 kV line using additional supports matching with length and type of existing support as per technical specifications, scope of works and approved drawings					
1.01	9.1 meter long /280 KG PCC Poles (PCC Pole as per state practice)	No				
1.02	13 m long H-Beam 152x152 mm 37.1 kg/m	No				
1.03	11 M long steel Tubular poles with welded steel base plate of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)	No				
1.04	13 M long steel Tubular poles with welded steel base plate of Designation 540 SP 72 (IS 2713, Pt I, II, III 1980)	No				
2.00	Augmentation of 3 phase 33 kV line using new Pre-fabricated steel items like V cross arm, top clamp, DC cross arm, bracket, clamps, cross bracings, bracings, strain plate, guarding channels, back clamp, transformer mounting structure etc made of MS Channels (100x50x6mm), MS angle (65x65x6mm), MS flats (65x8mm) of given sizes for over head structures as per technical specification, approved drawings and scope of work.	MT				
3.00	Augmentation of 3 phase 33 kV line replacing existing conductor with following type of new ACSR conductor including jointing sleeves, binding material and helical formed fittings etc as required as per technical specification approved drawings and scope of work					
3.01	6/4.72 mm+7/1.57 mm (100 mm ² Al. Area) - Dog replacing existing racoon conductor	km				
3.02	6/4.09 + 1/4.09 mm (80 mm ² Al. Area) - Raccoon replacing existing rabbit/weasel conductor	km				
3.03	30/3.00 + 7/3.00 mm (200 mm ² Al. Area) - Panther replacing existing dog/raccoon conductor	km				
4.00	Augmentation of 3 phase 33 kV line using new Insulator and hardware as per technical specification, approved drawings and scope of work					
4.01	33 KV polymer/porcelain Disc insulator 45 KN along with suitable hardware fittings	Set				
4.02	33 KV Polymer /porcelain Pin Insulators 10 KN with GI PIN	Set				
5.00	Augmentation of 3 phase 33 kV line using new Earthing arrangement as per technical specifications, approved drawings and scope of work.					
5.01	40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories complete	Set				
5.02	GI Earthing spike made of 20mm solid Rod	Set				

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
5.03	Chemical rod earthing including electrode, chemical, with 2000mm long, 50 mm diameter GI pipe, GI Strip of 24x3mm minimum in hard rock locations only.	Set				
5.04	8 SWG GI Coil 115 tonnes (1.85 kg)	No				
6.00	Augmentation of 3 phase 33 kV line using new Stay Set (Galvanised) with 50x8 mm stay clamp, guy insulator, anchor plate (300x300x8mm) , nut bolts, 2 Nos turn-buckles, 1.8 m long, 20 mm diameter solid GS stay rod & 7/4.00 mm dia GI stranded wire complete as per technical specification, approved drawings and scope of work.	Set				
7.00	Augmentation of 3 phase 33 kV line using new 33kV, 600A, 25kA, 3-ph, 3 Pin type, Horizontal/Vertical Mounting type (as desired by DISCOM), Gang Operated, AB Switch along with Support Insulators, Base Channel down Pipe, Arcing Horns etc. complete as per technical specifications, scope of works and approved drawings.	Set				
8.00	Augmentation of 3 phase 33 kV line using new GI wire for earthing and guarding as per technical specification, approved drawings and scope of work.					
8.01	6 SWG	MT				
8.02	8 SWG	MT				
F(III) Augmentation of 11 KV lines						
1.00	Augmentation of 3 phase 11 kV line using additional supports matching with length and type of existing support as per technical specifications, scope of works and approved drawings					
1.01	8 meter long /140 KG PCC Poles (PCC Pole as per state practice)	No				
1.02	13 m long H-Beam 152x152 mm 37.1 kg/m	No				
1.03	11 M long steel Tubular poles with welded steel base plate of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)	No				
1.04	13 M long steel Tubular poles with welded steel base plate of Designation 540 SP 72 (IS 2713, Pt I, II, III 1980)	No				
2.00	Augmentation of 3 phase 11 kV line using new Pre-fabricated steel items like V cross arm, top clamp, DC cross arm, bracket, clamps, cross bracings, bracings, strain plate, guarding channels, back clamp, transformer mounting structure etc made of MS Channels, MS angle, MS flats of given sizes for over head structures as per technical specification, approved drawings and scope of work.	MT				
3.00	Augmentation of 3 phase 11 kV line replacing existing conductor with following type of new ACSR conductor including jointing sleeves, binding material and helicon formed fittings etc as required as per technical specification, approved drawings and scope of work.					
3.01	6/3.35 + 1/3.35 mm (50 mm ² Al. Area) - Rabbit by replacing existing weasel/squirrel conductor	km				
3.02	6/4.09 + 1/4.09 mm (80 mm ² Al. Area) - Raccoon by replacing existing rabbit/weasel/squirrel conductor	km				
3.03	6/4.72 mm+7/1.57 mm (100 mm ² Al. Area) - Dog by replacing existing racoon/rabbit conductor	km				

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
4.00	Augmentation of 3 phase 11 kV line using new Insulator and hardware as per technical specification, approved drawings and scope of work					
4.01	11 KV polymer/porcelain Disc insulator 45 KN along with suitable hardware fittings	Set				
4.02	11 KV Polymer /porcelain Pin Insulators 10 KN with GI PIN	Set				
5.00	Augmentation of 3 phase 11 kV line using new Earthing arrangement as per technical specifications, approved drawings and scope of work					
5.01	40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories complete	Set				
5.02	GI Earthing spike made of 20mm solid Rod	Set				
5.03	Chemical rod earthing including electrode, chemical, with 2000mm long, 50 mm diameter GI pipe, GI Strip of 24x3mm minimum in hard rock locations only.	Set				
5.04	8 SWG GI Coil 115 tonnes (1.85 kg)	No				
6.00	Augmentation of 3 phase 11 kV line using new Stay Set (Galvanised) with 50x8 mm stay clamp, guy insulator, anchor plate (200x200x6mm) , nut bolts, 2 Nos turn-buckles, 1.8 m long, 16 mm diameter solid GI stay rod & 7/3.15 mm dia GI stranded wire complete as per technical specification, approved drawings and scope of work	Set				
7.00	Augmentation of 3 phase 11 kV line using new 11kV, 600A, 25kA, 3-ph, 3 Pin type, Horizontal/Vertical Mounting type (as desired by DISCOM), Gang Operated, AB Switch along with Support Insulators, Base Channel down Pipe, Arcing Horns etc. complete as per technical specifications, scope of works and approved drawings	Set				
8.00	Augmentation of 3 phase 11 kV line using new GI wire for earthing and guarding as per technical specification, approved drawings and scope of work.					
8.01	6 SWG	MT				
8.02	8 SWG	MT				
F(IV)	Conversion of existing LT lines on bare conductor to Areal bunch XLPE cable					
1.00	Conversion of existing LT lines with bare conductor to AB XLPE cable using additional supports matching with length and type of existing support as per technical specifications, scope of works and approved drawings					
1.01	8 m/140 kgs PCC Poles (PCC Pole as per state practice)	No				
1.02	13 m long H-Beam 152x152 mm, 37.1kg/mtr	No				
1.03	11 m long H-Beam 152x152 mm, 37.1kg/mtr	No				
1.04	11 M long Steel Tubular poles with welded steel base plate of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)	No				
1.05	9 M long Steel Tubular poles with welded steel base plate of Designation 540 SP 28 (IS 2713, Pt I, II, III 1980)	No				

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
2.00	Conversion of existing LT lines using new Galvanised Stay Set with anchor plate (200x200x6mm), 50x8mm stay clamp, Stay guy insulator, nut bolts, 2 Nos turn buckles, 1.8 m long, 16 mm diameter solid GS Stay rod & 7/3.15 mm Dia GI stranded wire etc as required as per technical specification, approved drawings and scope of work.	Set				
3.00	Conversion of existing LT lines using new Earthing as per approved drawings, technical specifications and scope of work					
3.01	Spike Earthing made of 20mm GI solid Rod	Set				
3.02	8 SWG GI wire for earthing and guarding	Set				
4.00	Conversion of existing LT bare conductor line with following arrangements using new areal bunched XLPE cable, tension clamps for dead end, suspension clamps, clamps for neutral, piercing connectors type-I & type-II, 16 mm dia MS nuts & bolts, pole clamps, spring loaded bus bar suitable for single phase and three phase systems etc. as required as per technical specification, approved drawings and scope of work:					
4.01	AERIAL BUNCHED XLPE CABLE 3 X 50 SQ.MM.+1x35 SQ. MM.+1x16 SQ. MM.	Km				
4.02	AERIAL BUNCHED XLPE CABLE 3 X 35 SQ.MM.+1x35 SQ. MM.+1x16 SQ. MM.	Km				
4.03	AERIAL BUNCHED XLPE CABLE 3 X 25 SQ.MM.+1x35 SQ. MM.+ 1x16 SQ. MM.	Km				
4.04	AERIAL BUNCHED XLPE CABLE 3 X 16 SQ.MM. + 1x16 SQ. MM. +1x25 SQ. MM.	Km				
4.05	AERIAL BUNCHED XLPE CABLE 2 X 35 SQ.MM. + 1x16 SQ. MM.	Km				
4.06	AERIAL BUNCHED XLPE CABLE 2 X 25 SQ.MM. + 1x16 SQ. MM.	Km				
F (V) Augmentation of 33/11 KV Fully outdoor type substation						
1.00	33/11 kV, 3 ph, 50 Hz, ONAN, Cu Wound, Outdoor Conventional type Power Transformer along with transformer oil, Buchholtz relay, breather, OTI & WTI, Marshalling Box, Conservator tank, oil level indicator, valves, 2 sets of 50x8 mm GS Neutral Earthing strips {(with braided conductor on bushing end), isolating link, isolation with insulators}, Vent explosion plug, control wiring between sensing equipment and marshalling box, cable supporting tray on the body of transformer, transformer wheels, LV/HV bushing etc as required as per technical specifications, approved drawings and scope of the work.					
1.01	1.60 MVA without tap changer	No				
1.02	3.15 MVA without tap changer	No				
1.03	5.00 MVA with off load tap changer	No				
1.04	8.00 MVA with off load tap changer	No				
1.05	10.0 MVA with off load tap changer	No				
	Gantry structures made of H-Beam 152x152 mm 37.1 kg 8 meter long, double MS Channel 100x50mm for bus bar supports (Beam), 65x65x6mm angle for cross arms/supporting structures and 50x8mm flats for clamps along with hardware items duly painted etc. as per technical specifications, approved drawings and scope of works	MT				
	OR					

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
2.00	Gantry structures made of Lattice structures of equal angles sections, flat as per approved drawings. State practices are to be adopted in the design. All structural steel members and bolts shall be galvanized after fabrication as per IS:4759 and zinc coating shall not be less than 610gm/sq. meter for all structural steel members. All L45x45x5 will have 23 mm back mark. All L50x50x6 will have 28mm back mark. 3.5mm spring washers are to be used under each nut, structural steel shall conform to IS 2026. All weld shall be 6mm filled weld unless specified otherwise. All nuts and bolts shall be of property class 5.6 of IS 1367. Plain washers shall be as per IS 2016 & spring washers shall be IS: 3063 as per technical specifications, approved drawings and scope of works. .	MT				
3.00	36kV, 1250A, 25kA for 3 seconds, 3-ph, Outdoor type Vacuum Circuit breaker along with 36kV, 1-Phase, 25kA/3 seconds, 200-100/5-5 Amps or 300-150/5-5 Amps 3 Nos outdoor type Current Transformers along with junction box (1 no junction box for 3 no of 1-phase CTs), Jumpers, earthing, supporting structures, bi-metallic clamps, permanent maintenance platform, marshalling box etc required as per technical specifications, scope of works and approved drawings	No				
4.00	33kV, Indoor, Control & Relay panel along with E/F & O/C relays, Mimic Diagram, Voltmeter, Ammeter, Annunciation Windows with annunciation relays and other components etc as per approved drawings, specifications and scope of works controlling:					
4.01	33 kV feeder VCB with Static Tri-Vector Energy Meter	No				
4.02	Power transformer 33 kV VCB with Static Tri-Vector Energy Meter	No				
5.00	36kV, 630A, 25kA for 3 seconds, 3-ph double break center rotating type (DBCR), Gang Operated, isolator along with Support Insulators, Operating Mechanism, Base Channel down Pipe and all required accessories complete as per technical specifications, scope of works and approved drawings	Set				
6.00	30 kV, 10kA, 1-ph Station Class Lightning Arrester with mounting platform, jumpering from bus bar, earthing connection using 50x6mm GS flat, hardware etc as required as per technical specifications, approved drawings and scope of the works	No.				
7.00	9kV, 10kA, 1-ph Station Class Lightning Arrester with mounting platform, jumpering from bus bar, earthing connection using 50x6mm GS flat, hardware, etc as required as per technical specifications, approved drawings and scope of the works	No.				
8.00	12 kV, 1250 A, 25kA for 3 seconds, 3-ph, Outdoor type Vacuum Circuit breaker along with 12 kV, 1-Phase, 600-300/5-5 or 300-150/5-5 or 200-100/5-5 3 Nos outdoor type Current Transformer along with junction box (1 no junction box for 3 no of 1-phase CTs), Jumpers, earthing, supporting structures, bi-metallic clamps, permanent maintenance platform, marshalling box, control cabling between VCB and indoor control panel and required accessories complete as per technical specifications, approved drawings and scope of the works.	No				

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
9.00	Indoor type control and relay panel as per technical specifications, approved drawings and scope of works:					
9.01	Indoor type control and relay panel for 11kV, 3phase, 1250 A VCB (Transformer Breaker) consisting of A-meter, volt-meter, Relays & accessories complete as per specifications for transformer breaker protection	No.				
9.02	Indoor type control and relay panel for 11 KV 3 phase, 1250 A VCB (Feeder Breakers) consisting of A-meter, volt-meter, Relays, energy meter (TVM) & accessories complete as per specifications for feeder breaker protection	No.				
10.00	24V, 80 AH (or as per State practice) Ni-Cd or Pb Acid battery, battery stand made of teak wood duly painted with anti rusting paint, battery insulators, inter-battery wiring using 30 sqmm, 1.1 kv, copper single core multi strand cable, terminal connectors, & all other accessories and connectors as per technical specifications, approved drawings and scope of works.	Set				
11.00	24V, 40 Amp. (or as per State practice) Float-cum-Boost Battery Charger with full wave rectification for 230 V, 1 phase, 50 Hz AC Input Supply as per technical specifications, approved drawings and scope of works.	set				
12.00	415 V, ACDB along with three phase-neutral voltmeter, three phase ammeter and Selector switches, 200 Amps TPN switch fuse unit as incomer, 32 Amps TPN switches as outgoing feeders suited for number of control panels, nos of VCB kiosk panel, having 20% spare outgoing feeders, mounting arrangements etc as per technical specifications, approved drawings and scope of works.	No				
13.00	24 Volts (or voltage as per state practices) Direct Current Distribution Board (DCDB) Indoor floor mounted comprising of 2P/100A DC Switch Fuse Unit as incomer and 2P/40A switch fuse units for each individual outgoing circuit of indoor control panels, indoor/outdoor VCB panels, control room emergency DC lighting including 20% as spare as per technical specifications, approved drawings and scope of works.	Set				
14.00	ACSR Conductor for Bus-Bars & Jumpers/Droppers/Terminations including hardware fittings, hardware, T-clamp etc as per technical specifications, approved drawings and scope of works					
14.01	6/4.72 mm+7/1.57 mm (100 mm ² Al. Area) - Dog	km				
14.02	30/3.00 + 7/3.00 mm (200 mm ² Al. Area) - Panther	km				
15.00	Earthing & Grounding conductor as per Approved Electrical Layout for each sub-station as per technical specifications, approved drawings and scope of works with					
15.01	75 x 8 mm GI flat for ground mat	MT				
15.02	50 x 6 mm Galvanized GI flat (risers)	MT				
15.03	25 x 3 mm Galvanized GI flat (risers)	MT				

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
15.04	25mm dia GI rod 3 m long for earth mat	MT				
16.00	40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover, placed on GI frame, bantonide powder and other accessories complete as per technical specification. (for Power Transformer Neutral, Station Transformer Neutral and Lightening Arresters direct earthing) as per technical specifications, approved drawings and scope of works.	Set				
17.00	33 and 11 KV Insulator - Pin, Post and Disc insulators along with suitable hardware & accessories suitable for Panther/Dog conductors as per approved drawings & specifications.	Set				
18.00	LT Control cables including their termination materials like glands, lugs etc. as per technical specifications, approved drawings and scope of the work.					
18.01	2 Core 2.5 sqmm armoured, stranded copper conductor, PVC insulated and PVC sheathed cable	km				
18.02	6 Core 2.5 sqmm armoured, stranded copper conductor, PVC insulated and PVC sheathed cable	km				
18.03	10 Core 2.5 sqmm armoured, stranded copper conductor, PVC insulated and PVC sheathed cable	km				
19.00	12 kV, 800A, 25kA for 3 seconds, 3-ph double break centre rotating type (DBCR), Gang Operated Isolator along with Support Insulators, Operating Mechanism, Base Channel, down Pipe and all required accessories complete as per technical specifications, scope of works and approved drawings	Set				
20.00	12kV, 600A, 25kA for 3 sec, 3-Phase, 3 Pin type, Vertical Mounting type, Gang Operated, AB Switch, along with support insulators, Base Channel, down pipe, Arching Horns etc. and all complete accessories as per technical specifications, scope of works and approved drawings	Set				
21.00	36 kV, 3-pole, 1-Phase, 33kV/110 volt, Single core outdoor type Potential Transformer along with junction box (1 no junction box for 3 no of 1-phase PTs) including earthing connection using 50x6mm GS flat, bi-metallic clamp and required accessories etc., complete as per technical specifications, approved drawings and scope of the works	Set				
22.00	12 kV, 3-pole, 1-Phase, 11kV/110 volt, Single core outdoor type Potential Transformer along with junction box (1 no junction box for 3 no of 1-phase PTs) including earthing connection using 50x6mm GS flat, bi-metallic clamp and required accessories etc., complete as per technical specifications, approved drawings and scope of the works	set				
F (VI)	Augmentation of 33/11 KV Partly outdoor type substation					

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
1.00	33/11 kV, 3 ph, 50 Hz, ONAN, Cu Wound, Outdoor Conventional type Power Transformer along with transformer oil, Buchholtz relay, breather, OTI & WTI, Marshalling Box, Conservator tank, oil level indicator, valves, 2 sets of 50x8 mm GS Neutral Earthing strips { (with braided conductor on bushing end), isolating link, isolation with insulators}, Vent explosion plug, control wiring between sensing equipment and marshalling box, cable supporting tray on the body of transformer, transformer wheels, LV/HV bushing etc as required as per technical specifications, approved drawings and scope of the work.					
1.01	1.60 MVA without tap changer	No				
1.02	3.15 MVA without tap changer	No				
1.03	5.00 MVA with off load tap changer	No				
1.04	8.00 MVA with off load tap changer	No				
1.05	10.0 MVA with off load tap changer	No				
	Gantry structures made of H-Beam 152x152 mm 37.1 kg 8 meter long, double MS Channel 100x50mm for bus bar supports (Beam), 65x65x6mm angle for cross arms/supporting structures and 50x8mm flats for clamps along with hardware items duly painted etc. as per technical specifications, approved drawings and scope of works.	MT				
	Or					
2.00	Gantry structures made of Lattice structures of equal angles sections, flat as per approved drawings. State practices are to be adopted in the design. All structural steel members and bolts shall be galvanized after fabrication as per IS:4759 and zinc coating shall not be less than 610gm/sq. meter for all structural steel members. All L45x45x5 will have 23 mm back mark. All L50x50x6 will have 28mm back mark. 3.5mm spring washers are to be used under each nut, structural steel shall conform to IS 2026. All weld shall be 6mm filled weld unless specified otherwise. All nuts and bolts shall be of property class 5.6 of IS 1367. Plain washers shall be as per IS 2016 & spring washers shall be IS: 3063 as per technical specifications, approved drawings and scope of works. .	MT				
3.00	36kV, 1250A, 25kA for 3 seconds, 3-ph, Outdoor type Vacuum Circuit breaker along with 36kV, 1-Phase, 25kA/3 seconds, 200-100/5-5 Amps or 300-150/5-5 Amps 3 Nos outdoor type Current Transformers along with junction box (1 no junction box for 3 no of 1-phase CTs), Jumpers, earthing, supporting structures, bi-metallic clamps, permanent maintenance platform, marshalling box etc required as per technical specifications, scope of works and approved drawings	No				
4.00	33kV, indoor, Control & Relay panel along with E/F & O/C relays, Mimic Diagram, Voltmeter, Ammeter, Annunciation Windows with annunciation relays and other components etc as per approved drawings, specifications and scope of works controlling.					
4.01	33 kV feeder VCB with Static Tri-Vector Energy Meter	No				
4.02	Power transformer 33 kV VCB with Static Tri-Vector Energy Meter	No				

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
5.00	36kV, 630A, 25kA for 3 seconds, 3-ph double break centre rotating type (DBCR), Gang Operated, isolator along with Support Insulators, Operating Mechanism, Base Channel down Pipe and all required accessories complete as per technical specifications, scope of works and approved drawings	Set				
6.00	30 kV, 10kA, 1-ph Station Class Lightning Arrester with mounting platform, jumpering from bus bar, earthing connection using 50x6mm GS flat, hardware etc as required as per technical specifications, approved drawings and scope of the works	No.				
7.00	9kV, 10kA, 1-ph Station Class Lightning Arrester with mounting platform, jumpering from bus bar, earthing connection using 50x6mm GS flat, hardware, etc as required as per technical specifications, approved drawings and scope of the works	No.				
8.00	12 kV, 1250 A, 25kA for 3 seconds, 3-ph, indoor type Vacuum Circuit breaker along with 12 kV, 1-Phase, 600-300/5-5 or 300-150/5-5 or 200-100/5-5 3 Nos indoor type Current Transformer, indoor mounting type control panel for Transformer breaker, control cabling between VCB and indoor control panel and required accessories, bi-metallic clamps, A-meter, volt-meter, Relays & accessories complete as per specifications for transformer breaker protection	No				
9.00	12 kV, 1250 A, 25kA for 3 seconds, 3-ph, indoor type Vacuum Circuit breaker along with 12 kV, 1-Phase, 300-150/5-5 or 200-100/5-5 3 Nos indoor type Current Transformer, indoor mounting type control panel for feeder protection, control cabling between VCB and indoor control panel and required accessories, bi-metallic clamps, A-meter, volt-meter, 3-phase electronic energy meter, Relay & accessories complete as per specifications for feeder breaker protection	Set				
10.00	12 kV, 1250 A, 25kA for 3 seconds, 3-ph, indoor type Vacuum Circuit breaker along with 12 kV, 1-Phase, 600-300/5-5 or 300-150/5-5 3 Nos indoor type Current Transformer, indoor mounting type control panel for bus coupler, control cabling between VCB and indoor control panel and required accessories, bi-metallic clamps, A-meter, volt-meter, 3-phase electronic energy meter, Relay & accessories complete as per specifications for bus coupler protection	Set				
11.00	24V, 80 AH (or as per state practices) Ni-Cd or Lead Acid battery, battery stand made of teak wood duly painted with anti rusting paint, battery insulators, inter-battery wiring using 30 sqmm, 1.1 kv, copper single core multi strand cable, terminal connectors, & all other accessories and connectors as per technical specifications, approved drawings and scope of works.	Set				
12.00	24V, 40 Amp. (or as per state practice) Float-cum-Boost Battery Charger with full wave rectification for 230 V, 1 phase, 50 Hz AC Input Supply with built in DCDB as per technical specifications, approved drawings and scope of works.	set				

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
13.00	415V, ACDB along with three phase-neutral voltmeter, three phase ammeter and Selector switches, 200 Amps TPN switch fuse unit as incomer, 32 Amps TPN switches as outgoing feeders suited for number of VCB-cum-control panels, nos of VCB kiosk panel, having 20% spare outgoing feeders, mounting arrangements etc as per technical specifications, approved drawings and scope of works.	No				
14.00	24 Volts (or voltage as per state practices) Direct Current Distribution Board (DCDB) Indoor floor mounted comprising of 2P/100A DC Switch Fuse Unit as incomer and 2P/40A switch fuse units for each individual outgoing circuit of indoor VCB-cum-control panels, indoor/outdoor VCB panels, control room emergency DC lighting including 20% as spare as per technical specifications, approved drawings and scope of works.	Set				
15.00	ACSR Conductor for Bus-Bars & Jumpers/Droppers/Terminations including hardware fittings, hardware, T-clamp etc as per technical specifications, approved drawings and scope of works.					
15.01	6/4.72 mm+7/1.57 mm (100 mm ² Al. Area) - Dog	km				
15.02	30/3.00 + 7/3.00 mm (200 mm ² Al. Area) - Panther	km				
16.00	Earthing & Grounding conductor as per Approved Electrical Layout for each sub-station with					
16.01	75 x 8 mm GI flat for ground mat	MT				
16.02	50 x 6 mm Galvanized GS flat (risers)	MT				
16.03	25 x 3 mm Galvanized GI flat (risers)	MT				
16.04	25mm dia GI rod 3 m long for earth mat	MT				
17.00	40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plates on GI frame, bantoxide powder and other accessories complete as per technical specification. (for Power Transformer Neutral, Station Transformer Neutral and Lightning Arresters direct earthing)	Set				
18.00	33 and 11 KV Insulator - Pin, Post and Disc insulators along with Hardware & accessories suitable for Panther/Dog conductors as per approved drawings & specifications.	Set				
19.00	LT Control cables including their termination materials like glands, lugs etc. as per technical specifications, approved drawings and scope of works.					
19.01	2 Core 2.5 sqmm armored, stranded copper conductor, PVC insulated and PVC sheathed cable	km				
19.02	6 Core 2.5 sqmm armored, stranded copper conductor, PVC insulated and PVC sheathed cable	km				
19.03	10 Core 2.5 sqmm armored, stranded copper conductor, PVC insulated and PVC sheathed cable	km				
20.00	12 kV, 400A, 25kA for 3 seconds, 3-ph double break center rotating type (DBCR), Gang Operated, isolator along with Support Insulators, Operating Mechanism, Base Channel, down Pipe and all required accessories complete as per technical specifications, scope of works and approved drawings	Set				

Ex-works supply of materials

F Augmentation, Renovation and Modernisation of existing lines and substations						
Sr. No.	Description	Unit	Qty	Unit Ex-works price	Total Ex-works price	Mode of Transaction (Direct/Bought-out items)
21.00	12kV, 600A, 25kA for 3 sec, 3-Phase, 3 Pin type, Vertical Mounting type, Gang Operated, AB Switch, along with support insulators, Base Channel, down pipe, Arching Horns etc. and all complete accessories as per technical specifications, scope of works and approved drawings	Set				
22.00	36 kV, 3-pole, 1-Phase, 33kV/110 volt, Single core outdoor type Potential Transformer including accessories etc., complete as per technical specifications, approved drawings and scope of the works.	Set				
23.00	11 KV, XLPE, 3 phase power cable armored, aluminium conductor, stranded as per technical specifications, approved drawings and scope of works.					
23.01	3Cx 300 sqmm	km				
23.02	3Cx 185sqmm	km				
23.03	3Cx35 Sqmm	km				
24.00	Cable termination kit suitable for termination in transformer cable box/ breaker panel/ outdoor 11 KV terminals complete with all accessories etc. as per technical specifications, approved drawings and scope of works					
24.01	3Cx 300 sqmm	set				
24.02	3Cx 185sqmm	set				
24.03	3Cx35 Sqmm	set				
25.00	12 kV, 3-pole, 1-Phase, 11kV/110 volt, Single core Indoor type Potential Transformer along with required accessories etc., complete as per technical specifications, approved drawings and scope of the works	Set				
F(VII)	11 KV CAPACITOR BANK INCLUDING MOUNTING STEEL GALVANISED STRUCTURE AND ACCESSORIES AS REQUIRED AS PER DETAILED TECHNICAL SPECIFICATIONS, DRAWING AND SCOPE OF WORKS IN FOLLOWING ARRANGEMENTS:					
1.00	CAPACITOR BANK 600 KVAR - FIXED TYPE SUBSTATION MOUNTED WITH CAPACITOR SWITCH AND ASSOCIATED ACCESSORIES	Set				
2.00	CAPACITOR BANK 1200 KVAR - AUTO TYPE SUBSTATION MOUNTED WITH ALL ASSOCIATED EQUIPMENT LIKE 11 KV VCB, C&R PANEL, CTs, 11 KV 200A ISOLATORS WITH EARTH SWITCH, RVT, 11 KV STATION CLASS LA, RED OXIDE / ALUMINIUM PAINTING, 2.5 SQ.MM. PVC ARMoured STRANDED COPPER CONTROL CABLES, METERING EQUIPMENT WITH ENERGY METER, PROTECTION CIRCUIT AND EQUIPMENT, EARTHING, 16 MM DIA MS NUTS & BOLTS ETC AS REQUIRED AS PER APPROVED TECHNICAL SPECIFICATIONS, DRAWING AND SCOPE OF WORKS	Set				
3.00	CAPACITOR BANK 1500 KVAR - AUTO TYPE SUBSTATION MOUNTED WITH ALL ASSOCIATED EQUIPMENT LIKE 11 KV VCB, C&R PANEL, CTs, 11 KV 200A ISOLATORS WITH EARTH SWITCH, RVT, 11 KV STATION CLASS LA, RED OXIDE / ALUMINIUM PAINTING, 2.5 SQ.MM. PVC ARMoured STRANDED COPPER CONTROL CABLES, METERING EQUIPMENT WITH ENERGY METER, PROTECTION CIRCUIT AND EQUIPMENT, EARTHING, 16 MM DIA MS NUTS & BOLTS ETC AS REQUIRED AS PER APPROVED TECHNICAL SPECIFICATIONS, DRAWING AND SCOPE OF WORKS	Set				

Local Transportation, Insurance and other Incidental Services

Schedule-1 (8/8)

Rural Electrification works in XXXX (Name of Project) Project in XXXX (Name of State) under DDUGJY
(Schedule of rates and prices)

Local Transportation, Insurance and other Incidental Services

Bidder's Name & Address:

All prices in Indian Rupees

H METERING					
Sr. No.	Description	Unit	Qty	Unit Freight & Insurance Charges	Total Freight & Insurance Charges
1.00	<u>Feeder Metering:</u>				
1.01	33 KV feeder Metering at 33/11 kV substation and intermediary points using 33 kV/110 V, 3 ph 4 wire CT ratio 400-200/5 A outdoor oil immersed type metering equipment including supporting steel fabricated structure, earthing coil, 2Cx2.5 sqmm copper control stranded unarmoured cable, 16 mm dia MS nuts & bolts, meter with MS meter box (trivector DLMS compliant category 'A' meter suitable for substation/feeder metering, 3 ph 4 W, 110 V, 5 A accuracy class 0.5s with GSM (GPRS compatible) modem, ring type lugs, terminal block, cable glands double compression brass, DC cross arm (100x50x6 mm), danger board, GI earth wire etc as per specification, approved drawing & scope of works	Set			
1.02	11 KV feeder Metering at 33/11 kV substation and intermediary points using 11 kV/110 V, 3 ph 4 wire CT ratio 400-150/5 A outdoor oil immersed metering equipment type metering including supporting steel fabricated structure, earthing coil, 2Cx2.5 sqmm copper control stranded unarmoured cable, 16 mm dia MS NUTS & bolts, meter (HT trivector DLMS compliant category A meter suitable for substation/feeder metering, 3 ph, 4 W, 110 V, 5 A, accuracy class 0.5s with GSM (GPRS compatible) modem, ring type lugs, terminal block, cable glands double compression brass, DC cross arm (100x50x6 mm), danger board, GI earth wire etc as per specification, approved drawing & scope of works	Set			
2.00	Distribution Transformer metering on LT side using ring type current transformer of suitable ratio, MS meter box, including supporting steel fabricated structure, earthing using 8 SWG GI wire, 2Cx2.5 sqmm copper control stranded unarmoured cable, 16 mm dia nuts & bolts, energy meter (3 ph 4 w 240 V 5 A accuracy class 0.5s with GSM (GPRS compatible) modem), ring type lugs, terminal block, double compression brass cable glands, danger board, etc as per specification, approved drawing & scope of works for following rating of Distribution Transformers:				
2.01	Three Phase 16 KVA	No			
2.02	Three Phase 25 KVA	No			
2.03	Three Phase 63 KVA	No			
2.04	Three Phase 100 KVA	No			
2.05	Three Phase 200 KVA	No			
2.06	Three Phase 315 KVA	No			
3.00	Supply of LT metering materials as per technical specification, approved drawing & scope of works:				
3.01	1-Ph 2 wire, 5-30Amp, 1.0 Accuracy class static electronic meter with metallic meter box and wooden board. Old meter is to be deposited in the owner stores.	Set			
3.02	3-Ph 4 wire, 10-40Amp, 1.0 Accuracy class static electronic meter with metallic meter box and wooden board. Old meter is to be deposited in the owner stores.	Set			
4.00	<u>Earthing arrangement as per technical specification, approved drawings and scope of work.</u>				
4.01	40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories complete	Set			
4.02	Spike earthing made of 20mm dia solid GI rod	Set			
4.03	8 SWG GI Wire	MT			

Installation/Erection Charges

Schedule-3 (8/8)

Rural Electrification works in XXXX (Name of Project) Project in XXXX (Name of State) under DDUGJY
(Schedule of rates and prices)

Bidder's Name & Address:

Installation / Erection Charges :

H METERING					
Sl. No.	Description	Unit	Quantity	Unit Erection Charges	Total Erection Charges (4x5)
1	2	3	4	5	6
1.00	Feeder Metering:				
1.01	Erection, testing & commissioning of 33 KV feeder Metering at 33/11 kV substation and intermediary points using 33 kV/110 V, 3 ph 4 wire CT ratio 400-200/5 A outdoor oil immersed type metering equipment including supporting steel fabricated structure, earthing coil, 2Cx2.5 sqmm copper control stranded unarmoured cable, 16 mm dia MS nuts & bolts, meter with MS meter box (trivector DLMS compliant category 'A' meter suitable for substation/feeder metering, 3 ph 4 W, 110 V, 5 A accuracy class 0.5s with GSM (GPRS compatible) modem, ring type lugs, terminal block, cable glands double compression brass, DC cross arm (100x50x6 mm), danger board, GI earth wire etc as per specification, approved drawing & scope of works	Set			
1.02	Erection, testing & commissioning of 11 KV feeder Metering at 33/11 kV substation and intermediary points using 11 kV/110 V, 3 ph 4 wire CT ratio 300-150/5 A outdoor oil immersed metering equipment type metering equipment including supporting steel fabricated structure, earthing coil, 2Cx2.5 sqmm copper control stranded unarmoured cable, 16 mm dia MS NUTS & bolts, meter (HT trivector DLMS compliant category A meter suitable for substation/feeder metering, 3 ph, 4 W, 110 V, 5 A, accuracy class 0.5s with GSM (GPRS compatible) modem, ring type lugs, terminal block, cable glands double compression brass, DC cross arm (100x50x6 mm), danger board, GI earth wire etc as per specification, approved drawing & scope of works	Set			
2.00	Erection, testing & commissioning of Distribution Transformer metering on LT side using ring type current transformer of suitable ratio, MS meter box, including supporting steel fabricated structure, earthing using 8 SWG GI wire, 2Cx2.5 sqmm copper control stranded unarmoured cable, 16 mm dia nuts & bolts, energy meter (3 ph 4 w 240 V 5 A accuracy class 0.5s with GSM (GPRS compatible) modem, ring type lugs, terminal block, double compression brass cable glands, danger board, etc as per specification, approved drawing & scope of works for following rating of Distribution Transformers as per specification, approved drawing & scope of works:				
2.01	Three Phase 16 KVA	No			
2.02	Three Phase 25 KVA	No			
2.03	Three Phase 63 KVA	No			
2.04	Three Phase 100 KVA	No			
2.05	Three Phase 200 KVA	No			
2.06	Three Phase 315 KVA	No			
3.00	Erection, testing & commissioning by Shifting of existing meters at Accessible/call bell location outside the premises by providing new service cable, GI wire, meter box, etc. and all other associated materials as per specification, approved drawing & scope of works:				
3.01	Shifting, testing & commissioning of 1-Ph meter outside the premises by providing new service cable 2Cx2.5 Sqmm Armoured Aluminium cable, 8 SWG GI service / Earthing wire, Push -fit type metallic meter box for 1-ph meter, etc as required.	Set			
3.02	Shifting, testing & commissioning of 1-Ph meter outside the premises by providing new service cable 2Cx4.0 Sqmm Armoured Aluminium cable, 8 SWG GI service / earthing wire, Push -fit type metallic meter box for 1-ph meter, etc as required.	Set			

Installation/Erection Charges

H METERING					
Sl. No.	Description	Unit	Quantity	Unit Erection Charges	Total Erection Charges (4x5)
1	2	3	4	5	6
3.03	Shifting, testing & commissioning of 3-Ph meter outside the premises by providing new service cable 4Cx6.0 Sqmm Armoured Aluminium cable, 8 SWG GI service / earthing wire, Push -fit type metallic meter box for 3-ph meter, etc as required.	Set			
3.04	Shifting, testing & commissioning of 3-Ph meter outside the premises by providing new service cable 4Cx10.0 Sqmm Armoured Aluminium cable, 8 SWG GI service / earthing wire, Push -fit type metallic meter box for 3-ph meter, etc as required.	Set			
4.00	Erection, testing & commissioning by providing new static meter replacing existing defective/stopped/electromagnetic meters as per specification, approved drawing & scope of works:				
4.01	Replacement of 1-Ph 2 wire, 5-30Amp, 1.0 Accuracy class static electronic meter with metallic meter box and wooden board. Old meter is to be deposited in the owner stores.	Set			
4.02	Replacement of 3-Ph 4 wire, 10-40Amp, 1.0 Accuracy class static electronic meter with metallic meter box and wooden board. Old meter is to be deposited in the owner stores.	Set			
5.00	Erection, testing & commissioning of following type of Earthing arrangement as per technical specification, approved drawings and scope of work.				
5.01	40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories complete	Set			
5.02	Spike earthing made of 20mm dia solid GI rod	Set			
5.03	8 SWG GI Wire	MT			
5.04	8 SWG GI Coil 115 tonnes (1.85 kg)	No			
6.00	Erection, testing & commissioning of LT Distribution Box made of Cold Rolled MS sheet of 20 SWG thick, IP 54 without welding joints, deep drawn process of following types as per technical specification, approved drawing & scope of works:				
6.01	225x285x120 mm incoming 2Cx25 sqmm, outgoing 8 Nos. 2Cx10 sqmm	No			
6.02	418x300x120 mm incoming 4Cx35 sqmm, outgoing 4 Nos. 4Cx16 sqmm	No			
7.00	Erection, testing & commissioning of LT XLPE Power Cables including their termination materials like glands, lugs, tagging etc. as per technical specifications, approved drawings and scope of the work.				
7.01	4 Core 35 Sq. mm armoured, stranded aluminium conductor, XLPE cable	km			
7.02	2 Core 25 Sq. mm armoured, stranded aluminium conductor, XLPE cable	km			
8.00	Erection, testing & commissioning of Outdoor mounting type ETC cum metering box made of MS sheet of thickness not less than 18 SWG CRCA sheet by deep drawn method, dust and moisture vermin, weather proof with degree of protection with trivector 3 Ph energy meter, suitable bus bars, earthing bus, earthing terminals, box illumination, front door operated with proper locking arrangement, lugs, mounting channel frame, internal wiring with FRLS cables, danger plate, numbering, back clamps, hardware as per scope of the work, technical specifications and approved drawings suitable for following transformer:				
8.01	11/0.4 KV Distribution Transformer 63 KVA 3 phase Aluminium wound DTR	No			
8.02	11/0.4 KV Distribution Transformer 100 KVA 3 phase Aluminium wound DTR	No			
8.03	11/0.4 KV Distribution Transformer 200 KVA 3 phase Aluminium wound DTR	No			
8.04	11/0.4 KV Distribution Transformer 315 KVA 3 phase copper wound DTR	No			

Installation/Erection Charges

H METERING					
Sl. No.	Description	Unit	Quantity	Unit Erection Charges	Total Erection Charges (4x5)
1	2	3	4	5	6
		Total			
	% discount, if any: _____				

Rural Electrification works in XXXX (Name of Project) Project in XXXX (Name of State) under DDUGJY

Bidder's Name and Address (Sole Bidder) :

To:
XXXX (Name and Address of Employer)

Name:
Address:

Dear Sir,

We declare that the ratings, performance figures and availability of the system furnished by us for subject Package covered under this specification are guaranteed by us. We further declare that in the event of any deficiencies in meeting the guarantees in respect of the characteristics mentioned below as established after conducting the factory test, you may at your discretion, reject or accept the equipment after assessing the liquidated damages as specified in the relevant clauses of Bid document.

Equipment	Guaranteed losses at rated output (KW per unit)	
	Copper/Aluminium Loss at 75 degree C at rated current	Iron loss at rated voltage and frequency
Power Transformers:		
10MVA, 33/11kV, 3 ph.		
8MVA, 33/11kV, 3 ph.		
5MVA, 33/11kV, 3 ph.		
3.15MVA, 33/11kV, 3 ph.		
1.6MVA, 33/11kV, 3 ph.		
Station Transformer:		
100KVA, 11/0.433kV, 3ph		
Distribution Transformers:		
10KVA, 11/0.250kV, 1ph.		
16KVA, 11/0.250kV, 1ph.		
16KVA, 11/0.433kV, 3ph.		
25KVA, 11/0.433kV, 3ph.		
63KVA, 11/0.433kV, 3ph.		
100KVA, 11/0.433kV, 3ph		
200KVA, 11/0.433kV, 3ph		
315KVA, 11/0.433kV, 3ph		

Date :
Place :

(Signature)
(Printed Name)
(Designation)
(Common Seal)

STANDARD BIDDING DOCUMENT

(FULL TURNKEY CONTRACT)

FOR

**RURAL/URBAN ELECTRIFICATION WORKS OF ~~XXXX~~
(NAME OF DISTRICT) DISTRICT OF ~~XXXX~~ (NAME OF
STATE) UNDER DEENDAYAL UPADHYAYA GRAM
JYOTI YOJANA/INTEGRATED POWER DEVELOPMENT
SCHEME**

VOLUME-II

**(PMS, QUALITY ASSURANCE & EVALUATION
MECHANISM, BID FORMS AND PRICE
SCHEDULES)**

**Section-I: PMS, Quality Assurance & Evaluation Mechanism
(QAM), Documentation & PMA**

Section-II: Bid Forms

Section-III: Price Schedules

SPECIFICATION No.:.....

DOCUMENT NO.:.....

VOLUME-III: SECTION – I

TECHNICAL SPECIFICATIONS

Section-I

Technical Specification for Equipment's

All materials required to complete the work as per given specifications & drawings etc. must be manufactured and supplied using fresh raw material. Re-moulded, re-circulated materials are not acceptable. The procurement of materials must be made by the contractor directly from manufacturer or through authorized dealer/distributors. Documentary evidences to this effect are to be made available to Employer for necessary checks/verification of source of supply of materials. Second hand materials/ partial used materials/ used materials would not acceptable.

Climatic condition details are given with various materials specifications however, bidder shall note that materials covered under project specific DDUGJY works shall be utilized in that particular project only. Hence, the geographical location of that particular project site and its associated climatic condition shall be applicable for all the materials of that particular project.

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Power Transformers

1 SCOPE

1.1 This

specification provides for design, engineering, manufacture, assembly, stage inspection, final inspection and testing before dispatch, packing and delivery at destination stores by road transport, transit insurance of 3.15/5/6.3/8/10/12.5MVA, 33/11KV Power Transformer(s), complete with all fittings, accessories, associated equipment's, spares, 10% extra Transformer Oil, required for its satisfactory operation in any of the sub-stations of the purchaser.

1.2

The core shall be constructed either from high grade, non-aging Cold Rolled Grain Oriented (CRGO) silicon steel laminations conforming to HIB grade of BIS certified with lamination thickness not more than 0.23mm to 0.27mm or better (Quoted grade and type shall be used). The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall be such that it should under 10% overvoltage condition should not be more than 1.9 Tesla. The supplier shall provide saturation curve of the core material, proposed to be used. Laminations of different grade(s) and different thickness (s) are not allowed to be used in any manner or under any circumstances.

1.3

The scope of supply includes the provision of type test. The equipment offered should have been successfully type tested within five years from date of tender and the design should have been in satisfactory operation for a period not less than three years as on the date of order. Compliance shall be demonstrated by submitting, (i) authentic and certified copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./State Govt. or their undertakings.

1.4

The Power Transformers shall conform in all respects to highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the employer shall have the power to reject any work or material, which, in his judgment, is not in full accordance therewith. The Transformer(s) offered, shall be complete with all components, necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of supply, irrespective of whether those are specifically brought out in this specification and /or the commercial order or not.

The Engineer reserves the right to reject the transformers if on testing the losses exceed the declared losses beyond tolerance limits as per IS or the temperature rise in oil and/or winding exceed the value, specified in technical particular or impedance value differ from the guaranteed value including tolerance as per this specification and if any of the test results do not match with the values, given in the guaranteed technical particulars and as per technical specification.

2 SPECIFIC TECHNICAL REQUIREMENTS

1	Rated MVA (ONAN rating)	3.15/5/6.3/8/10/12.5MVA
2	No. of phases	3
3	Type of installation	Outdoor
4	Frequency	50 Hz (± 5%)
5	Cooling medium	Insulating Oil (ONAN)
6	Type of mounting	On Wheels, Mounted on rails.
7	Rated voltage	
	a) High voltage winding	33KV
	b) Low voltage winding	11KV

8	Highest continuous system voltage		
	a) Maximum system voltage ratio (HV / LV)	36KV / 12 KV	
	b) Rated voltage ratio (HV / LV)	33KV / 11 KV	
9	No. of windings	Two winding Transformers	
10	Type of cooling	ONAN (Oil natural / Air natural)	
11	MVA Rating corresponding to ONAN Cooling system	100%	
12	Method of connection:		
	HV :	Delta	
	LV :	Star	
13	Connection symbol	Dyn11	
14	System earthing	Neutral of LV side to be solidly earthed.	
15	Intended regular cyclic overloading of windings	As per IEC-76-1, Clause 4.2	
16	a) Anticipated unbalanced loading	Around 10%	
	b) Anticipated continuous loading of windings (HV / LV)	110 % of rated current	
17	a) Type of tap changer (For 3.15, 5, 6.3, 8, 10 & 12.5 MVA only)		
	On or Off load tap changer as per BOQ		
	b) Range of tapping	+ 5% to -15% in 9 equal steps of 2.5% each for	
	Off-load tap and in 17 equal steps of 1.25% each for		On-load tap changer on HV winding
18	Neutral terminal to be brought out	On LV side only	
19	Over Voltage operating capability and duration	112.5 % of rated voltage (continuous)	
20	Maximum Flux Density in any part of the core and yoke at rated MVA with +12.5% combined voltage and frequency variation from rated voltage and frequency.	1.9 Tesla	
21	Insulation levels for windings:- 1.2 / 50 microsecond wave shape Impulse withstand (KVP)	33KV 170	11KV 75
	a) Power frequency voltage withstand (KVrms)	70	28
22	Type of winding insulation		
	a) HV winding	Uniform	
	b) LV winding	Uniform	
23	Withstand time for three phase short circuit	2 Seconds	
24	Noise level at rated voltage and frequency	As per NEMA Publication No. TR-1.	

2.1 MARSHALLING BOX

A metal enclosed, weather, vermin and dust proof marshalling box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch etc. shall be provided with each transformer to accommodate temperature indicators, terminal block etc. It shall have degree of protection of IP55 or better as per IS:2147 (Refer Clause 3.12).

2.2 CAPITALIZATION OF LOSSES AND LIQUIDATED DAMAGES

Capitalisation of losses will be as per Annexure B which is attached herewith. No (+)ve tolerance shall be allowed at any point of time, on the quoted losses after the award. In case, the losses during type testing, routine testing etc are found above the quoted losses, the award shall stand cancelled. In such a case, the CPG money shall also be forfeited.

2.3 PERFORMANCE

- i) Transformers shall be capable of withstanding for two seconds without damage to any external short circuit, with the short circuit MVA available at the terminals.
- ii) The maximum flux density in any part of the core and yoke at rated Voltage and frequency shall be such that at the flux density with + 12.5% combined voltage and frequency variation from rated voltage and frequency shall not exceed 1.9 Tesla.
- iii) Transformers shall under exceptional circumstances due to sudden disconnection of the load, be capable of operating at the voltage approximately 25% above normal rated voltage for a period of not exceeding one minute and 40% above normal for a period of 5 seconds.
- iv) The transformer may be operated continuously without danger on any particular tapping at the rated MVA \pm 1.25% of the voltage corresponding to the tapping.
- v) The thermal ability to withstand short circuit shall be demonstrated by calculation.
- vi) Transformers shall be capable of withstanding thermal and mechanical stresses caused by any asymmetric and asymmetric fault on any winding.

2.4 DRAWINGS/DOCUMENTS INCORPORATING THE FOLLOWING PARTICULARS SHALL BE SUBMITTED WITH THE BID

- a) General outline drawings showing shipping dimensions and overall dimensions, net weights and shipping weights, quality of insulating oil, spacing of wheels in either direction of motion, location of coolers, marshalling box and tap changer etc.
- b) Assembly drawings of core, winding etc. and weight of main components/ parts.
- c) Height of centerline on HV and LV connectors of transformers from the rail top level.
- d) Dimensions of the largest part to be transported.
- e) GA drawings / details of various types of bushing
- f) Tap changing and Name Plated diagram
- g) Type test certificates of similar transformers.

h) Illustrative & descriptive literature of the Transformer.

i) Maintenance and Operating Instructions.

2.5 MISCELLANEOUS

i) Padlocks along with duplicate keys as asked for various valves, marshalling box etc. shall be supplied by the contractor, wherever locking arrangement is provided.

ii) Foundation bolts for wheel locking devices of Transformers shall be supplied by the Contractor.

2.6 DELIVERY

The full quantity of the equipments shall be delivered as per the delivery schedule appended to this specification.

2.7 SCHEDULES

All Schedules annexed to the specifications shall be duly filled by the bidder separately.

2.8 ALTITUDE FACTOR

If the equipment is to be installed in the hilly area, necessary correction factors as given in the Indian Standard for oil temperature rise, insulation level etc. shall be applied to the Standard Technical Parameters given above.

2.9 NAMEPLATE

Transformer rating plates shall contain the information as given in clause 15 of IS-2026 (part-I). The details on rating plates shall be finalized during the detailed engineering. Further, each transformer shall have inscription of Employer's name. The name plate shall also include (i) The short circuit rating, (ii) Measured no load current and no load losses at rated voltage and rated frequency, (iii) measured load losses at 75 °C (normal tap only), (iv) D.C. resistance of each winding at 75 °C.

3. SERVICE CONDITIONS

The service conditions shall be as follows: (To be confirmed by PIAs per locality of project)		
	Plain area	Hilly area
Maximum altitude above sea level	1000m	5000m
Maximum ambient air temperature	50° C	50° C
Maximum daily average ambient air temperature	35° C	40° C
minimum ambient air temperature	-5° C	-30° C
maximum temperature attainable by an object exposed to the sun	60° C	60° C
maximum yearly weighted average ambient temperature	32° C	32° C
maximum relative humidity	100%	100%
average number of thunder storm days per annum (isokeraunic level)	70	70

average number of rainy days per annum	120	120
average annual rainfall	1500 mm	1500 mm
maximum wind pressure	260 Kg/m ²	260 Kg/m ²

* HP, J&K, Uttarakhand, Sikkim, Assam, Meghalaya, Manipur, Nagaland, Tripura and Mizoram will be considered as Hilly Area.

Environmentally, the region where the equipment will be installed includes coastal areas, subject to high relative humidity, which can give rise to condensation. Onshore winds will frequently be salt laden. On occasions, the combination of salt and condensation may create pollution conditions for outdoor insulators. Therefore, outdoor material and equipment shall be designed and protected for use in exposed, heavily polluted, salty, corrosive, tropical and humid coastal atmosphere.

4 SYSTEM CONDITIONS

The equipment shall be suitable for installation in supply systems of the following characteristics.

Frequency		50 Hz ± 5%
Nominal system voltages		33 KV 11 KV
Maximum system voltages	33KV System 11KV System	36.3 KV 12 KV
Nominal short circuit level (Basing on apparent power)	33KV System 11KV System	31.5 KA 13.1 KA
Insulation levels : 1.2/50 μ sec impulse withstand voltage	33KV System 11KV System	170KV (peak) 75 KV (peak)
Power frequency one minute withstand (wet and dry) voltage	33KV System 11KV System	70KV (rms) 28KV (rms)
Neutral earthing arrangements	11 KV System	Solidly earthed

5 CODES & STANDARDS

5.1 (i) The design, material, fabrication, manufacture, inspection, testing before dispatch and performance of power transformers at sites shall comply with all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes of practice. Nothing in this specification shall be construed to relieve the contractor of this responsibility.

5.2 The equipment and materials covered by this specification shall conform to the latest applicable provision of the following standards.

IS: 5	Colour for ready mixed paints
IS: 325	Three Phase Induction Motors
IS: 335	New insulating oil for transformers, switch gears
IS: 1271	Classification of insulating materials for electrical

	machinery and apparatus in relation to their stability in services
IS:2026(Part I to IV)	Power Transformer
IS:2071	Method of high voltage testing
IS:2099	High voltage porcelain bushings
IS:2147	Degree of protection
IS:2705	Current Transformers
IS:3202	Code of practice for climate proofing of electrical equipment
IS:3347	Dimensions for porcelain Transformer Bushings
IS:3637	Gas operated relays
IS:3639	Fittings and accessories for power Transformers
IS:5561	Electric Power Connectors
IS:6600/BS:CP"10:0	Guide for loading of oil immersed Transformers
IS:10028	Code of practice for selection, installation and maintenance of transformers, Part I, II and III
C.B.I.P. Publication	Manual on Transformers

If the standard is not quoted for any item, it shall be presumed that the latest version of Indian Standard shall be applicable to that item.

The equipment complying with other internationally accepted standards, may also be considered if they ensure performance superior to the Indian Standards.

5.3 DRAWINGS

- a) The contractor shall furnish, within fifteen days after issuing of Letter of Award. Six copies each of the following drawings/documents incorporating the transformer rating for approval.
 - i) Detailed overall general arrangement drawings showing front and side elevations and plan of the transformer and all accessories including radiators and external features with details of dimensions, spacing of wheel sineither direction of motion, net weights and shipping weights, crane lift for un-tanking, size of lugs and eyes, bushing lifting dimensions, clearances between HV and L.V terminals and ground, quantity of insulating oil etc.
 - ii) Assembly drawings of core and winging and weight of main components /parts
 - iii) Foundation plan showing loading on each wheel and jacking points with respect to centre line of transformer.
 - iv) GA drawings details of bushing and terminal connectors.
 - v) Name plated drawing with terminal marking and connection diagrams.
 - vi) Wheel locking arrangement drawing.
 - vii) Transportation dimensions drawings.

- Viii) Magnetization characteristic curves of PS class neutral and phase side current transformers, if applicable.
 - ix) Interconnection diagrams.
 - x) Overfluxing withstand time characteristic of transformer.
 - xi) GA drawing of marshalling box.
 - xii) Control scheme/wiring diagram of marshalling box.
 - xiii) Technical leaflet of major components and fittings.
 - xiv) As built drawings of schematics, wiring diagram etc.
 - xv) Setting of oil temperature indicator, winding temperature indicator.
 - xvi) Completed technical data sheets.
 - xvii) Details including write-up of tap changing gear.
 - xviii) HV & LV bushing.
 - xix) Bushing Assembly.
 - xx) Bi-metallic connector suitable for connection to 100 mm² to 232 mm² AAAC Conductor.
 - xxi) GA of LV cable Box.
 - xxii) Radiator type assembly.
- b) All drawings, documents, technical data sheets and test certificates, result calculations shall be furnished.
- 5.4 Any approval given to the detailed drawings by the Employer's shall not relieve the contractor of the responsibility for correctness of the drawing and in the manufacture of the equipment. The approval given by the employer shall be general with overall responsibility with contractor.
- 6. GENERAL CONSTRUCTIONAL FEATURES**
- 6.1 All material used shall be of best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions without distortion or deterioration or the setting up of undue stresses which may impair suitability of the various parts for the work which they have to perform.
- 6.2 Similar parts particularly removable ones shall be interchangeable.
- 6.3 Pipes and pipe fittings, screws, studs, nuts and bolts used for external connections shall be as per

therelevant standards.Steel boltsand nuts exposed toatmosphereshallbe galvanized.

- 6.4 Nuts, bolts and pins used inside the transformers and tap changer compartments shall be provided with lock washer or lock nuts.
- 6.5 Exposed parts shall not have pockets where water can collect.
- 6.6 Internal design of transformers shall ensure that air is not trapped in any location.
- 6.7 Material in contact with oil shall be such as not to contribute to the formation of acid in oil. Surface in contact with oil shall not be galvanized or cadmium plated
- 6.8 Labels, indelibly marked, shall be provided for all identifiable accessories like Relays, switches current transformer etc. All label plates shall be of non-corrodible material.
- 6.9 All internal connections and fastenings shall be capable of operating under overloads and over-excitation, allowed as per specified standards without injury.
- 6.10 Transformer and accessories shall be designed to facilitate proper operation, inspection, maintenance and repairs.
- 6.11 No patching, plugging, shimming or other such means of overcoming defects, discrepancies or errors will be accepted.
- 6.12 Schematic Drawing of the wiring, including external cables shall be put under the prospan sheet on the inside door of the transformer marshalling box.
- 6.13 Painting
 - 6.13.1 All paints shall be applied in accordance with the paint manufacturer's recommendations. Particular attention shall be paid to the following:
 - a) Proper storage to avoid exposure as well as extremes of temperature.
 - b) Surface preparation prior to painting.
 - c) Mixing and thinning
 - d) Application of paints and the recommended limit on time intervals between coats.
 - e) Shelf life for storage.
 - 6.13.1.1 All paints, when applied in normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.
 - 6.13.1.2 All primers shall be well marked into the surface, particularly in areas where repainting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to the manufacturer's recommendations. However, wherever airless spray is not possible, conventional spray be used with prior approval of Employer.
 - 6.13.1.3 The suppliers shall, prior to painting protect name plates, lettering gauges, sight glasses, light fittings and similar such items.

6.13.2 Cleaning and Surface Preparation

6.13.2.1 After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, weldingslag or spatter and other contamination prior to any painting.

6.13.2.2 Steel surfaces shall be prepared by Sand/Shot blast cleaning or Chemical cleaning by Seven tank process including Phosphate to the appropriate quality.

6.13.2.3 The pressure and Volume of the compressed air supply for the blast cleaning shall meet the work requirements and shall be sufficiently free from all water contamination prior to any painting. 6.13.2.4 Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale and shall only be used where blast cleaning is impractical.

6.13.3

Protective Coating As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anticorrosion protection.

6.13.4 Paint Material

Following are the type of paints that may be suitably used for the items to be painted at shop and supply of matching paint to site:

- i) Heat resistant paint (Hot oil proof) for inside surface.
- ii) For external surfaces one coat of Thermo Setting Paint or 2 coats of Zinc chromate followed by 2 coats of POLYURETHANE. The color of the finishing coat shall be dark admiral grey conforming to No. 632 or IS 5:1961.

6.13.5 Painting Procedure

6.13.5.1 All paintings shall be carried out in conformity with both specifications and with the paint manufacturer's recommendations. All paints in any one particular system. Whether shop or site applied, shall originate from one paint manufacturer.

6.13.5.2 Particular attention shall be paid to the manufacturer's instructions on storage, mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacturer e.g. brush, roller, conventional or airless spray and shall be applied under the manufacturer's recommended conditions. Minimum and maximum time intervals between coats shall be closely followed.

6.13.5.3 All prepared steel surfaces should be primed before visible rusting occurs or within 4 hours whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is warm.

6.13.5.4 Where the quality of film is impaired by excess film thickness, (wrinkling, mud cracking or general softness) the suppliers shall remove the unsatisfactory paint coatings and apply another. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%. In all instances, where two or more coats of the same paint are specified, such coatings may or may not be of contrasting colors.

6.13.5.5 Paint applied to items that are not to be painted, shall be removed at supplier's expense, leaving the surface clean, un-stained and undamaged.

6.13.6 Damage to Paints Work

6.13.6.1 Any damage occurring to any part of the painting scheme shall be made good to the same standard of corrosion protection and appearance as that originally employed.

6.13.6.2 Any damaged paintwork shall be made as follows:

- a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
- b) A priming coat shall immediately be applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the originally damaged.

6.13.6.3 The repainted surfaces shall present a smooth surface. This shall be obtained by carefully chamfering the painted edges before & after priming.

6.13.7 Dry Film Thickness

6.13.7.1 To the maximum extent practicable, the coats shall be applied as a continuous film of uniform thickness and free of pores. Over-spray, skips, runs, sags and drips should be avoided. The different coats may or may not be the same color.

6.13.7.2 Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendations.

6.13.7.3 Particular attention must be paid to full film thickness at edges.

6.13.7.4 The requirement for the dry film thickness (DFT) of paint and the material to be used shall be as given below:

Sl.No	Paint Type	Area to be painted	No of Coats	Total Dry film thickness (Min)
1	Liquid paint			
	a) Zinc Chromate (Primer)	Outside	02	45micron
	b) POLYURETHANE Paint (Finish Coat)	Outside	02	35micron
	c) Hot Oil paint	inside	01	35micron

7.1 DETAILED DESCRIPTION

7.2 Tank

7.2.1 The transformer tank and covers shall be fabricated from high grade low carbon plate steel of tested quality. The tank and covers shall be of welded construction.

7.2.2 Tank shall be designed to permit lifting by crane or jack of the complete transformer assembly filled with oil. Suitable lugs and bosses shall be provided for this purpose.

7.2.3 All brems, flanges, lifting lugs, braces and permanent parts attached to the tank shall be welded and where practicable, they shall be double welded.

7.2.4 The main tank body of the transformer, excluding tap changing compartments and radiators, shall be

capable of withstanding pressure of 760 mm of Hg.

- 7.2.5 Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminal setc.
- 7.2.6 Gasket of nitrile rubber or equivalent shall be used to ensure perfect oil tightness. All gaskets shall be closed design (without open ends) and shall be of one piece only. Rubber gaskets used for flange type connections of the various oil compartments, shall be laid in grooves or ring groove equivalent sections on bolt sides of the gasket, throughout their total length. Care shall be taken to secure uniformly distributed mechanical strength over the gaskets and retain throughout the total length. Gaskets of neoprene and/or any kind of impregnated/bonded core or cork only which can easily be damaged by overpressing are not acceptable. Use of hemp gasket material is also not acceptable.
- 7.2.7 Suitable guides shall be provided for positioning the various parts during assemble or dismantling. Adequate space shall be provided between the cores and windings and the bottom of the tank for collection of any sediment.

7.3 Tank Cover

The transformer top shall be provided with a detachable tank cover with bolted flanged gasket joint. Lifting lugs shall be provided for removing the cover. The surface of the cover shall be suitable sloped so that it does not retain rain water.

7.4 UNDERCARRIAGE

- 7.4.1 The transformer tank filled with oil shall be supported on steel structure with detachable plain rollers. Suitable channels for movement of roller with transformer shall be space accordingly, rollers wheels shall be provided with suitable rollers bearings, which will resist rust and corrosion and shall be equipped with fittings for lubrication.

7.5 CORE

- 7.5.1 Each lamination shall be insulated such that it will not deteriorate due to mechanical pressure and the action of hot transformer oil.
- 7.5.2 The core shall be constructed either from high grade, non-aging Cold Rolled Grain Oriented (CRGO) silicon steel laminations conforming to HIB grade with lamination thickness not more than 0.23 mm to 0.27 mm or better (Quoted grade and types shall be used). The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall not be more than 1.69 Tesla. The Bidder shall provide saturation curve of the core material, proposed to be used. Laminations of different grade(s) and different thickness(s) are not allowed to be used in any manner or under any circumstances.

CRGO steel for core shall be purchased only from the approved vendors, list of which is available at <http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20kV-CM%20List.pdf>

- 7.5.3 The bidder should offer the core for inspection starting from the destination port to enable Employer for deputing inspecting officers for detail verification as given below and approval by the Employer during the manufacturing stage. Bidder's call notice for the purposes should be accompanied with the following documents applicable as a proof towards use of prime core material: The core coils, if found suitable, are to be sealed with proper seals which shall be opened in presence of the inspecting officers during core-cutting at the manufacturer's or its sub-vendor's premises as per approved design drawing.
- a) Purchase Order No. & Date.
 - b) Invoice of the supplier
 - c) Mill test certificate

- d) Packing list
- e) Bill of lading
- f) Bill of entry certificate to customs

Core material shall be directly procured either from the manufacturer or through their accredited marketing organization of repute, but not through any agent.

Please refer to "Check-list for Inspection of Prime quality CRGO for Transformers" attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

- 7.5.4 The lamination shall be free of all burrs and sharp projections. Each sheet shall have an insulating coating resistant to the action of hot oil.
- 7.5.5 The insulation structure for the core to bolts and core to clamp plates, shall be such as to withstand 2000 V DC voltage for one minute.
- 7.5.6 The completed core and coil shall be so assembled that the axis and the plane of the outer surface of the core assembly shall not deviate from the vertical plane by more than 25mm.
- 7.5.7 All steel sections used for supporting the core shall be thoroughly shot or sand blasted, after cutting, drilling and welding.
- 7.5.8 The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.
- 7.5.9 The core clamping structures shall be designed to minimize eddy current loss.
- 7.5.10 The framework and clamping arrangements shall be securely earthed.
- 7.5.11 The core shall be carefully assembled and rigidly clamped to ensure adequate mechanical strength.
- 7.5.12 Oil ducts shall be provided, where necessary, to ensure adequate cooling inside the core. The welding structure and major insulation shall not obstruct the free flow of oil through such ducts.
- 7.5.13 The design of magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself to the earth clamping structure and production of flux component at right angle to the plane of the lamination, which may cause local heating. The supporting framework of the core shall be so designed to avoid the presence of pockets, which would prevent complete emptying of the tank through the drain valve or cause trapping of air during filling.
- 7.5.14 The construction is to be of boltless core type. The core shall be provided with lugs suitable for lifting the complete core and coil assembly. The core and coil assembly shall be so fixed in the tank that shifting will not occur during transport or short circuits.
- 7.5.15 The temperature gradient between core & surrounding oil shall be maintained less than 20 deg. Centigrade. The manufacturer shall demonstrate this either through test (procurement to be mutually agreed) or by calculation.

7.6 INTERNAL EARTHING

- 7.6.1 All internal metal parts of the transformer, with the exception of individual laminations and their individual clamping plates shall be earthed.
- 7.6.2 The top clamping structures shall be connected to the tank by a copper strap. The bottom clamping structures shall be earthed by one or more of the following methods:
- a) By connection through vertical tie-rods to the top structure.
 - b) By direct metal to metal contact with the tank base.
 - c) By a connection to the structure on the same side of the core as the main earth connection to the tank.
- 7.6.3 The magnetic circuit shall be connected to the clamping structure at one point only and this shall be brought out of the top cover of the transformer tank through a suitably rated insulator. A disconnecting link shall be provided on transformer tank to facilitate disconnections from ground for IR measurement purpose.
- 7.6.4 Coil clamping rings of metal at earth potential shall be connected to the adjacent core clamping structure on the same side as the main earth connections.
- 7.7 WINDING**
- 7.7.1 Windings shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service. 7.6.2 Allow voltage windings for use in the circular coil concentric windings shall be wound on a performed insulating cylinder for mechanical protection of the winding in handling and placing around the core.
- 7.7.2 Windings shall not contain sharp bends which might damage the insulation or produce high dielectric stresses. No strip conductor wound on edges shall have width exceeding six times the thickness. The conductor shall be of electrolytic grade copper free from scales and burrs. The conductor insulation shall be made from high-density (at least 0.75 gm/cc) paper having high mechanical strength. The barrier insulation including space r shall be made from high-density pre-compressed pressboard (1.1 gm/cc minimum for load bearing and 1 to 1.3 gm/cc minimum for non-load bearing) to minimize dimensional changes.
- 7.7.3 Materials used in the insulation and assembly of the windings shall be insoluble, non catalytic and chemically inactive in the hot transformer oil and shall not soften or be otherwise affected under the operating conditions.
- 7.7.4 Winding and connections shall be braced to withstand shocks during transport or short circuit.
- 7.7.5 Permanent current carrying joints in the windings and leads shall be welded or brazed. Clamping bolts for current carrying parts inside oil shall be made of oil resistant material which shall not be affected by acidity in the oil. Steel bolts, if used, shall be suitably treated.
- 7.7.6 Terminals of all windings shall be brought out of the tank through bushings for external connections.
- 7.6.6.1 The completed core and coil assemblies shall be dried in vacuum at not more than 0.5 mm of mercury absolute pressure and shall be immediately impregnated with oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum over or in the transformer tank.
- 7.6.6.2 The windings shall be so designed that all coil assemblies of identical voltage ratings shall be interchangeable and field repairs to the winding can be made readily without special equipment. The coils shall have high dielectric strength.
- 7.6.6.3 Coils shall be made of continuous smooth high grade electrolytic copper conductor, shaped and braced to

provide for expansion and contraction due to temperature changes.

- 7.6.6.4 Adequate barriers shall be provided between coils and core and between high and low voltage coil. End turn shall have additional protection against abnormal line disturbances.
- 7.6.6.5 The insulation of windings shall be designed to withstand voltage stress arising from surge in transmission lines due to atmospheric or transient conditions caused by switching etc.
- 7.6.6.6 Tappings shall not be brought out from inside the coil or from intermediate turns and shall be so arranged as to preserve as far as possible magnetic balance of transformer at all voltage ratios.
- 7.6.6.7 Magnitude of impulse surge transferred from HV to LV windings by electromagnetic induction and capacitance coupling shall be limited to 10% of LV winding.

7.7 INSULATING OIL

- 7.7.1 The insulating oil for the transformers shall be of EHV grade, generally conforming to IS: 335. No inhibitors shall be used in the oil.
- 7.7.2 The quantity of oil required for the first filling of the transformer and its full specifications shall be stated in the bid. Transformer shall be supplied complete with all fittings, accessories and new transformer oil required for first filling plus 10% extra oil. The extra quantity of oil shall be supplied in non-returnable drums along with the oil required for the radiator banks.
- 7.7.3 The design and materials used in the construction of the transformers shall be such as to reduce the risk of the development of acidity in the oil.
- 7.7.4 The oil parameters shall be as per Table-1 of IS 335.

7.8 VALVES

- i) Valves shall be of forged carbon steel up to 50 mm size and of gun metal or of cast iron bodies with gun metal fittings for sizes above 50 mm. They shall be of full way type with screwed ends and shall be opened by turning counter clockwise when facing the hand wheel. There shall be no oil leakage when the valves are in closed position.

Each valve shall be provided with an indicator to show the open and closed positions and shall be provided with facility for padlocking in either open or closed position. All screwed valves shall be furnished with pipe plugs for protection. Padlocks with duplicate keys shall be supplied along with the valves.

- ii) All valves except screwed valves shall be provided with flanges having machined faced drilled to suit the applicable requirements. Oil tight blanking plates shall be provided for each connection for use when any radiator is detached and for all valves opening to atmosphere. If any special radiator valve tools are required the contractor shall supply the same.
- iii) Each transformer shall be provided with following valves on the tank:
 - a) Drain valves located at top to completely drain the tank & to be provided with locking arrangement.
 - b) Two filter valves on diagonally opposite corners of 50 mm size & to be provided with locking arrangement.
 - c) Oil sampling valves not less than 8 mm at top and bottom of main tank & to be provided with locking

arrangement.

- d) One 15mm air release plug.
- e) Valves between radiators and tank. Drain and filter valves shall be suitable for applying vacuum as specified in the specifications.

7.9 ACCESSORIES

7.9.1 Bushing

- i) All porcelain used in bushings shall be homogeneous, non-porous, uniformly glazed to brown colour and free from blisters, burns and other defects.
- ii) Stress due to expansion and contraction in any part of the bushing shall not lead to deterioration.
- iii) Bushing shall be designed and tested to comply with the applicable standards.
- iv) Bushing rated for 400A and above shall have non-ferrous flanges and hardware.
- v) Fittings made of steel or malleable iron shall be galvanized.
- vi) Bushing shall be located on the transformer that full flash over strength will be utilized. Minimum clearances as required for the BIL shall be realized between live parts and live parts to earthed structures.
- vii) All applicable routine and type tests certificates of the bushings shall be furnished for approval.
- viii) Bushing shall be supplied with bi-metallic terminal connector/clamp/washers suitable for fixing to bushing terminal and the Employer's specified conductors. The connector/clamp shall be rated to carry the bushing rated current without exceeding a temperature rise of 55°C over an ambient of 50°C. The connector/clamp shall be designed to be corona free at the maximum rated line to ground voltage.
- ix) Bushing of identical voltage ratings shall be interchangeable.
- x) The insulation class of high voltage neutral bushing shall be properly coordinated with the insulation class of the neutral of the low voltage winding.
- xi) Each bushing shall be so coordinated with the transformer insulation that a full flash over will occur outside the tank.
- xii) The extended bushing busbar shall be used for termination of 11KV cables. LV busings shall be housed in completely sealed metallic enclosure.
- xiii) Sheet steel, weather, vermin and dust proof cable box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch, water-tight hinged and padlocked door of a suitable construction shall be provided with each transformer to accommodate 11KV cables etc. The box shall have slopping roof and the interior and exterior paintings shall be in accordance with the specification. Padlock along with duplicate keys shall be supplied for marshaling box. The degree of protection shall be IP-55 or better. To prevent internal condensation, a metal clad heater with thermostat shall be provided. The heaters shall be controlled by a MCB of suitable rating mounted in the box. The ventilation louvers, suitably padded with felt, shall also be provided. The louvers shall be provided with suitable felt pad to prevent ingress of dust. All incoming cables shall enter the kiosk from the bottom and the minimum 4mm thick, non-

magnetic gland plates shall not be less than 600mm from the base of the box. The gland plate and associated compartments shall be sealed in suitable manner to prevent the ingress of moisture from the cable trench – for those transformers which are used in partly indoors substation, If required as per BOQ, a cable box for LV bushings shall be provided.

7.9.2 Protection & Measuring Devices

i) Oil Conservator Tank

- a) The Conservator tank shall have adequate capacity between highest and lowest visible level to meet the requirement of expansion of the total cold oil volume in the transformer and cooling equipment.
- b) The conservator tank shall be bolted in top position so that it can be removed for cleaning purposes.
- c) The conservator shall be fitted with magnetic oil level gauge with low level electrically insulated alarm contact.
- d) Plain conservator fitted with silica gel breather.

ii) Pressure Relief Device.

The pressure relief device provided shall be of sufficient size for rapid release of any pressure that may be generated in the tank and which may result in damage of the equipment. The devices shall operate at a static pressure of less than the hydraulic test pressure of transformer tank. It shall be mounted directly on the tank. A pair of electrically insulated contacts shall be provided for alarm and tripping.

iii) Buchholz Relay

A double float type Buchholz relay shall be provided. Any gas evolved in the transformers shall collect in this relay. The relay shall be provided with a test cocks suitable for a flexible pipe connection for checking its operation. A copper tube shall be connected from the gas collector to a valve located about 1200mm above ground level to facilitate sampling with the transformer in service. The devices shall be provided with two electrically independent potential free contacts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure.

iv) Temperature Indicator

a) Oil Temperature Indicator (OTI)

The transformers shall be provided with a micro switch contact type thermometer with 150mm dial for top oil temperature indication. The thermometers shall have adjustable, electrically independent potential free alarm and trip contacts. Maximum reading pointer and resetting devices shall be mounted in the local control panel. A temperature sensing element suitably located in a pocket on top oil shall be furnished. This shall be connected to the OTI by means of capillary tubing. Accuracy class of OTI shall be $\pm 1\%$ or better. One No electrical contact capable of operating at 5A ac at 230volts supply.

b) Winding Temperature indicator (WTI)

A device for measuring the hot spot temperature of the windings shall be provided. It shall comprise the following.

- i) Temperature sensing element.
- ii) Image Coil.
- iii) Microswitch contacts.
- iv) Auxiliary CTS, If required to match the image coil, shall be furnished and mounted in the local control panel.
- v) 150 mm dial local indicating instrument with maximum reading pointer mounted in local panel and with adjustable electrically independent ungrounded contacts, besides that required for control of cooling equipment, one for high winding temperature alarm and on for trip.
- vi) Two number electrical contact each capable of operating at 5A ac at 230 Volt supply.

7.9.3 Oil Preservation Equipment

7.9.3.1 Oil Sealing

The oil preservation shall be diaphragm type oil sealing in conservator to prevent oxidation and contamination of oil due to contact with atmospheric moisture.

The conservator shall be fitted with a dehydrating filter breather. It shall be so designed that.

- i) Passage of air is through a dust filter & Silicagel.
- ii) Silicagel is isolate from atmosphere by an oil seal.
- iii) Moisture absorption indicated by a change in colour of the crystal of the silicagel can be easily observed from a distance.
- iv) Breather is mounted not more than 1400 mm above rail top level.

7.10 MARSHALLING BOX

- i) Sheet steel, weather, vermin and dust proof marshaling box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch, water-tight hinged and padlocked door of a suitable construction shall be provided with each transformer to accommodate temperature indicators, terminal block etc. The box shall have slopping roof and the interior and exterior paintings shall be in accordance with the specification. Padlock along with duplicate keys shall be supplied for marshaling box. The degree of protection shall be IP-55 or better.
- ii) The schematic diagram of the circuitry inside the marshaling box be prepared and fixed inside the door under a propanesheet.
- iii) The marshaling box shall accommodate the following equipment:
 - a) Temperature indicators.
 - b) Space for accommodating Control & Protection equipment in future for the cooling fan (for ONAF type cooling, maybe provided in future).
 - c) Terminal blocks and gland plates for incoming and outgoing cables.

All the above equipment except c) shall be mounted on panels and back of panel wirings shall be used for inter-connection. The temperature indicators shall be so mounted that the dials are not more than 1600 mm from the ground level and the door(s) of the compartment(s) shall be provided with glazed window of adequate size. The transformers shall be erected on a plinth which shall be 2.5 feet above ground level.

- iv) To prevent internal condensation, a metal clad heater with thermostat shall be provided. The heaters shall be controlled by a MCB of suitable rating mounted in the box. The ventilation louvers, suitably padded with felt, shall also be provided. The louvers shall be provided with suitable felt pads to prevent ingress of dust.
- v) All incoming cables shall enter the kiosk from the bottom and the gland plates shall not be less than 450 mm from the base of the box. The gland plate and associated compartments shall be sealed in suitable manner to prevent the ingress of moisture from the cable trench.

7.11 TAPCHANGER

7.11.1 ON-LOAD TAP-CHANGERS

- i) The 3.15/5/6.3/8/10/12.5 MVA transformers shall be provided with On-load Taps. Specification of OLTC is attached herewith as Annexure.
- ii) The Transformer with off-load tap changing gear shall have taps ranging from +5% to -15% in 9 equal steps of 2.5% each for Off Load Tap.
- iii) The tap changing switch shall be located in a convenient position so that it can be operated from ground level. The switch handles shall be provided with locking arrangement along with tap position indication, thus enabling the switch to be locked in position.

7.12 FITTINGS AND ACCESSORIES

The following fittings and accessories shall be provided on the transformers:

- i) Conservator with isolating valves, oil filling hole with cap and drain valve. The conservator vessel shall be filled with constant oil pressure diaphragm oil sealing system.
- ii) Magnetic type oil level gauge (150 mm dia) with low oil level alarm contacts.
- iii) Prismatic/toughened glass oil level gauge.
- iv) Silica gel breather with oil seal and connecting pipe complete with first fill of activated silica gel or Alumina mounted at a level of 1300 mm above ground level.
- v) A double float type Buchholz relay with isolating valve. Bleeding pipe and a testing cock, the test cock shall be suitable for flexible (pipe connection for checking its operation). A 5 mm dia. Copper pipe shall be connected from the relay test cock to a valve located at a suitable height above ground level to facilitate sampling of gas with the transformer in service. Interconnection between gas collection box and relay shall also be provided. The devices shall be provided with two electrically independent underground contacts, one for alarm on gas accumulation and the other for tripping on sudden oil surge. These contacts shall be wired up to transformer marshaling box. The relay shall be provided with shut off valve on the conservator side as well as on the tank side.

- vi) Pressure relief devices (including pressure relief valve) and necessary air equalizer connection between his and the conservator with necessary alarm and trip contacts.
- vii) Air release plugs in the top cover.
- viii) Inspection cover, access holes with bolted covers for access to inner ends of bushing etc.
- ix) Winding temperature (hot spot) indicating device for local mounting complete in all respects. Winding temperature indicator shall have two set of contacts to operate at different settings :
 - a) To provide winding temperature high alarm
 - b) To provide temperature too high trip
- x) Dial thermometer with pocket for oil temperature indicator with one set of alarm and one set of trip contacts and maximum reading pointer.
- xi) Lifting eyes or lugs for the top cover, core and coils and for the complete transformer.
- xii) Jacking pads
- xiii) Haulage lugs.
- xiv) Protected type mercury / alcohol in glass thermometer and a pocket to house the same.
- xv) Top and bottom filter valves on diagonally opposite ends with padlocking arrangement on both valves.
- xvi) Top and bottom sampling valves.
- xvii) Drain valve with padlocking arrangement
- xviii) Rating and connection diagram plate.
- xix) Two numbers tank earthing terminals with associated nuts and bolts for connections to Employer's grounding strip.
- xx) Marshaling Box (MB)
- xxi) Shut off valve on both sides of flexible pipe connections between radiator bank and transformer tank.
- xxii) Cooling Accessories:
 - a) Requisite number of radiators provided with :-
 - One shut off valve on top
 - One shut off valve at bottom
 - Air release device on top

- Drain and sampling device at bottom
- Lifting lugs.

b) Air released device and oil drain plug on oil pipe connectors:

- xxiii) Terminal marking plates for Current Transformer and Main Transformer
- xxiv) On/Off Load Tap changer as per BOQ
- xxv) Oil Preservation Equipment
- xxvi) Oil Temperature indicator
- xxvii) Transformers shall be supplied with all control cable, WTI & OTI, sensing cable, glands, lug set c (complete control).

Note:

1. The fittings listed above are indicative and any other fittings which are generally required for satisfactory operation of the transformer are deemed to be included in the quoted price of the transformer.
2. The contacts of various devices required for alarm and trip shall be potential free and shall be adequately rated for continuous, making and breaking current duties as specified.

7.13 CONTROL CONNECTIONS AND INSTRUMENT AND WIRING TERMINAL BOARD AND FUSES

- i) Normally no fuses shall be used anywhere instead of fuses MCB's (both in AC & DC circuits) shall be used. Only in cases where a MCB cannot replace a fuse due to system requirements, a HRC fuse can be accepted.
- ii) All wiring connections, terminal boards, fuses MCB's and link shall be suitable for tropical atmosphere. Any wiring liable to be in contact with oil shall have oil resisting insulation and the bare ends of stranded wire shall be sweated together to prevent seepage of oil along the wire.
- iii) Panel connections shall be neat and squarely fixed to the panel. All instruments and panel wirings shall be in PVC or non-rusting metal cleats of the compression type. All wiring to a panel shall be taken from suitable terminal boards.
- iv) Where conduits are used, the run shall be laid with suitable falls, and the lowest part of the run shall be external to the boxes. All conduit runs shall be adequately drained and ventilated. Conduits shall not be run at or below ground level.
- v) When 400 volt connections are taken through junction boxes or marshaling boxes, they shall be adequately screened and 400 volts Danger Notice must be affixed to the outside of the junction boxes or marshaling box. Proper colour code for Red, Yellow, Blue wire shall be followed.
- vi) All box wirings shall be in accordance with relevant ISS. All wirings shall be of stranded copper (48 strands) of 1100 Volt grade and size not less than 2.5 sq. mm

- vii) All wires on panels and all multi-core cables shall have ferrules, for easy identifications, which bear the same number at both ends, as indicated in the relevant drawing.
- viii) At those points of interconnection between the wiring carried out by separate contractors, where a change of number cannot be avoided double ferrules shall be provided on each wire. The change of numbering shall be shown on the appropriate diagram of the equipment.
- ix) The same ferrule numbers shall not be used on wires in different circuits on the same panels.
- x) Ferrules shall be of white insulating material and shall be provided with glossy finish to prevent the adhesion of dirt. They shall be clearly and durably marked in black and shall not be affected by dampness or oil.
- xi) Stranded wires shall be terminated with tinned Ross Courtney terminals, claw washers or crimped tubular lugs. Separate washers shall be suited to the size of the wire terminated. Wirings shall, in general, be accommodated on the sides of the box and the wires for each circuit shall be separately grouped. Back of panel wiring shall be arranged so that access to the connecting items of relays and other apparatus is not impeded.
- xii) All circuits in which the voltage exceeds 125 volts, shall be kept physically separated from the remaining wiring. The function of each circuit shall be marked on the associated terminal boards.
- xiii) Where apparatus is mounted on panels, all metal cases shall be separately earthed by means of stranded (48 No.) copper wire of strip having a cross section of not less than 2 sq. mm where strip is used, the joints shall be sweated. The copper wires shall have green coloured insulation for earth connections.
- xiv) All wiring diagram for control and relay panel shall preferably be drawn as viewed from the back and shall show the terminal boards arranged as in services.
- xv) Terminal block rows should be spaced adequately not less than 100 mm apart to permit convenient access to external cables and terminations.
- xvi) Terminal blocks shall be placed with respect to the cable gland (at a minimum distance of 200 mm) as to permit satisfactory arrangement of multicore cable tails.
- xvii) Terminal blocks shall have pair of terminals for incoming and outgoing wires. Insulating barriers shall be provided between adjacent connections. The height of the barriers and the spacing between terminals shall be such as to give adequate protection while allowing easy access to terminals. The terminals shall be adequately protected with insulating dust proof covers. No live metal shall be exposed at the back of the terminal boards. CT terminals shall have shorting facilities. The terminals for CT should have provision to insert terminal plugs and with isolating links.
- xviii) All interconnecting wiring, as per the final approved scheme between accessories of transformer and marshaling box is included in the scope of this specification and shall be done by the Transformer supplier.
- xix) The schematic diagram shall be drawn and fixed under a transparent prospane sheet on the inner side of the marshaling box cover.
- xx) To avoid condensation in the Marshaling Box, space heaters shall be provided with an MCB and thermostat.
- xxi) Suitable MV, CFL light shall be provided in the Marshaling Box for lightning purpose.

7.14 RADIO INTERFERENCE AND NOISE LEVEL

Transformers shall be designed with particular care to suppress at least the third and fifth harmonic voltage so as to minimize interference with communication circuits. Transformer noise level when energized at normal voltage and frequency shall be as per NEMA stipulations.

8 INSPECTION AND TESTING

- (i) The Contractor shall carry out a comprehensive inspection and testing program during manufacture of the transformer. This is, however, not intended to form a comprehensive program as it is contractor's responsibility to draw up and carry out such a program duly approved by the Employer.
- (ii) Transformer of each rating will be as per pre-type tested design.
- (iii) The pre-shipment checks shall also be carried out by the contractor.
- (iv) The requirements on site tests are as listed in the specifications.
- (v) Certified test report and oscillogram shall be furnished to the Employer Consultants for evaluation as per the schedule of distribution of documents. The Contractor shall also evaluate the test results and rectify the defects in the equipment based on his and the Employer's evaluation of the tests without any extra charge to the Employer. Manufacturer's Test Certificates in respect of all associated auxiliary and ancillary equipments shall be furnished.
- (vi) The bidder shall state in his proposal the testing facilities available at his works. In case full testing facilities are not available, the bidder shall state the method proposed to be adopted so as to ascertain the transformer characteristics corresponding to full capacity.

8.1 INSPECTION

Transformers not manufactured as per Type-Tested design shall be rejected.

- i) Tank and Conservator
 - a) Inspection of major weld.
 - b) Crack detection of major strength weld seams by dye penetration test.
 - c) Check correct dimensions between wheels, demonstrate turning of wheels, through 90° and further dimensional check.
 - d) Leakage test of the conservator.
- ii) Core
 - a) Sample testing of core materials for checking specific loss, properties, magnetization characteristics and thickness.
 - b) Check on the quality of varnish if used on the stampings.
 - c) Check on the amount of burrs.
 - d) Visual and dimensional check during assembly stage.
 - e) Check on completed core for measurement of iron loss, determination of maximum flux density,

- f) Visual and dimensional checks for straightness and roundness of core, thickness of limbs and suitability of clamps.
- g) High voltage DC test (2KV for one minute) between core and clamps.

Please refer to "Check-list for Inspection of Prime quality CRGO for Transformers" attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

iii) Insulating Material

- a) Sample check for physical properties of materials.
- b) Check for dielectric strength
- c) Check for the reaction of hot oil on insulating materials.

iv) Winding

- a) Sample check on winding conductor for mechanical and electrical conductivity.
- b) Visual and dimensional checks on conductor for scratches, dent mark etc.
- c) Sample check on insulating paper for PH value, electric strength.
- d) Check for the bonding of the insulating paper with conductor.
- e) Check and ensure that physical condition of all material taken for windings is satisfactory and free of dust.
- f) Check for absence of short circuit between parallel strands.

v) Checks Before Drying Process

- a) Check condition of insulation on the conductor and between the windings.
- b) Check insulation distance between high voltage connections, between high voltage connections cables and earth and other live parts.
- c) Check insulating distances between low voltage connections and earth and other parts.
- d) Insulating test for core earthing.

vi) Check During Drying Process

- a) Measurement and recording of temperature and drying time during vacuum treatment.
 - b) Check for completeness of drying
- vii) Assembled Transformer
- a) Check completed transformer against approved outlined drawing, provision for all fittings, finish level etc.
 - b) Jacking test on the assembled Transformer.
- viii) Oil All standard tests in accordance with IS: 335 shall be carried out on Transformer oil sample before filling in the transformer.
- ix) Test Report for bought out items The contractor shall submit the test reports for all bought out/subcontracted items for approval.
- a) Buchholz relay
 - b) Sudden pressure rise relay on Main Tank
 - c) Winding temperature indicators (for TX capacity 5 MVA)
 - d) Oil temperature indicators
 - e) Bushings
 - f) Bushing current transformers in neutral (If Provided)
 - g) Marshaling box
 - h) On/Off Load Tap changer as per BOQ
 - i) Any other item required to complete the works.
 - j) Porcelain, bushings, bushing current transformers, wherever provided, winding coolers, control devices, insulating oil and other associated equipments shall be tested by the

contractor in accordance with relevant IS. If such requirement is purchased by the contractor on a sub-contract, he shall have them tested to comply with these requirements.

8.2 FACTORY TESTS

- i) All standards routine tests in accordance IS:2026 with dielectric tests corresponding as per latest amendments to IS:2026 shall be carried out.
- ii) All auxiliary equipments shall be tested as per the relevant IS. Test certificates shall be submitted for bought out items.
- iii) High voltage withstand tests shall be performed on auxiliary equipment and wiring after complete assembly.
- iv) Following additional routine tests shall also be carried out on each transformer:
 - a) Magnetic Circuit Test Each core shall be tested for 1 minute at 2000 Volt AC
 - b) Oil leakage test on transformer

8.2.1 Type Test

8.2.1.1 The measurements and tests should be carried out in accordance with the standards specified in each case as indicated in the following table if the same tests were not conducted earlier at CPRI or any NABL accredited Laboratory on the transformers of the offered design without any cost implication on employer.

Table 6: Transformer type tests

Type Test	Standard
Temperature Rise Test	IEC76/IS2026/IS6600
Impulse Voltage Withstand Test, including Full Waves and Chopped Waves as listed below	IEC76/IS2026
Noise Level Measurement	IEC551

In accordance with IEC76-3 the following sequence of impulses should have been/should be applied;

- One full wave at 50% BIL;
- One full wave at 100% BIL;
- One chopped wave at 50% BIL
- Two chopped waves at 100% BIL and
- Two full waves at 100% BIL.

8.2.1.2 If the type test report(s) submitted by the bidder do not fulfill the criteria, as stipulated in this technical specification/Bidder's offer, the relevant type test(s) has/have to be conducted by the Bidder at his own cost in CPRI/NABL accredited laboratory in the presence of employer's representative(s) without any financial liability to employer in the event of order placed on him.

8.2.1.3 The offered transformer must be manufactured as per type tested design. A copy of type test certificate must be submitted by manufacturer to Engineer/Employer. Transformers offered with out type tested however design shall not be accepted. In case manufacturer agrees for type testing of transformers, testing shall be conducted on manufacturer's cost. No claim shall be acceptable toward type testing. The transformer shall be accepted only on acceptance of type testing results by employer.

8.2.1.4 The suppliers shall furnish calculations in accordance with IS:2026 to demonstrate the Thermal stability of the transformer to withstand Short Circuit forces.

8.2.1(A) Special Test

The short circuit test shall be a mandatory test for each design shall be supplied by the manufacturer and no exceptions shall be allowed. The test shall be conducted as per latest standard tabled below:

8.2.2 STAGE INSPECTION

The suppliers shall offer the core, windings and tank of each transformer for inspection by the Employer's representative(s). During stage inspection, all the measurements like diameter, window height, leg centre, stack width, stack thickness, thickness of lamination etc. for core assembly, conductor size, insulation thickness, I.D., O.D, winding height, major and minor insulation for both H.V and L.V windings, length, breadth, height and thickness of plates of transformer tank, the quality of fittings and accessories will be taken/determined. The supplier can offer for final inspection of the transformers subject to clearance of the stage inspection report by the Employer.

8.2.3 Routine Tests

Transformer routine tests shall include tests stated in latest issue of IS:2026 (Part-1). These tests shall also include but shall not be limited to the following :

- (i) Measurement of winding DC resistance.
- (ii) Voltage ratio on each tapping and check of voltage vector relationship.
- (iii) Impedance voltage at all tapings.
- (iv) Magnetic circuit test as per relevant ISS or CBIP manual or latest standard being followed.
- (v) Measurement of Load losses at normal tap and extreme taps.
- (vi) No load losses and no load current at rated voltage and rated frequency, also at 25% to 120 % of rated voltage in steps.
- (vii) Absorption index, insulation resistance for 15 seconds and 60 seconds (R₆₀/R₁₅) and polarization index, insulation resistance for 10 minutes and one minute (R_{10mt}/R_{1mt}).
- (viii) Induced overvoltage withstand test.
- (ix) Separate source voltage withstand test.
- (x) Tan delta measurement and capacitance of each winding to earth (with all other windings earthed) & between all windings connected together to earth.
- (xi) Measurement of zero sequence impedance

- (xii) Tests on On/Off Load Tap changer as per BOQ (fully assembled on transformer) as per IS 2026
- (xiii) Auxiliary circuit tests
- (xiv) Oil BDV tests
- (xv) Measurement of neutral unbalance current which shall not exceed 2% of the full rated current of the transformer.
- (xvi) Magnetic balance test
- (xvii) Leakage test.

Six (6) set of certified test reports and oscillographs shall be submitted for evaluation prior to dispatch of the equipment. The contractor shall also evaluate the test results and shall correct any defect indicated by his and Employer's evaluation of the tests without charge to the Employer.

8.4 TANK TESTS

a) Oil leakage Test:

The tank and oil filled compartments shall be tested for oil tightness completely filled with air or oil of viscosity not greater than that of insulating oil conforming to IS: 335 at the ambient temperature and applying a pressure equal to the normal pressure plus 35 kN/m² measured at the base of the tank. The pressure shall be maintained for a period of not less than 12 hours of oil and one hour for air and during that time no leak shall occur.

b) Pressure Test

Where required by the Employer, one transformer tank of each size together with its radiator, conservator vessel and other fittings shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35 kN/m² whichever is lower, measured at the base of the tank and maintained for one hour.

c) Vacuum Test

One transformer tank of each size shall be subjected to the vacuum pressure of 60 mm of mercury. The tanks designed for full vacuum shall be tested at an internal pressure of 3.33 kN/m² (25 mm of mercury) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the values specified in C. B. I. P. Manual on Transformers (Revised 1999) without affecting the performance of the transformer.

8.5 PRE-SHIPMENT CHECK AT MANUFACTURER'S WORKS

- i) Check for proper packing and preservation of accessories like radiators, bushings, explosion vent, dehydrating breather, rollers, Buchholz relay, control cubicle connecting pipes and conservator etc.
- ii) Check for proper provision of bracing to arrest the movement of core and winding assembly inside the tank.
- iii) Gas tightness test to conform tightness.

8.6 INSPECTION AND TESTING AT SITE

On receipt of transformer at site, shall be performed detailed inspection covering areas right from the receipt of material up to commissioning stage. An indicative program of inspection as envisaged by the Engineer is given below.

8.6.1 Receipt and Storage Checks

- i) Check and record condition of each package visible parts of the transformer set for any damage.
- ii) Check and record the gas pressure in the transformer tank as well as in the gas cylinder.
- iii) Visual check of core and coils before filling up with oil and also check condition of core and winding in general.

8.6.2 Installation Checks

- i) Inspection and performance testing of accessories like tap changers etc.
- ii) Check choking of the tubes of radiators
- iii) Test on oil sample taken from main tank top and bottom and cooling system. Samples should be taken only after the oil has been allowed to settle for 24 hours.
- iv) Check the whole assembly for tightness, general appearance etc.
- v) Oil leakage tests.

8.6.3 Pre-Commissioning Tests

After the transformer is installed, the following pre-commissioning tests and checks shall be done before putting the transformer in service.

- i) Megger Test
- ii) Phase relationship test (Vector group test)
- iii) Buchholz relay alarm & surge operation test (Physical)
- iv) Ratio test on all taps
- v) Low oil level (in conservator) alarm
- vi) Temperature Indicators (Physical)
- vii) Marshaling kiosk (Physical)

8.6.4 The following additional checks shall be made:

- i) All oil valves are in correct position closed or opened as required
- ii) All air pockets are cleared.

- iii) Thermometer pockets are filled with oil
- iv) Oil is at correct level in the bushing, conservator, diverter switch & tank etc.
- v) Earthing connections are made.
- vi) Bushing arcing horn is set correctly and gap distance is recorded.
- vii) CT polarity and ratio is correct.

8.7 PERFORMANCE

The performance of the transformer shall be measured on the following aspects.

- i) The transformer shall be capable of being operated without danger on any tapping at the rated KVA with voltage variations and $\pm 10\%$ corresponding to the voltage of the tapping
- ii) Radio interference and Noise Level
- iii) The transformer shall be designed with particular attention to the suppression of third and fifth harmonics so as to minimize interference with communication circuits.

8.8 FAULT CONDITIONS

- a) The transformer shall be capable of withstanding for two (2) seconds without damage any external short circuit to earth
- b) Transformer shall be capable of withstanding thermal and mechanical stresses conveyed by symmetrical or asymmetrical fault on any winding. This shall be demonstrated through calculation as per IS : 2026.
- c) Transformer shall accept, without injurious heating, combined voltage and frequency fluctuation which produce the 125% overfluxing condition for one minute and 140% for 5 seconds.

8.9 WITNESSING OF TESTS AND EXCESSIVE LOSSES

- i) The Employer reserves the right to reject the Transformer if losses exceed the maximum specified as per Clause No. 2. SPECIFIC TECHNICAL REQUIREMENTS (STANDARD CONDITIONS), item- 35 of this specification or if temperature rise of oil and winding exceed the values specified at item -26 of the above clause.

9 LIQUIDATED DAMAGES FOR EXCESSIVE LOSSES

There is no positive tolerance on the guaranteed losses offered by the bidder. However, the transformer(s) shall be rejected outrightly, if any of the losses i.e. no load loss or load loss or both exceed(s) the guarantee maximum permissible loss figures quoted by the bidder in the Technical Data Schedule with the bid.

10 SPARE PARTS

In case the manufacturer goes out of production of spare parts, then he shall make available the drawings of spare parts and specification of materials at no extra cost to the Employer to fabricate or procure spare parts from other sources.

Mandatory Spare Parts

The suppliers shall provide the following mandatory spares for each of Transformers supplied

1. H.V. & L.V. Bushing & Studs – Each 2 Nos
2. Bimetallic connector for H.V. & L.V. Bushings – Each 2 sets

10.1 INSTRUCTION MANUAL

Eight sets of the instruction manuals shall be supplied at least four (4) weeks before the actual dispatch of equipment. The manuals shall be in bound volumes and shall contain all the drawings and information required for erection, operation and maintenance of the transformer. The manuals shall include among other, the following particular:

- a) Marked erection prints identifying the components, parts of the transformer as dispatched with assembly drawings.
- b) Detailed dimensions, assembly and description of all auxiliaries.
- c) Detailed views of the core and winding assembly, winding connections and tapping tap changer construction etc. These drawings are required for carrying out overhauling operation at site.
- d) Salient technical particulars of the transformer.
- e) Copies of all final approved drawings.
- f) Detailed O&M instructions with periodical checklists and Performa etc.

10.2 COMPLETENESS OF EQUIPMENT

All fittings and accessories, which may not be specifically mentioned in the specification but which are necessary for the satisfactory operation of the transformer, shall be deemed to be included in the specification and shall be furnished by the supplier without extra charges. The equipment shall be complete in all details whether such details are mentioned in the specification or not, without any financial liability to the Employer under any circumstances.

11.0 COMMISSIONING

The utility will give a 10 days' notice to the supplier of transformer before commissioning. The manufacturer will depute his representative to supervise the commissioning. In case, the manufacturer fails to depute his representative, the utility will go ahead with the commissioning and under these circumstances, it would be deemed that commissioning is done as per recommendations of manufacturer.

12.0 GUARANTEE

The manufacturers of the transformer shall provide a guarantee of 60 months from the date of receipt of transformer at the stores of the Utility. In case the transformer fails within the guarantee period, the supplier will depute his representative within 15 days from date of

intimation by the utility for joint inspection. In case, the failure is due to the reasons attributed to supplier, the transformer will be replaced/repared by the supplier within 2 months from the date of joint inspection.

Annexure-B

Methodologyforcomputingtotalowningcost for
 Power Transformer

TOC=IC+(AxWi) +(BxWc) ; Losses in KW			
Where,			
TOC	=	TotalOwningCost	
IC	=	Initialcost including taxes of transformer as quoted by the manufacturer	
Afactor	=	Cost of no load lossesinRs/KW	(A = 334447)
Bfactor	=	Cost of load lossesin Rs/KW	(B = 151616)
Wi	=	Noloadlosses quoted by themanufacturerin KW	
Wc	=	Load losses quotedby the manufacturer in KW	

ONLOAD TAPCHANGER FOR 33/11 KV POWER TRANSFORMER

The tapping range of On Load Tap Changers shall be +5% to -15% in steps of 1.25% each. The number of taps shall be 17. The On Load Tap Changers shall be supplied with RTCC panel and AVR (Automatic Voltage Regulating Relay)

The continuous current rating of the tap changers shall be based on connected winding rating and shall have liberal and ample margin. Low rated tap changers connected in parallel are not acceptable.

The on-load tap changing equipment shall have the provision for mechanical and electrical control from a local position and electrical control from a remote position. For local mechanical operation, the operating handle shall be brought outside the tank for operation from floor level with provision to lock the handle in each tap position. Remote electrical operations shall have an AUTO-MANUAL selection at the remote location. When selected AUTO, the tap changing gear shall maintain steady voltage within practical limit on the transformer secondary bus from which the reference shall not respond to transient variation of voltage due to grid disturbance and system fault.

The required voltage relay shall not be sensitive to frequency variation and shall be suitable for sensing voltage from the secondary of potential transformers mounted on the 66KV, 33KV, or 11KV bus.

The tap changers shall be provided with over-current protection in order to prevent the tap-change operation during a short circuit, which would greatly stress the contacts of the diverters switch. The function of protection shall be arranged as follows;

- (i) Whenever overcurrent occurs, the control circuit for commanding OLTC motor operations shall be blocked by the normally close contacts of the overcurrent relays.
- (ii) If during tap change overcurrent occurs, the OLTC motor circuit shall be blocked through the mechanical cam switch, which is close from the very beginning to the very end of every tap change operation and to the normally open contacts of the overcurrent relays. The stop action of the motor shall be made through the motor brake contactor.

The design of the tap changing equipment shall be such that the mechanism will not stop in any intermediate position; however, if the mechanism through faulty operation does stop in an intermediate position, the full load must be carried by the transformer without injury to the equipment. The mechanical position indicator shall be equipped in the motor drive cubicle. The motor shall be designed to be of step control. In any case the operations shall be of step by step.

The voltage regulating relay shall be supplied together with the timer and undervoltage relay. The signal order from the voltage regulating relay to execute the tap changer operation, when the regulating voltage is out of the voltage regulating level shall be designed to be delayed by the adjustable timer. If the control voltage abnormally falls, the movement of the tap changers shall be locked by the contact of the undervoltage relay, even if the contacts of the voltage regulating relay are working.

The control circuit of the transformers shall be completely designed and provisions shall be made for parallel operation with another transformer.

The following accessories, control and selector switches and other necessary accessories shall be furnished.

Remote tap changer control board

(Placed in the control room)

- Voltmeter
- "AUTO-MANUAL" control switch

- "RAISE-LOWER"controlswitch
- Tappositionindicator
- Tapchangeroperationprogramindicator.

TransformerTapChangerdrivingmechanismcontrolcubicle

- "REMOTE-LOCAL-TEST"selector switch
- "AUTOMATIC-MANUAL" controlswitch
- "RAISE-LOWER" controlswitch
- Tappositionindicator
- Tapchangeroperationprogramindicator
- Voltmeter
- Tapchangeoperationcounter
- Meansformanualoperationwhenpowersupplyislost

Annexure - A

Check-list for Inspection of Prime quality CRGO for Transformers

During inspection of PRIME CRGO, the following points needs to be checked by the Transformer manufacturer. Utility's inspector shall verify all these points during inspection:-

i) In case PRIME CRGO cutting is at works of Transformer Manufacturer:

Review of documents:

Purchase Order (unpriced) to PRIME CRGO supplier/Authorised Agency
 Manufacturer's test certificate

Invoice of the Supplier

Packing List

Bill of Lading

Bill of Entry Certificate by Customs Deptt.

Reconciliation Statement as per format below

Certificate of Origin

BIS Certification

Format for Reconciliation/Traceability records

Packing List No./date /Quantity of PRIME CRGO received

Name of Manufacturer

Manufacturer test certificate No./date

Serial	Details of	Drawing	Quantity	Commulative	Balance
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No.	Package/Job	Reference	Involved	Quantity Consumed	Stock

(i).1 Inspection of PRIME CRGO Coils:

PRIME CRGO-Manufacturer's Identification Slip on PRIME CRGO Coils
 Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).
 Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.
 ISI logo sticker on packed mother coil and ISI logo in Material TC.

2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

3 Inspection of PRIME CRGO laminations: Transformer manufacturer will maintain records for traceability of laminations to prime CRGO coils and burr/bow on laminations shall be measured. Utility can review these records on surveillance basis.

4. Inspection at the time of core building:
 Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/ rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in A.2.2 above.

Above tests shall be witnessed by Utility. In case testing facilities are not available at Manufacturer's work, the sample(s) sealed by Utility to be sent to approved labs for testing.

Inspection Clearance Report would be issued after this inspection

(i) In case PRIME CRGO cutting is at Sub-vendor of Transformer Manufacturer:

Review of documents:

Purchase Order (unpriced) to PRIME CRGO supplier/ Authorised Agency

Purchase Order (unpriced) to Core Cutter

Manufacturer test certificate

Invoice of the Supplier

Packing List

Bill of Lading

Bill of Entry Certificate by Customs Deptt.

Reconciliation Statement as per format below

Certificate of origin

BIS Certification

Format for Traceability records as below: -

Packing List No./date /Quantity of PRIME CRGO received

Name of Manufacturer

Manufacturer test certificate No./date

Serial No.	Name of Customer	Deetails of Package/Job	Drawing Reference	Quantity Invoved	Commulative Quantity Consumed	Balance Stock	Dispatch details

(ii) .1 Inspection of PRIME CRGO Coils:

PRIME CRGO-Manufacturer's Identification Slip on PRIME CRGO Coils
 Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).
 Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.
 ISI logo sticker on packed mother coil and ISI logo in Material TC.

2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla, thickness depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

3 Inspection of PRIME CRGO laminations:

Transformer manufacturer representative will inspect laminations and issue their internal Inspection Clearance Report. Inspection will comprise of review of traceability to prime CRGO coils, visual Inspection of PRIME CRGO laminations and record of burr/bow. After clearance given by transformer manufacturer, Utility will issue an Inspection Clearance Report after record review. If so desired by Utility, their representative may also join transformer manufacturer representative during this inspection.

Inspection Clearance Report would be issued after this inspection

vi) Inspection at the time of core building:

Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in B.2.2.

Inspection Clearance Report would be issued after this inspection

NOTE :-

a) Transformer Manufacturer to ensure that PRIME CRGO is procured from POWERGRID approved vendors and CRGO manufacturer should have valid BIS Certificate for respective offered Grade.

14.1 Transformer Manufacturer should also involve themselves for ensuring the quality of CRGO laminations at their Core Cutter's works. They should visit the works of their Core cutter and carry out necessary checks.

a) General

If a surveillance sample is drawn and sent to TPL (if testing facility not available with the manufacturer), the Transformer manufacturer can continue manufacturing at their own risk and cost pending TPL test report on PRIME CRGO sample drawn. Decision for acceptance of PRIME CRGO shall be based upon report of the sample drawn.

These checks shall be read in-conjunction with approved Quality Plan, specification as a whole and conditions of contract.

Sampling Plan (PRIME CRGO)

33 / 11 kV	-1 st transformer and subsequently at random 10% of Transformers (min. 1) offered for inspection.
DTs and other ratings	-1 st transformer and subsequently at random 2% of Transformers (min. 1) offered for inspection.

NOTE:- One sample for each lot of CRGO shall be drawn on surveillance basis.

CRGO has to be procured only from POWERGRID approved vendors. List of such vendors is available at the following website. Since the list is dynamic in nature, the site may be checked from time to time to see the list of approved vendors.

<http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20kV-CM%20List.pdf>

1 SCOPE:

- 1.1 This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery at site of oil immersed naturally cooled 11kV/240V, 11/ 3kV/240V single phase distribution transformers for outdoor use.
- 1.2 The equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specifications and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether these are specifically brought out in this specification and/or the commercial order or not.
- 1.3 The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in the operation and maintenance of equipment.
- 1.4 All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.
- 1.5 **STANDARD RATINGS**
- 1.5.1 Standard ratings of single phase transformers shall be 5, 10, 16 and 25 kVA.

2 STANDARDS:

- 2.1 The materials shall conform in all respects to the relevant Indian Standard, with latest amendments there of unless otherwise specified herein; some of them are listed below.
- 2.2 Material conforming to the internationally accepted standards, which ensure equal or better quality than the standards mentioned above would also be acceptable. In case the bidder who wishes to offer material conforming to the other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English translation shall be furnished along with the offer.

3 SERVICE CONDITIONS:

Indian Standards	Title	International Standards
IS-2026	Specification for Power Transformers	IEC 76
IS 1180 (Part-I): 2014	Outdoor Type Oil Immersed Distribution Transformers upto and including 2500kVA, 33kV- Specification	
IS 12444	Specification for Copper wire rod	ASTM B-49
IS-335	Specification for Transformer/Mineral Oil	IEC Pub 296
IS-5	Specification for colors for ready mixed paints	
IS-104	Ready mixed paint, brushing zinc chromate, priming	
IS-2099	Specification for high voltage porcelain bushing	
IS-649	Testing for steel sheets and strips and magnetic circuits	
IS-3024	Cold rolled grain oriented electrical sheets and strips	
IS -4257	Dimensions for clamping arrangements for bushings	
IS -7421	Specification for Low Voltage bushings	

IS -3347	SpecificationforOutdoorBushings	DIN42531 to 33
IS -5484	SpecificationforAIWirerods	ASTMB- 233
IS -9335	Specification forInsulating Kraft Paper	IEC554
IS -1576	SpecificationforInsulatingPressBoard	IEC641
IS -6600	GuideforloadingofoilImmersedTransformers	IEC76
IS -2362	Determination of watercontent in oil forporcelain bushingoftransformer	
IS -6162	Papercovered Aluminumconductor	
IS -6160	RectangularElectricalconductorforelectricalmachines	
IS -5561	Electricalpowerconnector	
IS -6103	Testingof specificresistanceof electrical insulatingliquids	
IS -6262	Method of testfor powerfactorand dielectric constant of electrical insulating liquids	
IS -6792	Determination of electricalstrength ofinsulating oil	
IS -10028	Installationandmaintenance oftransformers.	

3.1 The distribution transformer to be supplied against this specifications shall be suitable for satisfactory continuous operation under the following climatic conditions as per IS 2026 (Part-I).

- i) Location : At various locations in the country
- ii) Max ambient air temperature (°C) : 50
- iii) Minimum ambient air temperature (°C) : -5
- iv) Maximum Averaged daily ambient air temperature (°C) : 40
- v) Maximum Yearly weighted average ambient temperature (°C) : 32
- vi) Maximum altitude above 5000 meters mean sea level (metres) :

For HP, J&K, Uttarakhand, Sikkim,
Assam, Meghalaya,
Manipur, Nagaland, Tripura, Arunachal
Pradesh and Mizoram

1. The climatic conditions specified above are indicative and can be changed by the user as per requirements.

2. The equipments shall generally be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth unless otherwise specified.

4 PRINCIPAL PARAMETERS:

4.1 The Transformer shall be suitable for outdoor installation with single phase, 50Hz, 11 kV systems in which the neutralise effectively earthened and they should be suitable for service under fluctuations in supply voltage up to plus 12.5% to minus 12.5%.

4.2 The transformers shall conform to the following specific parameters. Rated HV side value (11kV or 11/ 3 kV) shall be specified in the detailed bill of quantity by purchaser.

Sl.No	ITEM	SPECIFICATION
1.	System voltage(max)	7/ 12kV
2.	Rated voltage HV Rated	11/ 3 or 11 kV 240 V*
3.	Frequency	50 Hz +/-5%
4.	No.of Phases	Single
5.	Type of cooling	ONAN

4.3 INSULATION LEVELS

Voltage(Volts)	Impulse Voltage (kV Peak)	Power Frequency(kV)
433	-	3
11000	75	28
11000/ 3	60	20

5 TECHNICAL REQUIREMENTS:

5.1 CORE MATERIAL:

- 5.1.1 Transformer core shall be wound core type construction using new and high quality cold rolled grain oriented (CRGO) steel with heat resistant insulating coating or Amorphous metal.
- 5.1.2 The bidders should offer the core for inspection and approval by the purchaser during manufacturing stage. CRGO steel for core shall be purchased only from the approved vendors, list of which is available at <http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20kV-CM%20List.pdf>
- 5.1.3 The transformers shall be suitable for overfluxing (due to combined effect of voltage and frequency) upto 12.5% without injurious heating. The operating flux density shall be such that there is a clear safety margin over the overfluxing limit of 12.5%.
- 5.1.4 No-load currents shall not exceed 3% of full load current and will be measured by energizing the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 6% of full load current.
- 5.1.5 Please refer to "Check-list for Inspection of Prime quality CRGO for Transformers" attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

5.2 WINDINGS MATERIALS:

- 5.2.1 HV and LV windings shall be wound from Aluminum/Copper conductors covered with double paper/enamel. The interlayer insulation shall be of nomex/epoxy resin dotted kraft paper.
- 5.2.2 Proper bonding of interlayer insulation with the conductor shall be ensured. Test for bonding strength to be conducted.
- 5.2.3 The core coil assembly shall be dried in an oven. The type of windings shall be indicated in the tender. Whether LV windings are of conventional type or foil wound shall be indicated.
- 5.2.4 Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in guaranteed technical particulars (GTP).
- 5.2.5 The core coil assembly shall be securely held in position to avoid any movement under short circuit conditions.
- 5.2.6 Joints in the windings shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

5.3 WINDING CONNECTION AND TERMINAL ARRANGEMENTS:

- 5.3.1 For 11kV transformers both ends of primary windings shall be brought out through HV bushings. For 11/ 3kV transformers, neutral end of the primary HV windings shall be brought out for connecting to 'Neutral' supply wire through 1kV bushings. There shall be provision for connecting 'Neutral' terminal, to local 'Earth' by way of a tinned Copper strip of adequate size and dimension. The secondary windings shall be connected to two LV bushings.

5.4 OIL:

- 5.4.1 The insulating oil shall comply with the requirements of IS 335. Use of recycled oil is not acceptable. The specific resistance of the oil shall not be less than 2.5×10^{12} ohm-cm at 27°C when tested as per IS 6103.
- 5.4.2 Oil shall be filtered and tested for breakdown voltage (BDV) and moisture content before filling
- 5.4.3 The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

6 LOSSES:

- 6.1 The bidder shall guarantee individually the no-load loss and load loss without any positive tolerance. The bidder shall also guarantee the total losses (no load + load losses at 75°C) at the 50% of rated load and total losses at 100% of rated shall not exceed the maximum total loss values given in Table-9 of IS 1180 (Part-1):2014.
- 6.2 The maximum allowable losses at rated voltage and rated frequency permitted at 75°C for 11/0.433kV transformers can be chosen by the utility as per Table-9 for ratings 5, 10, 16, 25kVA as per Energy Efficiency Level-2 specified in IS 1180 (Part-1):2014 for single phase distribution transformers.

6.2 The above losses are maximum allowable and there would not be any positive tolerance. Bids with higher losses than the above specified values would be treated as non-responsive. However, the manufacturer can offer losses less than above stated values. The utility can evaluate offers with losses lower than the maximum allowable losses on total owning cost basis in accordance with methodology given in Annex-I.

7 PERCENTAGE IMPEDANCE:

- 7.1 The percentage impedance of single-phase transformers at 75⁰C for different ratings up to 25kVA shall be as per Table 9 of IS 1180 (Part-1):2014.
- 8 TEMPERATURE RISE:**
- 8.1 The permissible temperature rise shall be as per IS: 1180
- 8.2 Bids not conforming to the above limits of temperature rise will be treated as non-responsive.
- 9 PENALTY FOR NON PERFORMANCE**
- 9.1 During testing at supplier's works if it is found that the actual measured losses are more than the values quoted by the bidder, the purchaser shall reject the transformer and he shall also have the right to reject the complete lot.
- 9.2 Purchaser shall reject the entire lot during the test at supplier's works, if the temperature rise exceeds the specified values.
- 9.3 Purchaser shall reject any transformer during the test at supplier's works, if the impedance values differ from the guaranteed values including tolerance and if they do not meet the requirements of clause 7.1
- 10 BUSHINGS:**
- 10.1 The bushings shall be either porcelain or epoxy type and shall conform to the relevant standards specified. Polymer insulator bushings conforming with relevant IEC can also be used.
- 10.2 For HV, 12 kV class bushings shall be used and for LV, 1 kV class bushings shall be used.
- 10.3 The terminal arrangements shall not require separate oil chamber not connected to oil in the main tank.
- 10.4 The HV bushings shall be fixed to the top cover of the transformer and the LV bushings shall be fixed to transformer on sides and in the same plane.
- 10.5 The bushing rods and nuts shall be of brass/stainless steel.
- 10.6 Arcing horns will be provided on HV bushings shall not have arcing horns and 1 clamp for LA shall also be provided for each HT bushing. Supply of LA is not included in DT supplier's scope.
- 10.7 Bushings shall be marked with manufacturer's name, month and year of manufacture.
- 11 BUSHING TERMINALS:**
- 11.1 HV terminal shall be designed to directly receive ACSR conductor up to 7/2.59mm (without requiring the use of lug) and the LV terminal shall be suitable for directly receiving LT cables (aluminum) ranging from 10 Sqmm to 25 Sqmm both in vertical and horizontal position and the arrangements should be such as to avoid bimetallic corrosion. Terminal connectors must be type tested as per IS 5561.
- 12 TANK:**
- 12.1 The oil volume inside the tank shall be such that even under the extreme operating conditions, the pressure generated inside the tank does not exceed 0.4kg/sq.cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion.
- 12.2 The tank cover shall have plasticized surface at the top to guard against bird faults. Alternately, suitable insulating shroud shall be provided on the bushing terminals.
- 12.3 The Transformer tank shall be of robust construction round/rectangular in shape and shall be built up of

tested CRCA/Mild Steel Sheet.

- 12.4 The tank shall be capable of withstanding a pressure of 1 kg/cm^2 (g) and a vacuum of 760 mm of Hg for 30 minutes without any permanent deflection (Air pressure tests shall be conducted as per IS-1180 (Part-I):2014).
- 12.5 The L-seam joint, C-seam joint and all fittings and accessories shall be oil tight and no deflection / bulgings should occur during service.
- 12.6 Manufacturer should carry out the all the welding operations as per the relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificates to the Purchaser.
- 12.7 The circular bottom plate edges of the tank should be folded upward, for at least 25 mm, to have sufficient overlap with vertical sidewall of the transformer.
- 12.8 The Transformer tank and the top covers shall be designed in such a manner as to leave no external pockets in which water can lodge.
- 12.9 Tank shall have permanent lugs for lifting the transformer body and there shall be facilities for lifting the core coil assembly separately.
- 12.10 The transformers shall be provided with two mounting lugs suitable for fixing the transformer to a single pole by means of 2 bolts of 20 mm diameter as per ANSI C 57.12.20-1988.
- 12.11 Both mounting lugs are made with steel of minimum 5 mm thickness.
- 12.12 Jump proof lips shall be provided for upper mounting lug.
- 12.13 Mounting lug faces shall be in one plane.
- 12.14 Minimum Oil level mark shall be embossed inside the tank (at 25°C).
- 12.15 The top covers shall be fixed to the tank through clamping only.
- 12.16 HV bushing pocket shall be embossed to top side of the top covers so as to eliminate ingress of moisture and water.
- 12.17 The edges of the top cover shall be formed, so as to cover the top end of the tank and gasket.
- 12.18 Nitrile/polyurethane/neoprene rubber gaskets conforming to latest IS 4253 part-II shall be provided between tank and top cover.
- 12.19 The gaskets shall be continuous i.e. without any joint.

13 TANK SEALING:

- 13.1 The space on the top of the oil shall be filled with dry air or nitrogen. The nitrogen plus oil volume inside the tank shall be such that even under extreme operating conditions, the pressure generated inside the tank does not exceed 0.4 kg/sq.cm positive or negative. The nitrogen shall conform to commercial grade of the relevant standards.

14 SURFACE PREPARATION AND PAINTING:

14.1 GENERAL

14.1.1 All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

14.1.2 All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations.

14.2 CLEANING AND SURFACE PREPARATION:

14.2.1 After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting. Steel surfaces shall be prepared by Shotblast cleaning (IS 9954) to grade Sa. 2.5 of ISO 8501-1 or chemical cleaning including phosphating (IS 3618).

14.2.2 The pressure and volume of the compressed air supply for blast cleaning shall meet the work requirements and shall be sufficiently free from all water contamination to ensure that the cleaning process is not impaired.

14.2.3 Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale and shall only be used where shotblast cleaning is impractical. Manufacturer shall indicate such location, for purchaser's information, in his offer.

14.3 PROTECTIVE COATING:

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

14.4 PAINT MATERIAL:

Following are the types of paint that may be suitably used for the items to be painted at shop and supply of matching paint to site:

14.4.1 The painting shall be as per Annexure-Paint which is attached herewith.

14.4.2 For external surfaces one coat of Thermo Setting paint or 1 coat of epoxy primer followed by 2 coats of polyurethane base paint. These paints can be either air-drying or stoving.

14.4.3 In case of highly polluted area, chemical atmosphere or at a place very near the sea coast, paint as above with one intermediate coat of high build MIO (Micaceous iron oxide) as an intermediate coat may be used to give a total dry film thickness of 150 to 180 microns.

14.5 PAINTING PROCEDURE:

14.5.1 All prepared steel surfaces should be primed before visible rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.

14.5.2 Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coating and apply another. In all instances where two or more coats of the same paint are specified, such coatings may or may not be of contrasting colours.

14.5.3 DAMAGED PAINT WORK:

14.5.4 Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally employed.

14.5.5 Any damaged paint work shall be made good as follows:

- 14.5.6 The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
- 14.5.7 A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.
- 14.5.8 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the painted edges before and after priming.
- 14.6 DRY FILM THICKNESS:
- 14.6.1 To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats may or may not be of the same colour.
- 14.6.2 Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.
- 14.6.3 Particular attention must be paid to full film thickness at edges.
- 14.7 TESTS:
- The painted surfaces shall be tested for paint thickness.
 - The painted surfaces shall pass the cross-hatch adhesion test and impact test as routine test, Salt spray and Hardness test as per the relevant ASTM standards.
- 14.8 The paint shade shall be as per Annexure-Paint which is attached herewith.
- Note: Supplier shall guarantee the painting performance requirement for a period of not less than 5 years.
- 15 RATING AND TERMINAL PLATES:
- 15.1 Each transformer shall be provided with rating plate made of anodized aluminum/stainless steel material securely fixed on the outer body, easily accessible, showing the information given in Fig. 2 of IS 1180 (Part-1): 2014 for single phase transformers. The entries on the rating plates shall be indelibly marked by engraving.
- 15.2 Each transformer shall be provided with a terminal marking plate in accordance with Fig. 5 of IS 1180 (Part-1): 2014. The rating and terminal marking plates may be combined into one plate at the option of manufacturer.
- 15.3 The distribution transformer be marked with the Standard Mark and the use of Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and regulations made thereunder. As per Quality Control Order for Electrical Transformers- 2015, issued by Dept. of Heavy Industries, the Standard / ISI marking on Distribution Transformers is mandatory and the product should be manufactured in compliance with IS 1180 Part-1: (2014).
- 16 PRESSURE AND VACUUM REQUIREMENTS:
- 16.1 Single phase transformers up to 25kVA, the transformer tank shall be of robust construction, round in shape shall be capable of withstanding pressure of 100kPa and a vacuum of 760mm of mercury.
- 17 FITTINGS:
- 17.1 The following standard fittings shall be provided :
- 17.1.1 Two earthing terminals with earthing symbol.
- 17.1.2 Lifting lugs for the complete transformer as well as for core and winding assembly.

- 17.1.3 HV side neutral grounding strip (where one of the bushing terminal is connected to earth).
- 17.1.4 Rating and terminal marking plates. (Non detachable type)
- 17.1.5 Pressure relief device or self-ventilating cover
- 17.1.6 HV bushings.
- 17.1.7 LV bushings.
- 17.1.8 HV and LV terminal connectors.
- 17.1.9 Top cover fixing clamps.
- 17.1.10 Mounting lugs - 2 Nos.
- 17.1.11 Bird guard.
- 17.1.12 LV earthing arrangement.
- 17.1.13 Any other fitting required as per IS: 1180 (Part 1)

18 FASTENERS:

- 18.1 All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.
- 18.2 Bolts or studs shall not be less than 6 mm diameter except when used for small wiring terminals.
- 18.3 All nuts and pins shall be adequately locked.
- 18.4 Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.
- 18.5 All bolts/nuts/washers exposed to atmosphere should be as follows.
 - a) Size 12 mm or below – Stainless steel
 - b) Above 12 mm- steel with suitable finish like electro galvanized with passivation or hot dip galvanized.
- 18.6 Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay systems. If bolts and nuts are replaced so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.
- 18.7 The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.
- 18.8 Taper washers shall be provided where necessary. Protective washers of suitable material shall be provided front and back of the securing screws.

19 OVERLOAD CAPACITY:

- 19.1 The transformers shall be suitable for loading as per latest IS 6600.

20 TESTS:

All the equipment offered shall be fully type tested by the bidder as per the relevant standards including the additional type tests mentioned at clause 23. The type test must have been conducted on a transformer of same design during the last five years at the time of

bidding. The bidder shall furnish four sets of type test reports along with the offer. In case, the offered transformer is not type tested, the bidder will conduct the type test as per the relevant standards including the additional type tests at his own cost in CPRI / NABL accredited laboratory in the presence of employers representative(s) without any financial liability to employer in the event of order placed on him.

- 20.1 Special tests other than type and routine tests, as agreed between purchaser and bidder shall also be carried out as per the relevant standards
- 20.2 The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted with the bid. However, if the same are not available at the time of bidding, the same may be submitted after order but before commencement of supply.
- 20.3 The procedure for testing shall be in accordance with IS 1180 (Part-1): 2014/2026 as the case may be except for temperature rise.
- 20.4 Before dispatch each of the completely assembled transformers shall be subjected to the routine tests at the manufacturer's works.
- 21 ROUTINE TESTS:**
- 21.1 Ratio, polarity tests.
- 21.2 No load current and losses at service voltage and normal frequency.
- 21.3 Load losses at rated current and normal frequency.
- 21.4 Impedance Voltage test.
- 21.5 Resistance of windings cold (at or near the test bed temperature).
- 21.6 Insulation resistance.
- 21.7 Induced over voltage withstand test.
- 21.8 Separate source voltage withstand test. This test will not be applicable for single phase DTs with 11/ 3 kV as primary voltage.
- 21.9 Oil sample test (one sample per lot) to comply with IS 1866.
- 21.10 Air pressure test on empty tank as per IS 1180
- 22 TYPETESTS TO BE CONDUCTED ON ONE UNIT:**
- In addition to the tests mentioned above following tests shall be conducted:
- 22.1 Temperature rise test for determining the maximum temperature rise after continuous full load run. The ambient temperature and time of test should be stated in the test certificate.
- 22.2 Impulse voltage withstand test: As per IS 2026 part-III. Basic insulation level (BIL) for 11 kV shall be 75 kV peak while for 11/ 3 kV, it will be 60KVp
- 22.3 Air pressure test: As per IS 1180 (Part-I): 2014.
- 22.4 Short circuit withstand test: Thermal and dynamic ability.

- 22.5 Oil samples (Post short circuit and temperature rise test) - Only DGA & BDV test shall be conducted.
- 22.6 Noise level measurement.
- 22.7 Permissible flux density and overfluxing withstand test.
- 22.8 Type test certificates for the tests carried out on prototype of same specifications shall be submitted along with the bid.
- 22.9 The purchaser may select the transformer for type tests randomly.

23.10 Short Circuit Test and Impulse Voltage Withstand Test: The purchaser intends to procure transformers designed and successfully tested for short circuit and impulse test. In case the transformers proposed for supply against the order are not exactly as per the tested design, the suppliers shall be required to carry out the short circuit test and impulse voltage withstand test at their own cost in the presence of the representative of the purchaser.

23.11 The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test.

23.12 Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations.

23.13 It may also be noted that the purchaser reserves the right to conduct short circuit test and impulse voltage test in accordance with the IS, afresh on each order rating at purchaser's cost, even if the transformer of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the purchaser either at their works when they are offered in a lot for supply or randomly from the supplies already made to purchaser's Stores. The findings and conclusions of these tests shall be binding on the supplier.

24 TESTS AT SITE:

24.1 The purchaser reserves the right to conduct all tests on transformer after arrival at site and the manufacturer shall guarantee test certificate figures under actual service conditions.

25 ACCEPTANCE TESTS:

25.1 The transformers shall be subjected to the following routine/acceptance test in the presence of purchaser's representative at the place of manufacture before despatch without any extra charges. The testings shall be carried out in accordance with IS 1180, Part-1 (2014) and IS 2026. Checking of mass, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish and workmanship as per GTP/QA plan and contract drawings.

25.2 Physical verification of core coil assembly and measurement of flux density of one unit of each rating, in every inspection with reference to short circuit test report.

25.3 All tests as specified in clause 22.

26 INSPECTION:

26.1 In respect of raw materials such as core stampings, winding conductors, insulating paper and oil, suppliers shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers' test certificate as well as the proof of purchase from the manufacturers (excise gate pass) for information of the purchaser. The bidders shall furnish following documents along with their offer in respect of the raw materials:

- 26.1.1 Invoice of supplier.
- 26.1.2 Mill's certificate.
- 26.1.3 Packing List.
- 26.1.4 Bill of lading.
- 26.1.5 Bill of entry certificate by custom.
 Please refer to "Check-list for Inspection of Prime quality CRGO for Transformers" attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.
- 26.2 To ensure about the quality of transformers, the inspections shall be carried out by the purchaser's representative at following stages:
- 26.2.1 Online any time during receipt of raw material and manufacture/assembly whenever the purchaser desires.
- 26.2.2 When the raw material is received, and the assembly is in process in the shop floor.
- 26.2.3 At finished stage i.e. transformers are fully assembled and are ready for despatch.
- 26.3 After the main raw materials i.e. core and coil materials and tanks are arranged and transformers are taken for production in shop floor and a few assembly have been completed, the firm shall intimate the purchaser in this regard, so that an officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the stage inspection a few assembled cores shall be dismantled (only in case of CRGO material) to ensure that the CRGO laminations used are of good quality. Further, as and when the transformers are ready for despatch, an offer intimating about the readiness of transformers, for final inspection for carrying out tests as per relevant IS and as in clauses above, shall be sent by the firm along with routine test certificates. The inspections shall normally be arranged by the purchaser at the earliest after receipt of offer for pre-delivery inspection.
- 26.4 In case of any defect/defective workmanship observed at any stage by the purchaser's inspecting officer; the same shall be pointed out to the firm in writing for taking remedial measures. Further processing should only be done after clearance from the inspecting officer/purchaser.
- 26.5 All tests and inspections shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the inspector representing the purchaser all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include stage inspection during manufacturing stages as well as active part inspection during acceptance tests.
- 26.6 The manufacturer shall provide all services to establish and maintain quality of workmanship in his work and that of his sub-contractors to ensure the mechanical/electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 9000.
- 26.7 Along with the bid the manufacturer shall prepare Quality Assurance Plan (QAP) identifying the various stages of manufacture, quality checks performed at each stage and the customer hold points. The documents shall also furnish details of method of checking, inspection and acceptance standards/value and get the approval of purchaser or his representative before proceeding with manufacturing. However, purchaser or his representative shall have the right to review the inspection reports, quality checks and results of manufacturer's in-house inspection department which are not customer hold points and the manufacturer shall comply with the remarks made by purchaser or his representative on such reviews.

with regard to further testing, rectification or rejection etc. Manufacturers should submit the list of equipment for testing along with latest calibration certificates to the purchaser.

26.8 Purchaser shall have every right to appoint a third party inspection to carry out the inspection process. The purchaser has the right to have the test carried out at his own cost by an independent agency wherever there is a dispute regarding the quality of supply. Purchaser has right to test 1% of the supply selected either from the stores or field to check the quality of the product. In case of any deviation purchaser has every right to reject the entire lot or penalise the manufacturer, which may lead to blacklisting among other things.

27 QUALITY ASSURANCE PLAN:

27.1 The bidders shall invariably furnish following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of material offered.

27.2 Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw materials in presence of bidder's representative and copies of test certificates.

27.3 Information and copies of test certificates as above in respect of bought out accessories.

27.4 List of manufacturing facilities available.

27.5 Level of automation achieved and list of areas where manual processing exists.

27.6 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

27.7 List of testing equipment available with the bidder for final testing of equipment along with valid calibration report shall be furnished with the bid. Manufacturers shall possess 0.1 accuracy class instruments for measurement of losses.

27.8 Quality assurance plan with hold points for purchaser's inspection.

27.9 The successful bidder shall within 30 days of placement of order, submit following information to the purchaser.

27.9.1 List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

27.9.2 Type test certificates of the raw materials and bought out accessories.

27.10 The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.

27.11 ISI marking on the transformer is mandatory. As per Quality Control Order for Electrical Transformers- 2015, issued by Dept. of Heavy Industries, the Standard / ISI marking on Distribution Transformers is mandatory and the product should be manufactured in compliance with IS 1180 Part-1: (2014).

28 DOCUMENTATION:

28.1 Completely dimensioned drawings indicating general arrangement and details of fittings, clearances and winding details shall accompany the tender.

28.2 Drawings of internal constructional details and fixing details of coils should also be indicated. Tank dimensions, position of fittings, clearances between leads within the transformer, core grade of laminations, distance of core centers, area of conductor bare and within insulation. No. of coils, No. of turns per coil material

lofbushingmetalpartsetc.,shallalsobefurnishedwithtender.

29 PACKINGandFORWARDING:

29.1 Thepackingshall bedoneas per themanufacturer'sstandardpractice. However,heshouldensurethepackingissuchthat,thematerialshouldnotgetdamagedduringtransit by rail/road.

29.2 The markingoneachpackageshall beas pertherelevantIS.

30 GUARANTEE:

31.1 The manufacturers of the transformer shall provide a guarantee of 60 months from the date of receipt of transformer at the stores of the Utility. In case the transformer fails within the guarantee period, the supplier will depute his representative within 15 days from date of intimation by utility for joint inspection. In case, the failure is due to the reasons attributed to supplier, the transformer will be replaced/repared by the supplier within 2 months from date of joint inspection.

31.2 The outage period i.e. period from the date of failure till unit is repaired/replaced shall not be counted for arriving at the guarantee period.

31.3 In the event of the supplier's inability to adhere to the aforesaid provisions, suitable penal action will be taken against the supplier, which may inter alia include blacklisting of the firm for future business with the purchaser for a certain period.

Methodology for computing total owning cost
 Annex-I

TOC = IC + (AxWi) + (BxWc) ; Losses in KW			
Where,			
TOC	=	Total Owing Cost	
IC	=	Initial cost including taxes of transformer as quoted by the manufacturer	
A factor	=	Cost of no load losses in Rs/KW	(A = 288239)
B factor	=	Cost of load losses in Rs/KW	(B = 93678)
Wi	=	No load losses quoted by the manufacturer in KW	

Wc = Load losses quoted by the manufacturer in KW

Note:

No (+)ve tolerance shall be allowed at any point of time on the quoted losses after the award. In case, the losses during type testing ,routine testing etc. are found above the quoted losses, the award shall stand cancelled. In such a case, the CPG money shall also be forfeited.

Annexure-Paint

	Surface Preparation	primer coat	intermediate under coat	finish coat	total DFT	Colour shade
Main tank, pipes, conservator tank, etc. (External surfaces)	Blast cleaning Sa2½	Epoxy base Zinc primer 30-40 micron	Epoxy base Zinc primer 30-40 micron	Aliphatic Polyurethane (PU Paint) (min 50 micron	Min 110 micron	541 shade of IS:5

Main tank, pipes (above 80 NB), conservator tank, etc (Internal surfaces)	Blast cleaning Sa2½	Hot oil resistant, non-corrosive varnish or paint	--	--	Min 30 micron	Glossy white for paint
Radiator (External surfaces)	Chemical / blast cleaning (Sa2½)	Epoxy base zinc primer 30-40 micron	Epoxy base Zinc primer Min 30-40 micron	Aliphatic Polyurethane(PU Paint) (min)50 micron	Min 110 micron	541 shade of IS:5
Radiator and pipes up to 80 NB (Internal surfaces)	Chemical cleaning if required	Hot oil proof low viscosity varnish or hot oil resistant non corrosive paint	--	--	--	Glossy white for paint

Painting-Transformer Main tank, pipes, Conservator Tank, Radiator etc.-

Schedule I A

GUARANTEED TECHNICAL PARTICULARS FOR COMPLETELY SELF PROTECTED DISTRIBUTION TRANSFORMERS

Sl.No. Description 6.3kVA 10 kVA 16kVA 25kVA

1. Name of the manufacturer and place of manufacture
2. Continuous maximum rating as per this specification.
3. Normal ratio of transformer

4. Method of connection HV/LV
5. Maximum current density in Windings :
 1. HV (A/sqmm)
 2. LV (A/sqmm)
6. Maximum hotspot temperature⁰C. (Ambient air temperature on which above is based)⁰C.
7. Maximum temperature:⁰C
 - (a) Maximum observable oil temperature (ambient air temperature on which above is based)
 - (b) Maximum winding temperature at ambient temperature of
8. No-load losses at rated voltage (watt)
9. Full load losses at 75⁰C (watt)
10. Total losses at 100% load (watt)
11. Total losses at 50% load (watt)
12. Efficiency at normal voltage :
 - (i) Unity Power Factor
 - (a) At 50% load
 - (b) At 75% load
 - (c) At full load
 - (ii) 0.8 Power Factor
 - (a) At 50% load
 - (b) At 75% load
 - (c) At full load
13. Regulation as percentage of normal voltage:
 - (a) At unity power factor
 - (b) At 0.8 power factor lagging
14. Percentage impedance voltage at normal ratio between HV and LV windings
15. Type of transformers, CRGO/ amorphous type
16. Type of Insulation used in
 - HV Winding
 - LV Windings
17. Type of insulation used in
 - Core bolts
 - Core bolt washers
 - End plates
 - Core lamination
18. Impulse withstand test voltage level (kV)
 - HV Windings
 - LV Windings
19. Characteristics of transformer oil
20. Total content of oil in litres

- 21. Whether transformer will be transported without?
- 22. Type of transformer tank
- 23. Approximate overall dimensions

- a) Height mm
- b) Length mm
- c) Width mm

Tank dimensions

- a) Diameter mm
- b) Height mm

- 24. Mass of insulated conductor
 - HV (minimum) kg
 - LV (minimum) kg
- 25. Mass of core (minimum) kg (CRGO or amorphous metal)
- 26. Mass of complete transformer arranged for transport (kg)

ADDITIONAL DETAILS

Schedule I B

Sl.No.	Description	
1.	Core grade	
2.	Core dimensions	mm
3.	Gross core area	cm ²
4.	Net Core area	cm ²
5.	Flux density	Tesla
6.	Mass of Core	kg
7.	Loss per kg of core at the specified flux density	watt
8.	Core window height	mm
9.	Center to center distance of the core	mm
10.	No. of LV Turns	

11.	No. of HVturns	
12.	Size of LV Conductorbare/ covered(dia)	mm
13.	Size of HV conductorbare/covered(dia)	mm
14.	No.ofparallels	
15.	CurrentdensityofLVwinding	A/sq mm
16.	CurrentdensityofHVwinding	A/sq mm
17.	Massof the LV winding forTransformer	kg
18.	Massofthe HVwinding forTransformer	kg
19.	No.ofofLVCoils/phase	
20.	No. of HVcoils.phase	
21.	Height ofLVWindings	mm
22.	Height ofHVwinding	mm
23.	ID/ODofLVwindingHV	mm
24.	ID/ODofLVwinding	mm
25.	Sizeofthe ductinLVwinding	mm
26.	Sizeofthe ductinHVwinding	mm
27.	Sizeofthe ductbetween HV andLV	mm
28.	HV windingto LVclearance	mm
29.	HV windingto tank clearance	mm
30.	Calculatedimpedance	%
31.	HVto earthcreepagedistance	mm
32.	LV to earthcreepagedistance	mm

Schedule I I

SOURCEOFMATERIALS/PLACESOFMANUFACTURE, TESTINGAND

INSPECTION

Sl.No.	Item	Sourceof Material	PlaceofManu facture	Placeoftesti ngandinspe ction
1.	Laminations			
2.	Aluminium/Copper			
3.	Insulated windingwires			

4.	Oil			
5.	Pressboards			
6.	Kraftpaper			
7.	MSplates/Angles/Channels			
8.	Gaskets			
9.	Bushing HV/LV			
10.	Paints			

Annexure - A

Check-list for Inspection of Prime quality CRGO for Transformers

During inspection of PRIME CRGO, the following points needs to be checked by the Transformer manufacturer. Utility's inspector shall verify all these points during inspection:-

ii) In case PRIME CRGO cutting is at works of Transformer Manufacturer:

Review of documents:

Purchase Order (unpriced) to PRIME CRGO supplier/Authorised Agency
 Manufacturer's test certificate

Invoice of the Supplier

Packing List

Bill of Lading

Bill of Entry Certificate by Customs Deptt.

Reconciliation Statement as per format below
 Certificate of Origin
 BIS Certification

Format for Reconciliation/Traceability records

Packing List No./date /Quantity of PRIME CRGO received

Name of Manufacturer

Manufacturer test certificate No./date

Serial No.	Details of Package/Job	Drawing reference	Quantity Involved	Commulative Quantity Consumed	Balance Stock

(iii) .1 Inspection of PRIME CRGO Coils:

PRIME CRGO-Manufacturer's Identification Slip on PRIME CRGO Coils
 Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).
 Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.
 ISI logo sticker on packed mother coil and ISI logo in Material TC.

2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

3 Inspection of PRIME CRGO laminations: Transformer manufacturer will maintain records for traceability of laminations to prime CRGO coils and burr/bow on laminations shall be measured. Utility can review these records on surveillance basis.

4. Inspection at the time of core building:
 Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/ rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in A.2.2 above.

Above tests shall be witnessed by Utility. In case testing facilities are not available at Manufacturer's work, the sample(s) sealed by Utility to be sent to approved labs for testing.

Inspection Clearance Report would be issued after this inspection

(ii) In case PRIME CRGO cutting is at Sub-vendor of Transformer Manufacturer:
 Review of documents:

Purchase Order (unpriced) to PRIME CRGO supplier/ Authorised Agency

Purchase Order (unpriced) to Core Cutter

Manufacturer test certificate

Invoice of the Supplier

Packing List

Bill of Lading

Bill of Entry Certificate by Customs Deptt.

Reconciliation Statement as per format below

Certificate of origin

BIS Certification

Format for Traceability records as below:-

Packing List No./date /Quantity of PRIME CRGO received

Serial No.	Name of consumer	Details of Package/Job	Drawing reference	Quantity Involved	Commulative Quantity Consumed	Balance Stock	Dispatch

(iv) .1 Inspection of PRIME CRGO Coils:

PRIME CRGO-Manufacturer's Identification Slip on PRIME CRGO Coils

Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).

Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.

ISI logo sticker on packed mother coil and ISI logo in Material TC.

- 2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla, thickness depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

3 Inspection of PRIME CRGO laminations:

Transformer manufacturer representative will inspect laminations and issue their internal Inspection Clearance Report. Inspection will comprise of review of traceability to prime CRGO coils, visual Inspection of PRIME CRGO laminations and record of burr/bow. After clearance given by transformer manufacturer, Utility will issue an Inspection Clearance Report after record review. If so desired by Utility, their representative may also join transformer manufacturer representative during this inspection.

Inspection Clearance Report would be issued after this inspection

vii) Inspection at the time of core building:

Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in B.2.2.

Inspection Clearance Report would be issued after this inspection

NOTE :-

a) Transformer Manufacturer to ensure that PRIME CRGO is procured from POWERGRID approved vendors and CRGO manufacturer should have valid BIS Certificate for respective offered Grade.

14.2 Transformer Manufacturer should also involve themselves for ensuring the quality of CRGO laminations at their Core Cutter's works. They should visit the works of their Core cutter and carry out necessary checks.

b) General

If a surveillance sample is drawn and sent to TPL (if testing facility not available with the manufacturer), the Transformer manufacturer can continue manufacturing at their own risk and cost pending TPL test report on PRIME CRGO sample drawn. Decision for acceptance of PRIME CRGO shall be based upon report of the sample drawn.

These checks shall be read in-conjunction with approved Quality Plan, specification as a whole and conditions of contract.

Sampling Plan (PRIME CRGO)

33 / 11 kV	-1 st transformer and subsequently at random 10% of Transformers (min. 1) offered for inspection.
DTs and other ratings	-1 st transformer and subsequently at random 2% of Transformers (min. 1) offered for inspection.

NOTE:- One sample for each lot of CRGO shall be drawn on surveillance basis.

CRGO has to be procured only from POWERGRID approved vendors. List of such vendors is available at the following website. Since the list is dynamic in nature, the site may be checked from time to time to see the list of approved vendors.

<http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20kV-CM%20List.pdf>

3-Phase Distribution Transformers 11 or 33 kV/433-250V (Outdoor Type)

1. SCOPE:

i) This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery at site of oil immersed, naturally cooled 3-phase 11kV/433-250V and 33kV/433-250 V distribution transformers for outdoor use.

ii) The equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether these are specifically brought out in this specification and /or the commercial order or not.

iii) The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in operation and maintenance of equipment.

iv) All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

2 STANDARD RATINGS:

The standard ratings shall be 16, 25, 63, 100, 160, 200, 250, 315, 400, 500, 630, 1000, 1250, 1600, 2000 and 2500 kVA for 11 kV distribution transformers and 100, 160, 200, 315, 400, 500, 630, 1000, 1250, 1600, 2000, 2500 kVA for 33 kV distribution transformers.

3 STANDARDS:

3.1 The major materials used in the transformers shall conform in all respects to the relevant/specified Indian Standards and international Standards with latest amendments thereof as on bid opening date, unless otherwise specified herein. Some of the applicable Indian Standards are listed as hereunder:

3.2

Indian Standard	Title	International Standard
IS-2026	Specification for Power Transformers	IEC76
IS1180 (Part-I): 2014	Outdoor Type Oil Immersed Distribution Transformers upto and including 2500 kVA, 33 kV - Specification	
IS12444	Specification for Copper wire rod	ASTMB-49
IS-335	Specification for Transformer/Mineral Oil	IEC Pub296
IS-5	Specification for colors for ready mixed paints	
IS-104	Ready mixed paint, brushing zinc chromate, priming	
IS-2099	Specification for high voltage porcelain bushing	
IS-649	Testing for steel sheets and strips and magnetic circuits	
IS-3024	Cold rolled grain oriented electrical sheets and strips	
IS -4257	Dimensions for clamping arrangements for bushings	
IS -7421	Specification for Low Voltage bushings	
IS -3347	Specification for Outdoor Bushings	DIN42531 to 33
IS -5484	Specification for Al Wire rods	ASTMB- 233
IS -9335	Specification for Insulating Kraft Paper	IEC554
IS -1576	Specification for Insulating Press Board	IEC641
IS -6600	Guide for loading of oil Immersed Transformers	IEC76

IS -2362	Determination of water content in oil for porcelain bushing of transformer	
IS -6162	Paper covered Aluminium conductor	
IS -6160	Rectangular Electrical conductor for electrical machines	
IS -5561	Electrical power connector	
IS -6103	Testing of specific resistance of electrical insulating liquids	
IS -6262	Method of test for power factor and dielectric constant of electrical insulating liquids	
IS -6792	Determination of electrical strength of insulating oil	
IS -10028	Installation and maintenance of transformers.	

4 SERVICE CONDITIONS:

4.1 The Distribution Transformer to be supplied against this Specifications shall be suitable for satisfactory continuous operation under the following climatic conditions as per IS2026(Part-I).

i) Location : At various locations in the country

- ii) Maximum ambient air temperature ($^{\circ}\text{C}$) : 50
- iii) Minimum ambient air temperature ($^{\circ}\text{C}$) : -5
- iv) Maximum average daily ambient air temperature ($^{\circ}\text{C}$): 40
- v) Maximum yearly weighted average ambient temperature ($^{\circ}\text{C}$) : 32
- vi) Maximum altitude above Altitude of 5000 meters mean sea level (meters) :
 for HP, J&K, Uttarakhand, Sikkim, Assam, Meghalaya, Manipur, Nagaland, Tripura, Arunachal Pradesh and Mizoram

Note:

1. The climatic conditions specified above are indicative and can be changed by the user as per requirements.
2. The equipments shall generally be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth unless otherwise specified.

5 PRINCIPAL PARAMETERS:

5.1 The transformers shall be suitable for outdoor installation with three phase, 50Hz, 11kV or 33kV system in which the neutral is effectively earthed and they should be suitable for service with fluctuations in supply voltage up to plus 12.5% to minus 12.5%.

(i) The transformers shall conform to the following specific parameters:

Sl.No.	Item	11kV Distribution Transformers	33kV Distribution Transformers
1	System voltage (Max.)	12 kV	36 kV
2	Rated Voltage (HV)	11 kV	33 kV
3	Rated Voltage (LV)	433 -250V*	433 -250V*
4	Frequency	50 Hz +/-5%*	50 Hz +/-5%
5	No. of Phases	Three	Three
6	Connection HV	Delta	Delta
7	Connection LV	Star (Neutral brought out)	Star (Neutral brought out)
8	Vector group	Dyn-11	Dyn-11
9	Type of cooling	ONAN	ONAN

Audible sound levels (decibels) at rated voltage and frequency for liquid immersed distribution transformers shall be as below (NEMA Standards):

kVA rating	Audible sound levels (decibels)
0-50	48
51-100	51
101-300	55
301-500	56
750	57
1000	58
1500	60
2000	61
2500	62

TECHNICAL REQUIREMENTS:

6.1.1 CORE MATERIAL

6.1.2.1 The core shall be stack/wound type of high grade Cold Rolled Grain Oriented or Amorphous Core annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The completed design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

6.1.2.2 The bidders should offer the core for inspection and approval by the purchaser during manufacturing stage. CRGO steel for core shall be purchased only from the approved vendors, list of which is available at <http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20kV-CM%20List.pdf>

6.1.2.3 The transformer core shall be suitable for overfluxing (due to combined effect of voltage and frequency) upto 12.5% without injurious heating at full load conditions and shall not get saturated. The bidder shall furnish necessary design data in support of this situation.

6.1.2.4 No-load current upto 200kVA shall not exceed 3% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 6% of full load current.

or

No-load current above 200kVA and upto 2500kVA shall not exceed 2% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 5% of full load current.

6.1.2.5 Please refer to "Check-list for Inspection of Prime quality CRGO for Transformers" attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

7 WINDINGS:

(i) Material:

- 7.1.1 HV and LV windings shall be wound from Super Enamel covered / Double Paper covered Aluminum / Electrolytic Copper conductor.
- 7.1.2 LV windings shall be such that neutral formation will be at top.
- 7.1.3 The winding construction of single HV coil wound over LV coil is preferable.
- 7.1.4 Inter layer insulation shall be Nomex/Epoxy dotted Kraft Paper.
- 7.1.5 Proper bonding of interlayer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted.
- 7.1.6 Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in Guaranteed Technical Particulars (GTP Schedule I).
- 7.1.7 The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.
- 7.1.8 Joints in the windings shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

8 TAPPING RANGES AND METHODS:

- 8.1.1 No tapping shall be provided for distribution transformers up to 100 kVA rating.
- 8.1.2 The tapping shall be as per provisions of IS: 1180 Part-I (2014).
- 8.1.3 Tap changing shall be carried out by means of an externally operated self-position switch and when the transformer is in de-energised condition. Switch position No. 1 shall correspond to the maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Arrangement for padlocking shall be provided. Suitable aluminum anodized plates shall be fixed for tap changing switch to know the position number of tap.

9 OIL:

- 9.1 The insulating oil shall comply with the requirements of IS 335. Use of recycled oil is not acceptable. The specific resistance of the oil shall be as per IS 335.
- 9.2 Oil shall be filtered and tested for breakdown voltage (BDV) and moisture content before filling.
- 9.3 The oil shall be filled under vacuum.
- 9.4 The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

10 INSULATION LEVELS:

Sl. No.	Voltage (kV)	Impulse Voltage (kV Peak)	Power Frequency Voltage (kV)
1	0.433	-	3
2	11	75	28
3	33	170	70

11 LOSSES:

11.1 The transformer of HV voltage upto 11kV, the total losses (no-load + load losses at 75⁰C) at 50% of rated load and total losses at 100% of rated load shall not exceed the maximum total loss values given in Table-3 upto 200kVA & Table-6 for ratings above 200kVA of IS 1180 (Part-1):2014.

11.2 The maximum allowable losses at rated voltage and rated frequency permitted at 75⁰C for 11/0.433kV transformers can be chosen by the utility as per Table-3 upto 200kVA and Table-6 for ratings above 200kVA as per Energy Efficiency Level-2 specified in IS 1180 (Part-1):2014 for all kVA ratings of distribution transformers.

11.3 The above losses are maximum allowable and there would not be any positive tolerance. Bids with higher losses than the above specified values would be treated as non-responsive. However, the manufacturer can offer losses less than above stated values. The utility can evaluate offers with losses lower than the maximum allowable losses on total owning cost basis in accordance with methodology given in Annex-I.

12 TOLERANCES:

12.1 No positive tolerance shall be allowed on the maximum losses displayed on the label for both 50% and 100% loading values.

13 PERCENTAGE IMPEDANCE:

The percentage impedance of transformers at 75⁰C for different ratings upto 200kVA shall be as per Table 3 and for ratings beyond 200 kVA shall be as per Table 6 of IS 1180 (Part-1):2014.

14 Temperature rise: The temperature rise over ambient shall not exceed the limits given below:

14.1 The permissible temperature rise shall be as per IS: 1180 (Part-I):2014.

14.2 The transformers shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidders shall submit the calculations sheet in this regard.

15 PENALTY FOR NON PERFORMANCE:

15.1 During testing at supplier's works if it is found that the actual measured losses are more than the values quoted by the bidder, the purchaser shall reject the transformer and he shall also have the right to reject the complete lot.

15.2 Purchaser shall reject the entire lot during the test at supplier's works, if the temperature rise exceeds the specified values.

15.3 Purchaser shall reject any transformer during the test at supplier's works, if the impedance values differ from the guaranteed values including tolerance.

16 INSULATION MATERIAL:

16.1 Electrical grade insulation epoxy dotted Kraft Paper/Nomex and press board of standard make or any other superior material subject to approval of the purchaser shall be used.

16.2 All spacers, axial wedges/runners used in windings shall be made of pre-compressed Pressboard-solid, conforming to type B3.1 of IEC 641-3-2. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges/runners shall be properly milled to dovetail shapes so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations.

17.1 TANK:

- Transformer tank construction shall conform in all respect to clause 15 of IS1180(Part-1):2014.
- The internal clearance of tank shall be such, that it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.
- All joints of tank and fittings shall be oil tight and no bulging should occur during service.
- Inside of tank shall be painted with varnish/ hot oil resistant paint.
- The top cover of the tank shall be slightly sloping to drain rain water.
- The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle/Hook Type.
- Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificate to the customer.

i) PLAIN TANK:

17.2.1 The transformer tank shall be of robust construction rectangular/octagonal/round/elliptical in shape and shall be built up of electrically tested welded mild steel plates of thickness of 3.15mm for the bottom and top and not less than 2.5mm for the sides for distribution transformers up to and including 25kVA, 5.0mm and 3.15mm respectively for transformers of more than 25kVA and up to and including 100 kVA and 6mm and 4 mm respectively above 100kVA. Tolerances as per IS1852 shall be applicable.

17.2.2 In case of rectangular tanks above 100kVA the corners shall be fully welded at the corners from inside and outside of the tank to withstand a pressure of 0.8kg/cm² for 30 minutes. In case of transformers of 100kVA and below, there shall be no joints at corners and there shall not be more than 2 joints in total.

17.2.3 Under operating conditions the pressure generated inside the tank should not exceed 0.4 kg/sq. cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion. The space above oil level in the tank shall be filled with dry air or nitrogen conforming to commercial grade of IS 1747 for DT up to 63 KVA. For DT of 63 KVA and above rating, conservator shall be provided.

(i) The tank shall be reinforced by welded flats on all the outside walls on the edge of the tank.

(ii) Permanent deflection: The permanent deflection, when the tank without oil is subjected to a vacuum of 52.5mm of mercury for rectangular tank and 760mm of mercury for round tank, shall not be more than the values as given below:

(All figures are in mm)

Horizontal length of flat plate	Permanent deflection
Upto and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.0

17.2.4 The tank shall further be capable of withstanding a pressure of 0.8 kg/sq. cm and a vacuum of 0.7 kg/sq. cm (g) without any deformation.

17.2.5 The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise.

17.3 CORRUGATED TANK:

17.3.1 The bidder may offer corrugated tanks for transformers of all ratings.

17.3.2 The transformer tank shall be of robust construction corrugated in shape and shall be built up of tested sheets.

17.3.3 Corrugation panel shall be used for cooling. The transformers shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidders shall submit the calculations sheet in this regard.

17.3.4 Tanks with corrugation shall be tested for leakage test at a pressure of 0.25 kg/sq. cm measured at the top of the tank.

17.3.5 The transformers with corrugation should be provided with a pallet for transportation, the dimensions of which should be more than the length and width of the transformer tank with corrugations.

18 CONSERVATOR:

(i) Transformers of rating 63 kVA and above with plain tank construction, the provision of conservator is mandatory. For corrugated tank and sealed type transformers with or without inert gas cushion, conservator is not required.

(ii) When a conservator is provided, oil gauge and the plain or dehydrating breathing devices shall be fitted to the conservator which shall also be provided with a drain plug and a filling hole [32 mm (1 ¼")] normal size thread with cover. In addition, the cover of the main tank shall be provided with an air release plug.

(iii) The dehydrating agents shall be silica gel. The moisture absorption shall be indicated by a change in the color of the silica gel crystals which should be easily visible from a distance. Volume of breathers shall be suitable for 500 g of silica gel conforming to IS 3401 for transformers up to 200 kVA and 1 kg for transformers above 200 kVA.

(iv) The capacity of a conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations. The total volume of conservator shall be such as to contain 10% quantity of the oil. Normally 3% quantity of the oil shall be contained in the conservator.

(v) The cover of main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.

(vi) The inside diameter of the pipe connecting the conservator to the main tank should be within 20 to 50 mm and it should be projected into the conservator so that its end is approximately 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to 5°C) should be above the sump level.

19 SURFACE PREPARATION AND PAINTING:

(i) GENERAL

19.1.1 All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

19.1.2 All primers shall be well marked into the surface, particularly in areas where repainting is evident and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations. However, wherever airless spray is not possible, conventional spray be used with prior approval of purchaser.

19.2 CLEANING AND SURFACE PREPARATION:

a) After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.

b) Steel surfaces shall be prepared by shot blast cleaning (IS 9954) to grade Sq. 2.5 of ISO 8501-1 or chemical cleaning including phosphating of the appropriate quality (IS 3618).

c) Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale. These methods shall only be used where blast cleaning is impractical. Manufacturer to clearly explain such areas in his technical offer.

19.3 PROTECTIVE COATING:

19.3.1 As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

19.4 PAINT MATERIAL:

i) Following are the types of paint which may be suitably used for the items to be painted at shop and supply of matching paint to site: Heat resistant paint (Hot oil proof) for inside surface

ii) For external surfaces one coat of thermosetting powder paint or one coat of epoxy primer followed by two coats of synthetic enamel/polyurethane base paint. These paints can be either air drying or stoving.

iii) For highly polluted areas, chemical atmosphere or for places very near to the sea coast, paint as above with one coat of high build Micaceous iron oxide (MIO) as an intermediate coat may be used.

19.5 PAINTING PROCEDURE:

i) All prepared steel surfaces should be primed before visible rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.

ii) Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the suppliers shall remove the unsatisfactory paint coating and apply another coating. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%.

19.6 DAMAGED PAINTWORK:

(i) Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally applied.

(ii) Any damaged paint work shall be made good as follows:

19.6.2.1 The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

19.6.2.2 A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.

19.6.2.3 The repainted surfaces shall present a smooth surface. This shall be obtained by carefully chamfering the painted edges before and after priming.

19.6.2.4 The paint shade shall be as per Annexure-Paint which is attached herewith.

19.7 DRY FILM THICKNESS:

19.7.1 To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats may or may not be of the same colour.

19.7.2 Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.

19.7.3 Particular attention must be paid to full film thickness at the edges.

19.7.4 The requirements for the dry film thickness (DFT) of paint and the material to be used shall be as given below:

Sl. No.	Paint type	Area to be painted	No. of coats	Total dry film thickness (min.) (microns)
1.	Thermosetting powder paint	inside	01	30
		outside	01	60
2.	Liquid paint	outside	01	30
		outside	02	25 each
		inside	01	35/10

19.8 TESTS FOR PAINTED SURFACE:

19.8.1 The painted surface shall be tested for paint thickness.

19.8.2 The painted surface shall pass the cross hatch adhesion test

and impact test as acceptance test and Salt spray test and Hardness test as type test as per the relevant ASTM standards.

Note: Suppliers shall guarantee the painting performance requirement for a period of not less than 5 years.

20 BUSHINGS:

20.1 The bushings arrangement shall be decided by utility during detailed engineering.

20.2 For 33kV-36kV class bushings shall be used for transformers of ratings 500kVA and above. And for transformers below 500KVA, 33kV class bushings, for 11kV -12 kV class bushings and for 0.433 kV-1 kV class bushings shall be used.

20.3 Bushing can be of porcelain/epoxy material. Polymer insulator bushings conforming with relevant IEC can also be used.

20.4 Dimension of the bushings of the voltage class shall conform to the Standard specified and dimension of clamping arrangement shall be as per IS 4257

20.5 Minimum external phase to phase and phase to earth clearances of bushing terminal shall be as follows:

Voltage	Clearance	
	Phase to phase	Phase to earth
33 kV	350mm	320mm
11 kV	255mm	140mm
LV	75mm	40mm

For DTs of 200 KVA and above, the clearances of cable box shall be as below:

Voltage	Clearance	
	Phase to phase	Phase to earth
33 kV	350mm	220mm
11 kV	130mm	80mm
LV	25mm	20mm

20.6 Arcing horn shall be provided on HV bushings.

20.7 Brazing of all interconnections, jumpers from winding to bushings shall have cross section larger than the winding conductor. All the Brazes shall be qualified as per ASME, section-IX.

20.8 The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for insulators.

20.9 The terminal arrangements shall not require separate oil chamber not connected to oil in the main tank.

21 TERMINAL CONNECTORS:

21.1 The LV and HV bushing stem shall be provided with suitable terminal connectors as per IS 5082 so as to connect the jumper without disturbing the bushing stem. Connectors shall be with eye bolts so as to receive conductor for HV. Terminal connectors shall be type tested as per IS 5561.

22 LIGHTNING ARRESTORS:

22.1 9 kV, 5 kA metal oxide lightning arrestors of reputed make conforming to IS 3070 Part-III, one

number per phase shall be provided. (To be mounted on pole or to be fitted under the HV bushing with GI earth strip 25x4 mm connected to the body of the transformer with necessary clamping arrangement as per requirement of purchaser.) Lightning arrestors with polymer insulators in conformance with relevant IEC can also be used. 1 clamp for LA shall also be provided for each HT bushing. Supply of LA is not included in DT supplier's scope.

23 CABLEBOXES:

No cable box shall be provided in transformer below 200 kVA. Above 200kVA, Cable Boxes shall be provided on both HV & LV side.

- 23.1 In case HV/LV terminations are to be made through cables the transformers shall be fitted with suitable cable box on 11kV side to terminate one 11kV/3 core aluminium conductor cable upto 240 sq.mm. (Size as per requirement).

The bidders shall ensure the arrangement of HT Cable box so as to prevent the ingress of moisture into the box due to rain water directly falling on the box. The cable box on HT side shall be of the split type with faces plain and machined and fitted with Neo-k-Tex or similar quality gasket and complete with brass wiping gland to be mounted on separate split type peg and plate with nut-bolt arrangement and M S earthing clamp. The bushings of the cable box shall be fitted with nuts and stem to take the cable cores without bending them. The stems shall be of copper with copper nuts. The cross section of the connecting rod shall be stated and shall be adequate for carrying the rated currents. On the HV side the terminal rod shall have a diameter of not less than 12mm. The material of connecting rod shall be copper. HT Cable support clamp should be provided to avoid tension due to cable weight.

- 23.2 The transformers shall be fitted with suitable LV cable box having non-magnetic material gland plate with appropriate sized single compression brass gland on LV side to terminate 1.1kV/single core XLPE armoured cable (Size as per requirement).

24 TERMINAL MARKINGS:

High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letter 1U, 1V, 1W and low voltage winding for the same phase marked by corresponding small letter 2U, 2V, 2W. The neutral point terminal shall be indicated by the letter 2N. Neutral terminal is to be brought out and connected to local grounding terminal by an earthing strip.

- 26.1 The following standard fittings shall be provided :

- i. Rating and terminal marking plates, non-detachable.
- ii. Earthing terminals with lugs -2 Nos.
- iii. Lifting lugs for main tank and top cover
- iv. Terminal connector on the HV/LV bushings (For bare termination only).
- v. Thermometer pocket with cap -1 No.
- vi. Air release device (for non-sealed transformer)
- vii. HV bushings -3 Nos.
- viii. LV bushings -4 Nos.
- ix. Pulling lugs
- x. Stiffener
- xi. Radiators- No. and length may be mentioned (as per heat dissipation calculations)/corrugations.
- xii. Arcing horns on HT side - 3 No . Only clamps for lightning arrestor shall be provided.

- xiii. Prismatic oil level gauge.
- xiv. Drain cum sampling valve.
- xv. One filter valve on upper side of the transformer (For transformers above 200 kVA)
- xvi. Oil filling hole having p. 1-¼" thread with plug and drain plug on the conservator.
- xvii. Silica gel breather (for non-sealed type transformer)
- xviii. Base channel 75x40mm for up to 100kVA and 100mm x 50mm above 100kVA, 460mm long with holes to make them suitable for fixing on a platform or plinth.
- xix. 4 No. rollers for transformers of 200kVA and above.
- xx. Pressure relief device or explosion vent (above 200 kVA)
- xxi. Oil level gauge
 - A. -5 °C and 90 °C marking for non-sealed type Transformers
 - B. - 30 °C marking for sealed type transformers
- xxii. Nitrogen / air filling device/ pipe with welded cover
 Capable of reuse (for sealed type transformers)
- xxiii. Inspection hole for transformers above 200 kVA
- xxiii. Pressure gauge for sealed type transformers above 200 kVA.
- xxiv. Buchholz relay for transformers above 1000 KVA.

27 FASTENERS:

- 27.1 All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.
- 27.2 Bolts or studs shall not be less than 6mm in diameter except when used for small wiring terminals.
- 27.3 All nuts and pins shall be adequately locked.
- 27.4 Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.
- 27.5 All bolts/nuts/washers exposed to atmosphere should be as follows.
 - a) Size 12 mm or below – Stainless steel
 - b) Above 12 mm- steel with suitable finish like electro galvanized with passivation or hot dip galvanized.
- 27.6 Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are replaced so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.
- 27.7 The length of the screwed portion of the bolt shall be such that no screw thread may form part of a shear plane between members.
- 27.8 Taper washers shall be provided where necessary.
- 27.9 Protective washers of suitable material shall be provided front and back of these securing screws.

28 OVERLOAD CAPACITY:

28.1 The transformers shall be suitable for loading as per IS 6600.

29 TESTS:

29.1 All the equipment offered shall be fully type tested by the bidder or his collaborator as per the relevant standards including the additional type tests. The type test must have been conducted on a transformer of same design during the last five years at the time of bidding. The bidder shall furnish four sets of type test reports along with the offer. In case, the offered transformer is not type tested, the bidder will conduct the type test as per the relevant standards including the additional type tests at his own cost in CPRI / NABL accredited laboratory in the presence of employer's representative(s) without any financial liability to employer in the event of order placed on him.

29.2 Special tests other than type and routine tests, as agreed between purchaser and bidder shall also be carried out as per the relevant standards.

29.3 The requirements of site tests are also given in this clause.

29.4 The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted with the bid.

29.5 The procedure for testing shall be in accordance with IS 1180 (Part-1):2014/2026 as the case may be except for temperature rise test.

29.6 Before dispatch each of the completely assembled transformers shall be subjected to the routine tests at the manufacturer's works.

30 ROUTINE TESTS:

30.1 Ratio, polarity, phase sequence and vector group.

30.2 No load current and losses at service voltage and normal frequency.

30.3 Load losses at rated current and normal frequency.

30.4 The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted after the receipt of order.

30.5 Impedance voltage test.

30.6 Resistance of windings at each tap, cold (at or near the test bed temperature).

30.7 Insulation resistance.

30.8 Induced overvoltage withstand test.

30.9 Separate source voltage withstand test.

30.10 Neutral current measurement - The value of zero sequence current in the neutral of the star windings shall not be more than 2% of the full load current.

30.11 Oil samples (one sample per lot) to comply with IS 1866.

30.12 Measurement of no load losses and magnetizing current at rated frequency and 90%, 100% and 110% rated voltage.

30.13 Pressure and vacuum test for checking the deflection on one transformer of each type in every inspection.

31 TYPETESTSTOBECONDUCTEDONONEUNIT:

In addition to the tests mentioned in clause 30 and 31 following tests shall be conducted:

- 31.1 Temperature rise test for determining the maximum temperature rise after continuous full load run. The ambient temperature and time of test should be stated in the test certificate.
- 31.2 Impulse voltage test: with chopped wave of IS 2026 part-III. BIL for 11kV shall be 75kV peak.
- 31.3 Short circuit withstand test: Thermal and dynamic ability.
- 31.4 Air Pressure Test: As per IS –1180 (Part-1):2014.
- 31.5 Magnetic Balance Test.
- 31.6 Un-balanced current test: The value of unbalanced current indicated by the ammeters shall not be more than 2% of the full load current.
- 31.7 Noise-level measurement.
- 31.8 Measurement of zero-phase sequence impedance.
- 31.9 Measurement of Harmonic of no-load current.
- 31.10 Transformer tank shall be subjected to specified vacuum. The tank designed for vacuum shall be tested at an internal pressure of 0.35kg per sq cm absolute (250mm of Hg) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the values specified below:

Horizontal length of flat plate (in mm)	Permanent deflection (in mm)
Upto and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.0

- 31.11 Transformer tank together with its radiator and other fittings shall be subjected to pressure corresponding to twice the normal pressure or 0.35kg/sq. cm whichever is lower, measured at the base of the tank and maintained for an hour. The permanent deflection of the flat plates after the excess pressure has been released, shall not exceed the figures for vacuum test.
- 31.12 Pressure relief device test: The pressure relief devices shall be subject to increasing fluid pressure. It shall operate before reaching the test pressure as specified in the above class. The operating pressure shall be recorded. The device shall seal-off after the excess pressure has been released.
- 31.13 Short Circuit Test and Impulse Voltage Withstand Tests: The purchaser intend to procure transformers designed and successfully tested for short circuit and impulse test. In case the transformers proposed for supply against the order are not exactly as per the tested design, the suppliers shall be required to carry out the short circuit test and impulse voltage withstand test at their own cost in the presence of the representative of the purchaser.
- 31.13.1 The supply shall be accepted only after such test is done successfully, as it confirms successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test.

- 31.13.2 Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations.
- 31.13.3 It may also be noted that the purchaser reserves the right to conduct short circuit test and impulse voltage with stand test in accordance with the IS, afresh on each ordered rating at purchaser cost, even if the transformers of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the purchaser either at the manufacturer's works when they are offered in a lot for supply or randomly from the supplies already made to purchaser's stores. The findings and conclusions of these tests shall be binding on the supplier.

32 ACCEPTANCE TESTS:

- 32.1 At least 10% transformers of the offered lot (minimum of one) shall be subjected to the following routine/acceptance test in presence of purchaser's representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS: 1180 (Part-1):2014 and IS: 2026.
- 32.2 Checking of weights, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish and workmanship as per GTP and contract drawings on one transformer of each type in every inspection.
- 32.3 Physical verification of core coil assembly and measurement of flux density of one unit of each rating, in every inspection with reference to short circuit test report.
- 32.4 Temperature rise test on one unit of the total ordered quantity.

33 TESTS AT SITE:

The purchaser will conduct the following test on receipt of transformers in their store. The utility shall arrange all equipment, tools & tackle and manpower for the testing. The bidder will depute his representative to witness the same. All such test shall be conducted by utility not later than 10 days from receipt of transformers.

- i) Megger Test
- ii) Ratio test

34 INSPECTION:

- 34.1 In respect of raw materials such as core stampings, winding conductors, insulating paper and oil, suppliers shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers' test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the purchaser. The bidder shall furnish following documents along with their offer in respect of the raw materials:

- i. Invoice of supplier.
- ii. Mill's certificate.
- iii. Packing list.
- iv. Bill of lading.
- v. Bill of entry certificate by custom.

Please refer to "Check-list for Inspection of Prime quality CRGO for Transformers" attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

35 INSPECTION AND TESTING OF TRANSFORMER OIL:

- 35.1 To ascertain the quality of the transformer oil, the original manufacturer's tests report should be submitted at the time of inspection. Arrangements should also be made for testing of transformer oil as per IS: 335, after taking out the sample from the manufactured transformers and tested in the presence of purchaser's representative.
- 35.2 To ensure about the quality of transformers, the inspections shall be carried out by the purchaser's representative at following two stages:-
- 35.2.1 Anytime during receipt of raw material and manufacture/ assembly whenever the purchaser desires.
- 35.2.2 At finished stage i.e. transformers are fully assembled and are ready for dispatch.
- 35.3 The stage inspections shall be carried out in accordance with Annexure-11.
- 35.4 After the main raw-material i.e. core and coil material and tanks are arranged and transformers are taken for production on shop floor and a few assemblies have been completed, the firm shall intimate the purchaser in this regard, so that an officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the stage inspection a few assembled cores shall be dismantled to ensure that the laminations used are of good quality. Further, as and when the transformers are ready for despatch, an offer intimating about the readiness of transformers, for final inspection for carrying out tests as per relevant IS shall be sent by the firm along with Routine Test Certificates. The inspections shall normally be arranged by the purchaser at the earliest after receipt of offer for pre-delivery inspection. The proforma for pre-delivery inspection of Distribution transformers is placed at Annex-111.
- 35.5 In case of any defect/defective workmanship observed at any stage by the purchaser's Inspecting Officer, the same shall be pointed out to the firm in writing for taking remedial measures. Further process in should only be done after clearance from the Inspecting Officer/purchaser.
- 35.6 All tests and inspections shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the Inspector representing the Purchaser all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include Stage Inspection during manufacturing stage as well as Active Part Inspection during Acceptance Tests.
- 35.7 The manufacturer shall provide all services to establish and maintain quality of workmanship in his works and that of his subcontractor to ensure the mechanical/electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipments as per latest quality standards of ISO 9000.
- 35.8 Purchaser shall have every right to appoint a third party inspection to carry out the inspection process.
- 35.9 The purchaser has the right to have the test carried out at his own cost by an independent agency wherever there is a dispute regarding the quality supplied. Purchaser has right to test 1% of the supply selected either from the stores or field to check the quality of the product. In case of any deviation purchaser has every right to reject the entire lot or penalize the manufacturer, which may lead to blacklisting, among other things.

36 QUALITY ASSURANCE PLAN:

- 36.1 The bidder shall invariably furnish following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

- 36.2 Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw materials in the presence of bidder's representative, copies of test certificates.
- 36.3 Information and copies of test certificates as above in respect of bought out accessories.
- 36.4 List of manufacturing facilities available.
- 36.5 Level of automation achieved and list of areas where manual processing exists.
- 36.6 List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- 36.7 List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports. These shall be furnished with the bid. Manufacturers shall possess 0.1 accuracy class instruments for measurement of losses.
- 36.8 Quality Assurance Plan (QAP) with hold points for purchaser's inspection.
- 36.9 The successful bidder shall within 30 days of placement of order, submit following information to the purchaser :
- 36.9.1 List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.
- 36.9.2 Type test certificates of the raw materials and bought out accessories.
- 36.9.3 The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.
- 36.9.4 ISI marking on the transformer is mandatory. As per Quality Control Order for Electrical Transformers- 2015, issued by Department of Heavy Industries, Government of India, the Standard / ISI marking on Distribution Transformers is mandatory and the product should be manufactured in compliance with IS 1180 Part-1: (2014).
- 37 DOCUMENTATION:**
- 37.1 The bidder shall furnish along with the bid the dimensional drawings of the items offered indicating all the fittings.
- 37.2 Dimensional tolerances.
- 37.3 Weight of individual components and total weight.
- 37.4 An outlined drawing front (both primary and secondary sides) and end-elevation and plan of the tank and terminal gear, where in the principal dimensions shall be given.
- 37.5 Typical general arrangement drawings of the windings with the details of the insulation at each point and core construction of transformer.
- 37.6 Typical general arrangement drawings showing both primary and secondary sides and end-elevation and plan of the transformer.
- 38 PACKING AND FORWARDING:**
- 38.1 The packing shall be done as per the manufacturer's standard practice.

However, it should be ensured that the packing is such that, the material would not get damaged during transit by Rail / Road / Sea.

38.2 The marking on each package shall be as per the relevant IS.

39 GUARANTEE

41.1 The manufacturers of the transformer shall provide a guarantee of 60 months from the date of receipt of transformer at the stores of the Utility. In case the transformer fails within the guarantee period, the supplier will depute his representative within 15 days from date of intimation by utility for joint inspection. In case, the failure is due to the reasons attributed to supplier, the transformer will be replaced/ repaired by the supplier within 2 months from date of joint inspection.

41.2 The outage period i.e. period from the date of failure till unit is repaired/ replaced shall not be counted for arriving at the guarantee period.

41.3 In the event of the supplier's inability to adhere to the aforesaid provisions, suitable penal action will be taken against the supplier which may inter alia include blacklisting of the firm for future business with the purchaser for a certain period.

40 SCHEDULES:

42.1 The bidders shall fill in the following schedule which will be part of the offer. If the schedule are not submitted duly filled in with the offer, the offers shall be liable for rejection.

Schedule-A : Guaranteed Technical Particulars

Schedule-B : Schedule of Deviations

41 DEVIATIONS:

43.1 The bidders are not allowed to deviate from the principal requirements of the Specifications. However, the bidder is required to submit with his bid in the relevant schedule a detailed list of all deviations without any ambiguity. In the absence of a deviation list in the deviations schedule, it is understood that such bid conform to the bid specifications and no post-bid negotiations shall take place in this regard.

43.2 The discrepancies, if any, between the specification and the catalogues and/or literature submitted as part of the offer by the bidders, shall not be considered and representations in this regard shall not be entertained.

43.3 If it is observed that there are deviations in the offering guaranteed technical particulars other than those specified in the deviations schedule then such deviations shall be treated as deviations.

43.4 All the schedules shall be prepared by vendor and are to be enclosed with the bid.

Annex-I

METHODOLOGYFORCOMPUTINGTOTALOWNINGCOST

TOC=IC+ (AxWi) + (BxWc) ; Losses in KW		
Where,		
TOC	=	TotalOwningCost
IC	=	Initialcost including taxes of transformer as quoted by the manufacturer
Afactor	=	Cost of no load lossesinRs/KW (A = 288239)
Bfactor	=	Cost of load lossesin Rs/KW (B = 93678)
Wi	=	Noloadlosses quoted by themanufacturerin KW
Wc	=	Load losses quotedby the manufacturer in KW

Note: No (+)ve tolerance shall be allowed at any point of time on the quoted losses after the award. In case, the losses during type testing, routine testing etc are found above the quoted losses, the award shall stand cancelled. In such a case, the CPG money shall also be forfeited.

Annexure-Paint

Painting-Transformer Main tank, pipes, Conservator Tank, Radiator etc.-

	Surface Preparation	primer coat	intermediate under coat	finish coat	total DFT	Colour shade
Main tank, pipes, conservator tank, etc. (External surfaces)	Blast cleaning Sa2½	Epoxy base Zinc primer 30-40 micron	Epoxy base Zinc primer 30-40 micron	Aliphatic Polyurethane (PU Paint) (min 50 micron)	Min 110 micron	541 shade of IS:5
Main tank, pipes (above 80 NB), conservator tank, etc (Internal surfaces)	Blast cleaning Sa2½	Hot oil resistant, non-corrosive varnish or paint	--	--	Min 30 micron	Glossy white for paint
Radiator (External surfaces)	Chemical / blast cleaning (Sa2½)	Epoxy base zinc primer 30-40 micron	Epoxy base Zinc primer Min 30-40 micron	Aliphatic Polyurethane(PU Paint) (min)50 micron	Min 110 micron	541 shade of IS:5
Radiator and pipes up to 80 NB (Internal surfaces)	Chemical cleaning if required	Hot oil proof low viscosity varnish or hot oil resistant non corrosive paint	--	--	--	Glossy white for paint

Annexure– II

PROFORMA FOR STAGE I INSPECTION OF DISTRIBUTION TRANSFORMERS

(A) GENERAL INFORMATION:

1. Name of firm : M/s.
2. Order No. and Date :
3. Rating-wise quantity offered :
4. Details of offer
 - a) Rating
 - b) Quantity
 - c) Serial Numbers
5. Details of last stage inspected lot:
 - a) Total quantity inspected
 - b) Serial Numbers
 - c) Date of stage inspection
 - d) Quantity offered for final inspection of (a) above with date

(B) Availability of material for offered quantity:

Details to be filled in

(C) Position of manufacturing stage of the offered quantity:

- a) Complete tanked assembly
- b) Core and coil assembly ready
- c) Core assembled
- d) Coils ready for assembly
 - (i) HV Coils
 - (ii) LV Coils

Note: (i) A quantity of less than 100 Nos. shall not be entertained for stage inspection. If the awarded quantity is less than 100 Nos., then whole lot shall be offered in single lot.

(ii) The stage inspection shall be carried out in case :-

- (a) At least 25% quantity offered has been tanked and
- (b) core coil assembly of further at least 30% of the quantity offered has been completed.

(iii) Quantity offered for stage inspection should be offered for final inspection within 15 days from the date of issuance of clearance for stage inspection, otherwise stage inspection already cleared shall be liable for cancellation.

Sl. No	Particulars	As offered	As observed	Deviation and Remarks									
(D)	<u>Inspection of Core:</u>												
	(1) Core Material (1) Manufacturer's Characteristic Certificate in respect of grade of lamination used. (Please furnish test certificate)												
	(2) Remarks regarding <div style="text-align: center;">Rusting</div>												
	(3) Whether laminations used for top and bottom yoke are in one piece.												
	(II) Core Construction:												
	(1) No. of Steps												
	(2) Dimension of Steps												
	Step No.	1	2	3	4	5	6	7	8	9	10	11	12
	As offered:												
	W mm												
	T mm												
	As found:												
	W mm												
	T mm												
	(3) Core Dia (mm)												
	(4) Total cross section area of core												
	(5) Effective cross sectional area of core												
	(6) Clamping arrangement												
	(i) Channel Size												
	(ii) Bolt size and No.												
	(iii) Tie Rods size and No.												
	(iv) Painting												
	(a) Channels												
	(b) Tie Rods												
	(c) Bolts												

	(7) Whether topyoke is cut for LV connection.		
	(8) If yes, at 7 above, whether Reinforcement is done.		
	(9) Size of Support Channels provided for Core base and bottom yoke (Single piece of channels are only acceptable) This will not be applicable for Amorphous core. For Amorphous core, core clamps with locking arrangement with tank base cover will be provided. This will not be applicable for Amorphous core. For Amorphous core, core clamps with locking arrangement with tank base cover will be provided.		
	(10) Thickness of insulation provided between core base and support channel.		
	(11) core length (leg center to leg center)		
	(12) Window height		
	(13) Core height		
	(14) Core weight only (without channel etc.)		
(E)	INSPECTION OF WINDING		
	(I) Winding material		
	(1) Material used for		
	(a) HV winding		
	(b) LV winding		
	(2) Grade of material for		
	(a) HV winding		
	(b) LV winding		
	3) Test certificate of manufacturer (enclose copy) for winding material of:		
	(a) HV		

	(b) LV			
	(II) CONSTRUCTIONAL DETAILS			
	(1) Size of Cross Sectional area of			
	(a) HV winding			

	(b) LV winding			
	(2) Type of insulation for conductor of:			
	a) HV winding			
	(b) LV winding			
	(3) Diameter of wire used for delta formation (mm)			
	(4) Diameter of coils in:			
	a) LV winding			
	i) Internal dia (mm)			
	ii) Outer dia (mm)			
	b) HV winding			
	i) Internal dia (mm)			
	ii) Outer dia (mm)			
	(5) Current Density of winding material used for :			
	(a) HV			
	(b) LV			
	(6) Whether neutral formation on top.			
	(7) HV Coils/Phase			
	a) Number			
	b) Turns/coil			
	c) Total turns			
	(8) LV Coils/Phase			
	a) Number			
	b) Turns/coil			

	c) Total turns			
	(9) Method of HV Coil Joints			
	(10) Total weight of coil of			
	a) LV winding (kg)			
	b) HV winding (kg)			
(F)	INSULATION MATERIALS :			
	(I) MATERIAL:			
	1) Craft paper			
	a) Make			
	b) Thickness (mm)			
	c) Test Certificate of manufacturer (enclose copy)			
	2) Press Board			
	a) Make			
	b) Thickness (mm)			
	c) Test Certificate of manufacturer (enclose copy)			
	3) Material used for top and bottom yoke and insulation			
	(II) Type and thickness of material used: (mm)			
	a) Between core and LV			
	b) Spacers			
	c) Interlayer			
	d) Between HV and LV winding			
	e) Between phases			
	f) End insulation			
(G)	CLEARANCES: (mm)			
	(I) Related to core and windings			

	1) LV to Core (Radial) 2) Between HV and LV (Radial)			
	3) (i) Phase to phase between HV Conductor			

	(ii) Whether two Nos. Press Board each of minimum 1mm thick provided to cover the tie rods.			
	4) Thickness of locking spacers between LV coils (mm)			
	5) Axial wedges between HV and LV coils/phase (Nos.)			
	6) No. of radial spacers per phase			
	7) Size of duct between LV and HV winding (mm)			
	(II) Between core-coil assembly and tank: (mm)			
	1) Between winding and body:			
	a) Tank lengthwise			
	b) Tank Breadthwise			
	2) Clearance between top cover and top yoke upto 100 kVA and between top cover and top most live part of tap changings witch for 200 kVA and above.			
(H)	TANK : (I) Constructional details: 1) Rectangular shape 2) Thickness of sidewall (mm) 3) Thickness of top and bottom plate (mm) 4) Provision of slopping top cover towards HV bushing.			

Sl. N	Particulars	As offered	As observed	Deviation and Remarks
	b) Pressure of 0.8kg/sqcm for 30 minutes.			
(I)	RAIDATORS:			
	1. Fin Radiators of 1.25 mm thick sheet			
	a) Dimension of each fin (LxBxT)			
	b) Fins per radiator			
	c) Total No. of radiators			
	2. Verification of manufacturer's test certificate regarding Heat dissipation (excluding Top)			
	3. Verification of position of radiator with respect to bushing.			
(J)	CONSERVATOR:			
	1. Dimensions (L x D) (in mm)			
	2. Volume (m ³)			
	3. Inside dia of Conservator tank			
	4. Whether conservator outlet pipe is projected approx. 20mm			
	5. Whether arrangement made so that oil does not fall on			
	6. Whether die cast metal oil level gauge indicator having three positions at (-5°C, 30°C and			
	7. Whether drain plug and filling hole with cover is provided.			
	8. Inner side of the conservator Tank painted with			
(K)	BREATHER:			
	1. Whether Die cast Aluminium body breather for silica gel provided.			
	2. Make			
	3. Capacity			

Sl.No (L)	Particulars	As offered	As observed	Deviation and Remarks
	TERMINALS:			
	1. Material whether of Brass Rods/Tinned Copper.			
	a) HV			
	b) LV			
	2. Size (dia in mm)			
	a) HV			
	b) LV			
	3. Method of Star connection formed on LV side of 6mm thick (Should use Al./Cu. Flat bolted/ brazed with crimped lug on winding alternatively for 63 and 100 kVA ratings brazing is done covered with tubular sleeved duly crimped).			
	4. Method of Connection of LV winding to LV Bushing (end of windings should be crimped with lugs (Al/Cu) and bolted with			
	5. Method of Connection of HV winding to HV bushing (Copper joints should be done by using silver brazing alloy and for Aluminium, brazing rod or with tubular connector crimped			
	6. Whether SRB tube/insulated paper used for formation of Delta on HV.			
	7. Whether Empire sleeves used on the portion of HV winding joining to HV bushing.			
	8. Whether neutral formation is covered with cotton tape			
	Whether arrangement for studs for fitting of HV Bushing are in diamond shape (so that Arcing Horns are replaced vertically).			
	3. Position of mounting of LV bushings.			
	4. Bushing Clearance: (mm)			
	a) LV to Earth			

	b) HV to Earth			
	c) Between LV Bushings			
	d) Between HV Bushings			
(N)	TANK BASE CHANNEL / ROLLERS:			
	1. Size of channel (mm)			
	2. Whether channels welded across the length of the tank			
	3. Size and type of roller (mm)			
(O)	OIL :			
	1. Name of supplier			
	2. Breakdown voltage of oil: (kV)			
	i) Filled in tanked transformer			
	ii) In storage tank (to be tested by Inspecting Officer).			
	3. Supplier's test certificate (enclose copy)			
(P)	ENGRAVING:			
	1. Engraving / punching Sl. No. and name of firm on top channel / clamp or on separate plate which is firmly welded to the top channel / clamp.			
	i) On bottom of clamping channel of core-coil assembly.			
	ii) Engraving of Sl. No. and name of firm on side wall and top cover of tank along with date of dispatch.			
(Q)	i) MS plate of size 125x125 mm welded on width side of stiffener			
	ii) Following details engraved (as per approved GTP):			
	(a) Serial Number			
	(b) Name of firm			
	(c) Order No. and Date			
	(d) Rating			
	(e) Name of Inspecting Officer			
	(f) Designation			
	(g) Date of dispatch			
(R)	NAME PLATE DETAILS:			
	Whether Name Plate is as per approved drawing			
(S)	Colour of Transformer			
	1. Tank body colour shall be as per Annexure-Paint which is attached herewith			
	2. Conservator colour shall be as per Annexure-Paint which is attached herewith .			
(T)	CHECKING OF TESTING FACILITIES:			
	(Calibration certificate also to be checked for its validity)			
	TESTS:			
	1. No Load Current			
	2. No Load Loss			
	3. % Impedance			
	4. Load Losses			
	5. Insulation Resistance Test			

	6.Vector Group Test(phaserelationship)			
	7.RatioandPolaritytestrelationship			
	8. TransformerOilTest(Break Down Voltage)			
	9.Magnetic Balance			
	10. Measurementofwinding resistance(HVandLVboth)			
	11. Inducedovervoltagewithstandtest (DoublevoltageandDoublefrequency)			
	12.Separatesourcepowerfrequency withstandtestat28kVforHVand3kVforLV(oneminute).			
	13. Airpressure/Oil leakage Test			
	14.Vacuumtest			
	15.Unbalancedcurrenttest			
	16.Temperaturerise(HeatRun)test.			
(U)	We have specificallycheckedthefollowing and foundthesameas per G.T.P./deviationsobserved as			
	i) Rustlessnessof CRGO laminations used			
	ii)Core steps			
	iii) Core area			
	iv)Core weight			
	v) Winding crossectionalarea			
	a)LV			
	b) HV			
	vi) Weightofwindings			
	vii)Clearancebetweenwindingandwallof tank(mm)			
	a)Length-wise			
	b) Breadth-wise			
	viii)Clearancebetweentopofyoke/topmostlivepartoftapchangertotankcover.			
	ix)DetailsofNeutralformation			
	x) Connections tobushings:			
	a)LV			
	b) HV			
	xi) Slopeoftanktop			
	xii)Positionofmountingofbushings			

Annexure - A

Check-list for Inspection of Prime quality CRGO for Transformers

During inspection of PRIME CRGO, the following points needs to be checked by the Transformer manufacturer. Utility's inspector shall verify all these points during inspection:-

iii) In case PRIME CRGO cutting is at works of Transformer Manufacturer:

Review of documents:

Purchase Order (unpriced) to PRIME CRGO supplier/Authorised Agency
 Manufacturer's test certificate

Invoice of the Supplier

Packing List

Bill of Lading

Bill of Entry Certificate by Customs Deptt.

Reconciliation Statement as per format below
 Certificate of Origin
 BIS Certification

Format for Reconciliation/Traceability records

Packing List No./date /Quantity of PRIME CRGO received

Name of Manufacturer

Manufacturer test certificate No./date

Serial No.	Details of package/job	Drawing Reference	Quantity Involved	Cumulative Quantity Consumed	Balance stock

.1 Inspection of PRIME CRGO Coils:

PRIME CRGO-Manufacturer's Identification Slip on PRIME CRGO Coils
 Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).
 Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.
 ISI logo sticker on packed mother coil and ISI logo in Material TC.

2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

- 3 Inspection of PRIME CRGO laminations: Transformer manufacturer will maintain records for traceability of laminations to prime CRGO coils and burr/bow on laminations shall be measured. Utility can review these records on surveillance basis.

4. Inspection at the time of core building:

Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/ rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in A.2.2 above.

Above tests shall be witnessed by Utility. In case testing facilities are not available at Manufacturer's work, the sample(s) sealed by Utility to be sent to approved labs for testing.

Inspection Clearance Report would be issued after this inspection

- (iii) In case PRIME CRGO cutting is at Sub-vendor of Transformer Manufacturer:
 Review of documents:

Purchase Order (unpriced) to PRIME CRGO supplier/ Authorised Agency

Purchase Order (unpriced) to Core Cutter

Manufacturer test certificate

Invoice of the Supplier

Packing List

Bill of Lading

Bill of Entry Certificate by Customs Deptt.

Reconciliation Statement as per format below

Certificate of origin

BIS Certification

Format for Traceability records as below: -

Packing List No./date /Quantity of PRIME CRGO received

Name of Manufacturer

Manufacturer test certificate No./date

Serial No.	Name of Customer	Details of package/job	Drawing Reference	Quantity Involved	Cumulative Quantity Consumed	Balance stock	Dispatch Details

.1 Inspection of PRIME CRGO Coils:

PRIME CRGO-Manufacturer's Identification Slip on PRIME CRGO Coils

Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).

Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.

ISI logo sticker on packed mother coil and ISI logo in Material TC.

- 2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla, thickness depending on the

grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

3 Inspection of PRIME CRGO laminations:

Transformer manufacturer representative will inspect laminations and issue their internal Inspection Clearance Report. Inspection will comprise of review of traceability to prime CRGO coils, visual Inspection of PRIME CRGO laminations and record of burr/bow. After clearance given by transformer manufacturer, Utility will issue an Inspection Clearance Report after record review. If so desired by Utility, their representative may also join transformer manufacturer representative during this inspection.

Inspection Clearance Report would be issued after this inspection

viii) Inspection at the time of core building:

Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in B.2.2.

Inspection Clearance Report would be issued after this inspection

NOTE :-

- a) Transformer Manufacturer to ensure that PRIME CRGO is procured from POWERGRID approved vendors and CRGO manufacturer should have valid BIS Certificate for respective offered Grade.

14.3 Transformer Manufacturer should also involve themselves for ensuring the quality of CRGO laminations at their Core Cutter's works. They should visit the works of their Core cutter and carry out necessary checks.

c) General

If a surveillance sample is drawn and sent to TPL (if testing facility not available with the manufacturer), the Transformer manufacturer can continue manufacturing at their own risk and cost pending TPL test report on PRIME CRGO sample drawn. Decision for acceptance of PRIME CRGO shall be based upon report of the sample drawn.

These checks shall be read in-conjunction with approved Quality Plan, specification as a whole and conditions of contract.

Sampling Plan (PRIME CRGO)

33 / 11 kV	-1 st transformer and subsequently at random 10% of Transformers (min. 1) offered for inspection.
DTs and other ratings	-1 st transformer and subsequently at random 2% of Transformers (min. 1) offered for inspection.

NOTE:- One sample for each lot of CRGO shall be drawn on surveillance basis.

CRGO has to be procured only from POWERGRID approved vendors. List of such vendors is available at the following website. Since the list is dynamic in nature, the site may be checked from time to time to see the list of approved vendors.

<http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20kV-CM%20List.pdf>

1. ACSR CONDUCTOR

1. SCOPE

This section covers design, manufacture, testing before dispatch, packing, supply and delivery for destination of Kms of ACSR Squirrel, Weasel, Rabbit", Raccoon, Dog and Panther Conductor.

2. STANDARDS

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

The ACSR Conductor shall also conform to the following standards.

Sl. No.	Indian Standards	Title	International
1	IS:209-1979	Specification for Zinc	BS-3436-1961
2	IS:398-1996	Specification for aluminum conductors for overhead transmission purposes.	
		Aluminum conductors	IEC-209-1966
		Galvanized steel reinforced	BS-215(Part-II)
3	IS:1521-1972	Method of Tensile Testing of Steel wire	ISO/R89-1959
4	IS:1778-1980	Reels and Drums for Bare conductors	BS-1559-1949
5	IS:1841-1978	E.C. Grade Aluminum rod produced by rolling	
6	IS:2629-1966	Recommended practice for Hot Dip Galvanizing of iron and steel	
7	IS:2633-1986	Method of testing uniformity of coating of zinc coated articles.	
8	IS:4826-1968	Galvanized coatings on round steel wires.	ASTMA472-729
9	IS:5484-1978	E.C. Grade Aluminium rod produced by continuous casting and rolling.	
10	IS:6745-1972	Methods of determination of weight of zinc-coating of zinc coated iron and steel articles	BS-443-1969

Offers conforming to standards other than IS-398 shall be accompanied by the English version of relevant standards in support of the guaranteed technical particulars to be furnished as per format enclosed.

3. GENERAL TECHNICAL REQUIREMENTS

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

The Bidders shall furnish guaranteed technical particulars in Section-III.

3.1. MATERIALS/WORKMANSHIP

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

3.1.2. The steel wire shall be evenly and uniformly coated with electrolytic high grade, 99.95% purity zinc complying with the latest issue of IS-209 for zinc. The uniformity of zinc coating and the weight of coatings shall be in accordance with Section

n-II and shall be tested and determined according to the latest IS-2633 or any other authoritative standard.

- 3.1.3. The steel strands shall be hot dip galvanized as per IS: 4826. The coating shall be smooth, continuous, and of uniform thickness, free from imperfections and shall withstand minimum three dips after stranding in standard prece test. The steel strands shall be preformed and postformed in order to prevent spreading of strands in the event of cutting of composite core wire. The properties and characteristics of finished strands and individual wires shall be as prescribed in IEC: 888- 1987. If tested after stranding, reference shall also be made to cl. 4.1.1 and cl. 4.2.3 of IS : 4826.

4. CONDUCTOR PARAMETERS

The Parameters of individual strands and composite steel cored aluminum conductor, shall be in accordance with the values given in Section-II.

Creep in a conductor is attributed partly due to settlement of strands and partly due to non-elastic elongation of metal when subjected to load. The manufacturer of conductor shall furnish the amount of creep which will take place in 10, 20, 30, 40 and 50 years along with the supporting calculations. The calculations should be based on every day temperature of 32 °C and every day tension of 25% of UTS of conductor of 11/33 KV Lines.

5. TOLERANCES

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

The cross-section of any wire shall not depart from circularity by more than an amount corresponding to the tolerance on the standard diameter.

The details of diameters, lay ratios of Aluminum and steel wires shall be in accordance with the Section-II "Technical Requirements".

6. SURFACE CONDITIONS

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

7. JOINTS IN WIRES

7.1. Aluminum wires

During stranding, no aluminum wire welds shall be made for the purpose of achieving the required conductor length.

No joints shall be permitted in the individual aluminum wires in the outermost layer of the finished Conductor. However, joints in the 12 wire & 18 wire inner layer of the conductor are permitted but these joints shall be made by the cold pressure butt welding and shall be such that not two such joints shall be within 15 meters of each other in the complete stranded conductor.

7.2. Steel wires

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

8. STRANDING

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

In all constructions, the successive layers shall be stranded in opposed directions. The wires in each layer shall be evenly and closely stranded round the underlying wire or wires. The outer most layer of wires shall have a right hand lay. The lay ratio of the different layers shall be within the limits given under Section-II.

9. PACKING

- 9.1. The conductor shall be supplied in non-returnable strong wooden drums provided with lagging of adequate strength constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS-1778-1980 and latest version except as otherwise specified hereinafter. The conductor drums shall be adequate to wind one or more standard length of 2500 meters of SQUIRREL/WEASEL/RABBIT/RACCOON/DOG/PANTHER ACSR conductor.
- 9.2. The drum shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5KN. The conductor drum shall be provided with necessary clamping arrangements so as to be suitable for tension stringing of power conductor.
- 9.3. The bidder should submit their drawings of the conductor drums along with the bid. After placement of letter of intent the Manufacturer shall submit four copies of fully dimensioned drawing of the drum for Employer's approval. After getting approval from the Employer, Manufacturer shall submit 30 more copies of the approved drawings for further distribution and field use.
- 9.4. All wooden components shall be manufactured out of seasoned soft wood free from defects that may materially weaken the component parts of the drums. Preservative treatment for anti-termite/antifungus shall be applied to the entire drum with preservatives of a quality which is no harmful to the conductor.
- 9.5. All flanges shall be 2-ply construction with 64mm thickness. Each ply shall be nailed and clenched together at approximately 90 degrees. Nails shall be driven from the inside face of the flange, punched and then clenched on the outer face. Flange boards shall not be less than the nominal thickness by more than 2 mm. There shall not be less than 2 nails per board in each circle.
- 9.6. The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide around barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.
- 9.7. Barrel studs shall be used for construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing.
- 9.8. Normally, the nuts on the studs shall stand protruded of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of the barrel shall generally be flushed with the top of the nuts.
- 9.9. The inner cheek of the flanges and drum barrel surfaces shall be painted with bitumen based paint.
- 9.10. Before reeling, card board or double corrugated or thick bituminized waterproof bamboo paper or HDPE sheet shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. The paper should be dried before use. After reeling the conductor the exposed surface of the outer layer of

conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.

- 9.11. A minimum space of 75mm shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be a minimum of two binders consisting of hoop iron/galvanised steel wire. Each protective lagging shall have two recesses to accommodate the binders.
- 9.12. Each batten shall be securely nailed across grains as far as possible to the flange edges with at least 2 nails per end. The length of the nail shall not be less than twice the thickness of the battens. The nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the batten to be released due to corrosion.
- 9.13. The conductor ends shall be properly sealed and secured with the help of U-nails on one side of the flanges.
- 9.14. Only standard lengths of conductors shall be wound on each drum. The method of lagging to be employed shall be clearly stated in the tender.
- 9.15. As an alternative to wooden drum Bidders may also supply the conductors in non-returnable painted steel drums. The painting shall conform to IS: 9954-1981, reaffirmed in 1992. Wooden/steel drum will be treated at par for evaluation purpose and accordingly the Bidders should quote the package.

10. LABELLING AND MARKING

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

- i) Manufacturer's name and address.
- ii) Contract/Specification number.
- iii) Size and type of conductor.
- iv) Net weight of the conductor.
- v) Gross weight of the conductor and drum.
- vi) Length of the conductor.
- vii) Position of the conductor end.
- viii) Drum and lot number.
- ix) Name and address of the consignee.
- x) Month and year of manufacture.
- xi) The drum may also be marked with standard specification as per which the conductor is manufactured.

11. STANDARD LENGTHS

- 11.1. The standard length of the conductor shall be 2500 metres. A tolerance of plus or minus 5% on the standard length offered by the bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths.
- 11.2. Random lengths will be accepted provided no length is less than 70% of the standard length and total quantity of such random lengths shall not be more than 10% of the total quantity order. When on one number random length has been manufactured at any time, five (5) more individual lengths, each equivalent to the above random length with a tolerance of +/- 5% shall also be manufactured and all above six random lengths shall be dispatched in the same shipment. At any point, the cumulative quantity supplied including such random lengths shall not be more

than 12.5% of the total cumulative quantity supplied including such random lengths. However, the last 20% of the quantity ordered shall be supplied only in standard length as specified.

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

12. QUALITY ASSURANCE PLAN

A Quality Assurance Plan including customer hold points covering the manufacturing activities of the material shall be required to be submitted by the tenderer to the Employer along with the tender. The Quality Assurance Plan after the same is found acceptable, will be approved by the Employer.

The contractor shall follow the approved Quality Assurance Plan in true spirit. If desired by the Employer, he shall give access to all the documents and materials to satisfy the Employer that the Quality Assurance Plan is being properly followed.

13. TESTING

13.1. SELECTION OF TEST SAMPLES FOR TYPE TESTS

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

13.2. SELECTION OF TEST SAMPLES FOR ACCEPTANCE TESTS

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

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

- 13.2.3. The routine tests shall be same as acceptance test. The manufacturer will draw samples for routine tests as per Cl. 13.1.1 or 13.1.2 of IS: 398 (Part 2) and will maintain the record of routine tests for buyer's review. For acceptance tests, the sample shall be taken as per Cl. shall be as per Cl. 13.1.2 of IS: 398 (Part 2).

14. TESTS

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

14.1 Type Tests

- (i) Visual examination
- (ii) Measurement of diameters of individual aluminum and steel wires.
- (iii) Measurement of lay ratio of each layer
- (iv) Breaking load test
- (v) Ductility test
- (vi) Wrapping test
- (vii) Resistance test on aluminum wires.
- (viii) DC resistance Test on aluminum wires.
- (ix) Galvanizing test

- (x) Surface condition test
- (xi) StressStrain test
- (xii) Procedure qualification test on weldedjoint of Aluminum Strands.

NOTE: -The typetestreportsshallnotbeolderthanFIVEyearsandshallbevaliduptoexpiryof validity of offer.

Theaboveadditionallistsifnotconductedearlier,shallbedoneunderthesubjectproject packageatnoextracost.

14.2 AcceptancetestsandRoutinetests

- (ii) Visual anddimensional checkondrum.
- (iii) Visualexamination
- (iv) Measurement of diameters of individualaluminum and steelwires.
- (v) Measurementof layratio ofeach layer
- (vi) Breaking loadtest
- (vii) Ductilitytest
- (viii) Wrappingtest
- (ix) Resistance testonaluminumwires.
- (x) DCresistanceTeston CompositeConductor.
- (xi) Galvanizing test

14.3 TestsDuringManufacture

The followingtestsduringmanufacture shallbe carried out.

- (i) Chemicalanalysisof zincused for galvanising,
- (ii) Chemicalanalysis ofaluminumusedfor making aluminumstrands,
- (iii) Chemicalanalysisofsteelusedformaking steel strands,

14.4 Visualexamination

The conductorshall be examinedvisually for good workmanshipand generalsurface finishoftheconductor.Theconductor drumsshallberewoundinthepresenceofInspectingOffic er.TheInspectorwillinitiallycheckforScratches,Jointsetc.,andthattheconductorshallgenerall yconformtotherequirementsofthespecifications/IS398(Part-II)-1996.

14.5 MeasurementofdiametersofindividualAluminumandSteelWires.

The diametersofindividualAluminumandSteelWiresshallbecheckedtoensurethatthey conformtotherequirementsofthisspecification.

14.6 Measurementoflay-ratios

The lay-ratiosofeachlayeroftheconductorshallbemeasuredandcheckedtoensurethat theyconform tothe requirements ofthis specificationand IS:398 (Part-II)-1996.

14.7 Breakingloadtest

- a) Breakingloadtestoncompleteconductor.

Circlesperpendiculartotheaxisoftheconductorshallbemarkedattwoplacesonasampleofcond uctorofminimum5mlengthbetweenfixingarrangementsuitablyfixedonatensiletestingmachi ne.The loadshallbeincreasedatasteadyrateupto50%ofminimumspecifiedUTSandheldforon

eminute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at steady rate to 100% of UTS and held for one minute. The Conductors amples shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

b) Breaking load test on individual aluminum and galvanized steel wires.

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

14.8 Ductility Test

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

14.9 Torsion Test

One specimen cut from each of the samples taken shall be gripped in two places exactly 15 cms. apart. One of the pieces shall be made to revolve at a speed not exceeding one revolution per second and the other shall be capable of moving longitudinally to allow for contraction or expansion during testing. A small tensile load not exceeding 2 (two) percent of the breaking load of the wires shall be applied to the samples during testing. The test shall be continued until fracture occurs and the fracture shall show a smooth surface at right angle to the axis of the wire. After fracture, the specimen shall be free from helical splits. The samples shall with stand a number of twists equivalent to not less than 18 on length equal to 100 times the diameter. When twisted after stranding the number of complete twists before fracture occurs shall be not less than 16 on length equal to 100 times the diameter of the wire. In case test sample length is less or more than 100 times the stranded diameter of the strand, the minimum number of twists will be proportioned to the length and if number comes in the fraction then it will be rounded off to the next higher whole number. The fracture shall show a smooth surface at right angle to the axis of the wire.

14.10 Elongation Test

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

14.11 Wrapping Test

This test shall be conducted on both Aluminum and Galvanized steel wires.

14.11.1 Aluminum wires

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

14.11.2 Galvanized steel wires

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

14.12 Resistance Test

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

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

Where
 R_{20} = Resistance corrected at 20 degrees C.
 R_T = Resistance measured at T degrees C.
 α = Constant as temperature coefficient of resistance 0.004. T = Ambient temperature during measurement

This resistance calculated to 20 degrees C. shall be not more than the maximum value specified in section-II.

14.13 Galvanizing Test

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

14.14 Surface Condition Test

A sample of the finished conductor for use in 11/33KV system having a minimum length of 5 meter with compression type dead end clamps compressed on both ends in such manner as to permit the conductor to take its normal straight line shape, shall be subjected to a tension of 50 percent of the UTS of the conductor. The surface shall not depart from its cylindrical shape nor shall the strands move relative to each other so as to get out of place or disturb the longitudinal smoothness of conductor. The measured diameter at any places shall be not less than the sum of the minimum specified diameters of the individual aluminum and steel strands as indicated in Section-II.

14.15 Stress-Strain Test

The test is contemplated only to collect the creep data of the conductor from the manufacturer. A sample of conductor of minimum 10 meters length shall be suitably compressed with dead end clamps. (applicable only for conductors of nominal aluminium area 100 sq. mm and above)

15. TEST SET-UP

- 15.1. The test samples shall be supported in a trough over its full length and the trough adjusted so that the conductor will not be lifted by more than 10 mm undertension. This shall be ascertained by actual measurement.
- 15.2. The distance between the clamp and the sleeve mouth shall be monitored with callipers during the test to ensure that, after the test, it does not change by more than $1\text{mm} + 0.1\text{mm}$ from the value before the test.
- 15.3. The conductor strain shall be evaluated from the measured displacements at the two ends of the gauge length of the sample. The gauge reference targets shall be attached to the clamps which lock the steel and aluminum wire together. Target plates may be used with dial gauges or displacement transducers and care shall be taken to position the plates perpendicular to the conductor. Twisting the conductor, lifting it and moving it from side-to-side by the maximum amount expected during the test should introduce no more than 0.3 mm error in the reading.
16. TEST LOADS FOR COMPLETE CONDUCTOR
- The loading conditions for repeated stress-strain tests for complete conductor shall be as follows:
- 16.1. 1 kN load shall be applied initially to straighten the conductor. The load shall be removed after straightening and then the strain gauges are to be set at zero tension.
- 16.2. For non-continuous stress-strain data, the strain readings at 1 kN intervals at low tensions and 5 kN intervals above 30% of UTS shall be recorded.

- 16.3. The samples shall be reloaded to 30% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released then after the hold period.
- 16.4. The samples shall be reloaded to 50% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released then after the hold period.
- 16.5. Reloading up to 70% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes. The load shall be released.
- 16.6. Reloading up to 85% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes and the load shall be released then.
- 16.7. Tension shall be applied again and shall be increased uniformly until the actual breaking strength is reached. Simultaneous readings of tension and elongations shall be recorded up to 90% of UTS at the intervals described under Clause 16.6.
17. TEST LOADS FOR STEEL CORE ONLY (applicable only for conductors of nominal aluminum area 100 sq. mm and above)

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

- 17.1. The test shall consist of successive applications of load applied in a manner similar to that for the complete conductor at 30%, 50%, 70% and 85% of UTS.
- 17.2. The steel core shall be loaded until the elongation at the beginning of each hold period corresponds to that obtained on the complete conductor at 30%, 50%, 70% and 85% of UTS respectively.

18. STRESS-STRAIN CURVES

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

19. DC RESISTANCE TEST ON COMPOSITE CONDUCTOR

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

20. PROCEDURE QUALIFICATION TEST ON WELDED ALUMINUM STRANDS.

Two Aluminum wires shall be welded as per the approved quality plan and shall be subjected to tensile load. The breaking strength of the welded joint of the wire shall not be less than the guaranteed breaking strength of individual strands.

21. CHEMICAL ANALYSIS OF ALUMINUM AND STEEL

Sample taken from the Aluminum and Steel ingots/coils/strands shall be chemically/spectrographically analyzed. The same shall be in conformity with the requirements stated in this specification.

22. CHEMICAL ANALYSIS OF ZINC

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

23. VISUAL AND DIMENSIONAL CHECK ON DRUMS

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

24. REJECTION AND RETEST

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

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

25. CHECKING AND VERIFICATION OF LENGTH OF CONDUCTOR

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

26. ADDITIONAL TESTS

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

27. TESTING EXPENSES

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

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

27.3. The entire cost of testing for the acceptance and routine tests and tests during manufacture specified

ed herein shall be treated as included in the quoted unit price of the conductor, except for the expenses of the inspector/Employer's representative.

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

28. TEST REPORTS

- 28.1. Copies of type test reports shall be furnished in at least six copies along with one original. One copy will be returned duly certified by the Employer only after which the commercial production of the material shall start.
- 28.2. Record of Routine test reports shall be maintained by the Manufacturer at his works for periodic inspection by the Employer's representative.
- 28.3. Test certificates of Tests during manufacture shall be maintained by the Manufacturer. These shall be produced for verification as and when desired by the Employer.

29. TEST FACILITIES

The following additional test facilities shall be available at the Manufacturer's works:

- (i) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer, etc.
- (ii) Standard resistance for calibration of resistance bridges.
- (iii) Finished Conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 16 meters per minute). The rewinding facilities shall have appropriate clutch system and be free of vibrations, jerk etc. with traversing facilities.

30. INSPECTION

- 30.1. The Employer's representative shall, at all times, be entitled to have access to the works and all places of manufacture where conductor shall be manufactured and the representative shall have full facilities for unrestricted inspection of the Bidder's works, raw materials and process of manufacture and conducting necessary tests as detailed herein.
- 30.2. The Bidder shall keep the Employer informed in advance of the time of starting and of the progress of manufacture of conductor in its various stages so that arrangements can be made for inspection.
- 30.3. The contractor will intimate the Employer about carrying out of the tests at least 45 days in advance of the scheduled date of tests during which the Employer will arrange to depute his representative/ to be present at the time of carrying out of the tests. Six (6) copies of the test reports shall be submitted.
- 30.4. No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the employer in writing. In the later case also, the conductor shall be dispatched only after satisfactory testing for all tests specified herein has been completed and approved by the employer.

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

30.6. At least 50% of the total number of drums subject to a minimum of two in any lot put up for inspection, shall be selected at random to ascertain the length of conductor by the following method:

"At the works of the manufacturer of the conductor, the conductor shall be transferred from one drum to another at the same time measuring its length with the help of a graduated pulley and Cyclometer. The difference in the average length thus obtained and as declared by the Bidder in the packing list shall be applied to all the drums if the conductor is found short during checking".

31. SCHEDULE OF DEVIATIONS/VARIATIONS

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

SECTION-II SPECIFIC TECHNICAL REQUIREMENTS SCOPE

This section of the specification covers climatic and isoceraunic conditions, specific technical particulars, schedule of requirements & desired deliveries, for conductor for 11/33 kV lines.

1. CLIMATIC & ISOCERAUNIC CONDITIONS TO BE SPECIFIED BY EMPLOYER

1.11 Maximum Temperature

a) Conductor °C.

1.22 Minimum Temperature °C.

1.3 i) Max. ambient temperature °C

ii) Mean annual / everyday temperature °C

2.5 Relative humidity

i) Maximum %

ii) Minimum %

2.6 Average Rainfall (Max.) mm per annum

2.7a) Rainy months May to Sept.

15 Rainy days in a year (days)

2.8 Average number of thunderstorm

2.9 Altitude varying from sea level

2.10 Basic horizontal Seismic Co-efficient (horizontal) Basic vertical Seismic Co-efficient

2.11 System Particulars

- a) LineVoltage (kV)
- b) HighestSystem Voltage(kV)
- c) NumberofCircuits
- d) FrequencyHZ
- e) Neutral
- f) Shortcircuit level(KA)

2. SPECIFIC TECHNICAL REQUIREMENTS

CONDUCTOR:					
1. Conductor:	Rabbit/Raccoon/Dog/Weasel/PantherACSR				
2. ISapplicable:	IS-398 (part-II)1996latestrevision				
3.WireDiameter	Rabbit	Raccoon	Dog	Weasel	Panther
Aluminium(mm)	6/3.35	6/4.06	6/4.72	6/2.59	30/3.00
Steel(mm)	1/3.35	1/4.09	7/1.57	1/2.59	7/3.00
4. Number of strands:					
Steel centre		1	1	1	1
1st steel layer	-		6		6
1st Aluminium layer	6	6	6	6	12
2ndAluminium layer					18
5. Sectional Areaof Aluminium(sq.mm.)	52.88	78.83	105	31.61	212.1
6. TotalSectional Area(sq.mm.)	61.7	91.97	118.5	36.88	261.5
7. Overalldiameter(mm)	10.05	12.27	14.15	7.77	21

8. Approximate weight (Kg./Km.)	10.05	12.27	14.15	7.77	21
9. Calculated D.C resistance at 20 degrees C., maximum. (Ohms/Km)	0.552	4.371	2.2792	0.9289	0.139
10. Ultimate tensile strength (KN)	18.25	26.91	32.41	11.12	89.67
11. Final modulus of elasticity (GN/sq.m)	79	79	75	79	80
12. Coefficient of linear expansion x10 ⁻⁶ per C	19.1	19.1	19.8	19.1	17.8
13. Lay ratio	MaxMin	MaxMin	MaxMin	MaxMin	MaxMin
Steel core 6 wire layer			28 13		28 13
Aluminium 1st layer	14 10	14 10	14 10	14 10	14 10
2 nd layer					16 10

14. Technical Particulars

a. Diameter-mm	Rabbit		Raccon		Dog		Weasel		Panther	
	Al	Steel	Al	Steel	Al	Steel	Al	Steel	Al	Steel
Standard (mm)	3.35	3.35	4.09	4.09	1.57	4.72	2.59	2.59	3.00	3.00
Maximum (mm)	3.42	3.38	4.17	4.13	1.60	4.77	2.64	2.62	3.06	3.03
Minimum (mm)	3.28	3.32	4.01	4.05	1.54	4.67	2.54	2.56	2.94	2.97
b. Cross-sectional area of nominal diameter wire (mm ²)	8.814	8.814	13.14	13.14	1.93	17.50	5.269	5.269	7.069	7.069

c. Weight(Kg./Km)	68.75	23.82	102.48	35.51	15.10	47.30	41.09	14.24	55.13	19.11
d. Min.breakingload (KN)Beforestranding	11.58	1.43	17.27	2.08	2.70	2.78	6.92	0.89	9.29	1.17
After Stranding	11.00	1.36	16.4	1.98	2.57	2.64	6.57	0.85	8.83	1.11
e.		-3.265		-2.194		1.65		-5.49		
D.Cresistanceat20Cmin (Ohm/Km)				-4.079						

15. Zinccoating of steelcore:

- (i) The steel strands shall be hot dip galvanized as per IS: 4826.
- (ii) Processof Galvanizing: Hot dip.
- (iii) QualityofZinc : IS-209/1979or latestedition.

16. Jointsin strands

16.1 Steel : Notpermitted

16.2 Aluminium: NojointshallbepermittedintheAluminumwiresintheoutermostlayeroftheAC SRconductor.Butpermittedintheinnerlayerssuchthatnotwosuchjointsarewithin15meters ofeach otherin thecompletestrandedconductor.

15. Chemicalcompositionof highcarbon steelwire:

Element	%Composition
i) Carbon	0.5 to 0.85
ii)Manganese	0.5 to 1.10
iii)Phosphorus	Notmorethan0.035
iv) Sulphur	Notmorethan0.045
v)Silicon	0.10 to 0.35

2. AAA CONDUCTOR

1.1 TECHNICAL DESCRIPTION OF AAA CONDUCTOR

DETAILS OF CONDUCTORS

1.1.1 The AAAC Conductor shall generally conform to IS: 398 (Part-IV), IEC: 104-1987 except where otherwise specified herein.

1.1.2 The details of the AAAC Conductor of various sizes are given in the enclosed Table-I

1.2 WORKMANSHIP

1.2.1 All the Al-

alloy strands shall be smooth, uniform and free from all imperfections, such as spalls and splits, die marks, scratches, abrasions, etc., after drawing and also after stranding.

1.2.2 The finished conductor shall be smooth, compact, uniform and free from all imperfections including kinks (protrusion of wires), scuff marks, dents, press marks, cut marks, wire crossover, over riding, looseness (wire being dislocated by finger/hand pressure and/or unusual bang noise on tapping), material inclusions, white rust, powder formation or black spot (on account of reaction with trapped rain water etc.), dirt, grit etc.

1.3 JOINTS IN WIRES

1.3.1 No joint shall be permitted in any layer of finished conductor.

1.4 STRANDING

In all constructions, the successive layers shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the underlying wire or wires. The outermost layer of wires shall have a right hand lay. The lay ratios shall be as follows.

<u>Number of wires</u>	<u>3/6 Wire layer</u>		<u>12 Wire layer</u>		<u>18 Wire layer</u>	
	<u>Min</u>	<u>Max</u>	<u>Min</u>	<u>Max</u>	<u>Min</u>	<u>Max</u>
<u>3</u>	<u>10</u>	<u>14</u>	-	-	-	-
<u>7</u>	<u>10</u>	<u>14</u>	-	-	-	-
<u>19</u>	<u>10</u>	<u>16</u>	<u>10</u>	<u>14</u>	-	-
<u>37</u>	<u>10</u>	<u>17</u>	<u>10</u>	<u>16</u>	<u>10</u>	<u>14</u>

1.5 TOLERANCES

The manufacturing tolerances in diameter of individual aluminium alloy strands shall be as per Table-I.

1.6 MATERIALS

1.6.1 ALUMINUM ALLOY

The wire shall be of heat treated aluminum, magnesium silicon alloy having a composition appropriate to the mechanical & electrical properties as specified in IS 398 (Part-4).

The Aluminum Alloy strands drawn from heat treated aluminium alloy redraw rods conforming to Type B as per IEC: 104-latest amendment. The chemical composition conform to of redrawn rods shall IS 1997-91, as given below:

Elements	Percent
Si	0.50-0.90
Mg	0.60-0.90
Fe	0.50 max
Cu	0.10 max
Mn	0.03 max
Cr	0.03 max
Zn	0.10 max
B	0.06 max
Other Element (Each)	0.03 max
Other Element (Total)	0.10 max
Al	Remainder

1.7 STANDARD LENGTH

1.7.1 The standard length of the conductor shall be 2000 meters. A tolerance of +/-5% on the standard length offered by the Bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths. The conductor drums shall be adequate to wind one or more standard length of 2000 meters of SQUIRREL/WEASEL/RABBIT/RACOON/DOG/ PANTHER AAA conductor.

1.7.2 Random lengths will be accepted provided no length is less than 70% of the standard length and the total quantity of such random lengths shall not be more than 10% of the total quantity ordered.

1.7.3 Bidders shall also indicate the maximum single length, above the standard length, he can manufacture in the guaranteed technical particulars offered. The Owner reserves the right to place orders for the above lengths on the same terms and conditions applicable for the standard lengths during the execution of the Contract.

1.8 TESTS AND STANDARDS

The following tests to be conducted for AAAC conductor shall conform to IS 398 (Part-IV) 1979 and IEC 888 & 889.

1.8.1

TYPE/PERIODIC

The following tests shall be conducted on samples of each type of conductor :

- a) UTS test on stranded conductor)
) Annexure-A
- (b) DC resistance test on stranded conductor)

1.8.2

ACCEPTANCE TESTS

- (a) Visual check for joint scratches etc. and length measurement of conductor by rewinding)
) Annexure -A
- (b) Dimensional check on Al-alloy strands)
- (c) Check for lay-ratio)
)
- (d) Elongation test)
) Annexure-A
- (e) Breaking load/tensile test on)
) Aluminum alloy strands)
)
- (f) DC resistance test on)
) Aluminum alloy strands
- (g) Wrap test on)
) 104, IEC 1089 Aluminum alloy strands IEC
- (h) Visual and dimensional check on drum)
) IS:1778-1980

1.8.3

ROUTINE TEST

- (a) Check to ensure that there are no joints.

- (b) Check that there are no cuts, fin setc. on the strands.
- (c) Check that drums are as per Specification.
- (d) All acceptance tests as mentioned above to be carried out on each coil.

1.8.4

TESTS DURING MANUFACTURE

- (a) Chemical analysis of

Aluminum alloy used for making strands)
) Annexure-A

1.8.5

TESTING EXPENSES

- i) The type test charges for the conductor should be quoted in the relevant schedule of Bid Proposal Sheets.
- ii) Contractor shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that adequate facilities are available in the laboratories and the tests can be completed in these laboratories within the time schedule guaranteed by them.
- iii) In case of failure in any type test, the Contractor is either required to manufacture fresh sample lot and repeat all the tests successfully once or repeat that particular type test three times successfully on the sample selected from the already manufactured lot at his own expenses. In case a fresh lot is manufactured for testing, then the lot already manufactured shall be rejected.
- iv) The entire cost of testing for the acceptance and routine tests and Tests during manufacture specified herein shall be treated as included in the quoted unit price of conductor, except for the expenses of the Inspector/Owner's representative.
- v) In case of failure in any type test, if repeat type tests are required to be conducted, then all the expenses for deputation of Inspector/Owner's representative shall be deducted from the contract price. Also if on receipt of the Contractor's notice of testing, the Owner's representative does not find the material or testing facilities to be ready for testing the expenses incurred by the Owner for re-deputation shall be deducted from contract price.

1.8.6

ADDITIONAL TESTS

- i) The Owner reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's

premises, at site or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the materials comply with the Specifications.

- ii) The Owner also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Contractor's premises or at any other test centre. In case of evidence of non-compliance, it shall be binding on the part of Contractor to prove the compliance of the items to the technical specifications by repeat tests, or correction of deficiencies, or replacement of defective items all without any extra cost to the Owner.

1.8.7 SAMPLE BATCH FOR TYPE TESTING

- i) The Contractor shall offer material for selection of samples for type testing only after getting Quality Assurance Plan approved from Owner's Quality Assurance Deptt. These samples shall be manufactured strictly in accordance with the Quality Assurance Plan approved by Owner.
- ii) The Contractor shall offer at least three drums for selection of sample required for conducting all the type tests.
- iii) The Contractor is required to carry out all the acceptance tests successfully in presence of Owner's representative before sample selection.

1.8.8 TEST REPORTS

- i) Copies of type test reports shall be furnished in at least six copies along with one original. One copy will be returned duly certified by the Owner only after which the commercial production of the material shall start.
- ii) Record of routine test reports shall be maintained by the Supplier at this works for periodic inspection by the Owner's representative.
- iii) Test Certificates of tests during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Owner.

1.9 INSPECTION

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

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

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

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

1.9.5 TEST FACILITIES

The following additional test facilities shall be available at the Contractor's works:

- i) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc.
- ii) Standard resistance for calibration of resistance bridges.
- iii) Finished conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 16 meters per minute). The rewinding facilities shall have appropriate clutch system and free of vibrations, jerk etc. with traversing facilities.

1.10 PACKING

1.10.1 The conductor shall be supplied in non- returnable, strong, wood endrums provided with lagging of adequate strength, constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The Contractor shall be responsible for any loss or damage during transportation handling and storage due to improper packing. The drum shall generally conform to IS: 1778-1980, except as otherwise specified hereinafter.

1.10.2 The drum shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5 KN.

1.10.3 The Contractor should submit their proposed drum drawings along with the bid.

1.10.4 The Contractor may offer more than one length of the conductor in a single drum.

1.10.5 All wooden components shall be manufactured out of seasoned soft wood free from defects that may materially weaken the component parts of the drums. Preservative treatments shall be applied to the entire drum with preservatives of a quality, which is not harmful to the conductor.

1.10.6 The flange shall be of two-ply construction with a total thickness of 64 mm with each ply at right angles to the adjacent ply and nailed together. The nail shall be driven from the inside face flange, punched and then clenched on the outer face. Flange boards shall not be less than the nominal thickness by more than 2 mm. There shall not be less than 2 nails per board in each circle. Where a slot is cut in the flange to receive the inner end of the conductor the entrance shall be in line with the periphery of the barrel.

- 1.10.7 The wooden battens used for making the barrel of the conductor shall be of segmental type. The ends shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.
- 1.10.8 Barrel studs shall be used for the construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing.
- 1.10.9 Normally, the nuts on the studs shall stand protruded from the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of barrel shall generally be flushed with the top of the nuts.
- 1.10.10 The inner cheek of the flanges and drum barrel surface shall be painted with bitumen based paint.
- 1.10.11 Before reeling, card board or double corrugated or thick bituminous water-proof bamboo paper or HDPE sheet shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. The paper should be dried before use. After reeling the conductor the exposed surface of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.
- 1.10.12 A minimum space of 75mm for conductor shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/galvanized steel wire. Each protective lagging shall have two recesses to accommodate the binders.
- 1.10.13 Each batten shall be securely nailed across grains as far as possible to the flange, edges with at least 2 nails per end. The length of the nail shall not be less than twice the thickness of the battens. The nail shall not protrude above the general surface and shall not have exposed sharp edges to allow the batten to be released due to corrosion.
- 1.10.14 The nuts on the barrel studs shall be tack welded on the one side in order to fully secure them. On the second end, a spring washer shall be used.
- 1.10.15 A steel collar shall be used to secure all barrel studs. This collar shall be located between the washers and the steel drum and secured to the central steel plate by welding.
- 1.10.16 Outside the protective lagging, there shall be minimum of two binder consisting of hoop iron/galvanized steel wire. Each protective lagging shall have two recesses to accommodate the binders.
- 1.10.17 The conductor ends shall be properly sealed and secured with the help of U-nail on the side of one of the flanges to avoid loosening of the conductor layers during transit and handling.
- 1.10.18 As an alternative to wood drum Contractor may also supply the conductor in non-returnable painted steel drums. After preparation of steel surface according to IS: 9954, synthetic enamel paint shall be applied after application of one coat of primer. Wooden/Steel drum will be treated at par for evaluation purpose and accordingly

1.11 the Contractor should quote in the package.

MARKING

Each drum shall have the following information stenciled on it in indelible ink along with other essential data :

- a. Contract/Award letter number.
- b. Name and address of consignee.
- c. Manufacturer's name and address.
- d. Drum and lot number
- e. Size and type of conductor
- f. Length of conductor in meters
- g. Arrow marking for unwinding
- h. Position of the conductor ends
- i. Number of turns in the outermost layer.
- j. Gross weight of drum after putting lagging.
- k. Average weight of the drum without lagging.
- l. Net weight of the conductor in the drum.
- m. Month and year of manufacture of conductor

The above should be indicated in the packing list also.

1.12 VERIFICATION OF CONDUCTOR LENGTH

The Owner reserves the right to verify the length of conductor after unreeling at least Two (2) per cent of the drums in a lot offered for inspection.

For the balanced drums, length verifications shall be done by the owner based on report/certification from Manufacturer/Contractor.

1.13 STANDARDS

1.13.1 The conductor shall conform to the following Indian/International Standards, which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the Specification.

1.13.2 In the event of the supply of conductor conforming to standards other than specified, the Bidder shall confirm in his bid that these standards are equivalent to those specified. In case of award, a table of comparison between the standards proposed by the Contractor and those specified in this document will be provided by the Contractor to establish their equivalence.

SL .NO.	Indian Standard	Title	International Standard
1	IS: 398 (Part-IV)	Aluminum Alloy	IEC : 208-1966
		stranded conductor	BS-3242-1970
2	IS: 9997-1988	Aluminum Alloy Redraw Rods	IEC 104-1987
3	IS: 1778-1980 Reels	Reels and Drums for bare conductors	BS: 1559-1949

1.0 TESTS ON AAAC CONDUCTORS
1.1 UTS Test on Stranded Conductor

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5m length between fixing arrangements suitably fixed on a tensile testing machine. The load shall be increased at a steady rate up to 50% of minimum specified UTS and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at a steady rate to minimum UTS and held for one minute. The conductor samples shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

1.2 D.C. Resistance Test on Stranded Conductor
On a conductor sample of minimum 5m length two contact-clamps shall be fixed with a predetermined bolt torque. The resistances shall be measured by a Kelvin double bridge by placing the clamps initially zero meter and subsequently on one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20°C as per IS: 398-(Part-V)-1982. The resistance corrected at 20°C shall conform to the requirements of this Specification.

1.3 CHEMICAL ANALYSIS OF ALUMINIUM ALLOY
Samples taken from the Aluminium alloyingots/coils/strands shall be chemically/spectrographically analyzed. The same shall be in conformity to the requirements stated in this Specification.

1.4 VISUAL AND DIMENSIONAL CHECK ON DRUMS
The drums shall be visually and dimensionally checked to ensure that they conform to the requirements of this Specification.

1.5 VISUAL CHECK FOR JOINTS, SCRATCHES ETC.
Conductor drums shall be rewound in the presence of the Owner. The Owner shall visually check for scratches, joints etc. and that the conductor generally conforms to the requirements of this Specification. Two percent (2%) drums from each lot shall be rewound in the presence of the Owner's representative.

1.6 DIMENSIONAL CHECK ON ALUMINIUM ALLOY STRANDS
The individual strands shall be dimensionally checked to ensure that they conform to the requirement of this Specification.

1.7 CHECK FOR LAY-RATIOS OF VARIOUS LAYERS
The lay-ratios of various layers shall be checked to ensure that they conform to the requirements of this Specification.

1.8 TORSION AND ELONGATION TESTS ON ALUMINIUM ALLOY STRANDS
The test procedure shall be as per clause No. 10.3 of IEC: 888. In torsion test, the number of complete twists before fracture shall not be less than 18 on a length equal to 100 times the standard diameter of the strand. In case test sample length is less or more than 100 times the stranded diameter of the strand, the minimum number of twists will be proportioned to the length and if number comes in the fraction then it will be rounded off to next higher whole number. In elongation test, the elongation of the strand shall not be less than 4% for a gauge length of 250mm.

1.9 CHECK ON BARREL BATTEN STRENGTH OF DRUMS

The details regarding barrel batten strength test will be discussed and mutually agreed to by the Contractor & Owner in the Quality Assurance Programme.

1.10

Breaking Load Test on Individual Aluminium Alloy Wires

The test shall be conducted on Aluminium alloy wires. The breaking load of one specimen cut from each of the samples taken shall be determined by means of suitable tensile testing machine. The load shall be applied gradually in the jaws of the testing machine shall be not less than 25mm/min. and not greater than 100mm./min. The ultimate breaking load of the specimens shall be not less than the values specified in the Specification.

1.11

RESISTANCE TEST ON ALUMINIUM ALLOY WIRE

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

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

Where

R₂₀ = Resistance corrected at 20 degrees C.

R_T = Resistance measured at T degrees C.

alpha = Constant mass temperature coefficient of resistance 0.004.

T = Ambient temperature during measurement

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

Table-1

Details of parameters of AAA conductor

S.N	Parameter	Squirrel	Weasel	Rabbit	Raccon	DOG	wolf	Panther
1	Total section area of conductor (sqmm)	22	34	55	80	100	173	232
2	(No of Alstrand/dia in mm)	7/2.00	7/2.50	7/3.15	7/3.81	7/4.26	19/3.40	19/3.94
3	Overall diameter (mm)	6	7.5	9.45	11.43	12.78	17	19.7
4	approx mass (kg/km)	60.16	94	149.2	218.26	272.86	474.02	636.67
5	Resistance at 20 deg cel (ohms /km)	1.541	0.99	0.621	0.425	0.339	0.1969	0.1471
6	approx calculated break in load (kN)	6.45	10.11	16.03	23.41	29.26	50.54	68.05
7	Final modulus of Elasticity, GN/sqm (kg/sq cm)	0.6324 x 10 ⁶	0.6324 x 10 ⁶	0.6324 x 10 ⁶	0.6324 x 10 ⁶	0.6324 x 10 ⁶	0.612 x 10 ⁶	0.612 x 10 ⁶
8	Coefficient of linear Expansion / ° C	23.0 X10 ⁻⁶	23.0 X10 ⁻⁶	23.0 X10 ⁻⁶	23.0 X10 ⁻⁶	23.0 X10 ⁻⁶	23.0 X10 ⁻⁶	23.0 X10 ⁻⁶
9	Details of Aluminium							

S.N	Parameter	Squirrel	Weasel	Rabbit	Racco n	DOG	wolf	Panther
	Strands							
a	Minimum breaking load of the strand before stranding (kN)	0.97	1.52	2.41	3.52	4.4	2.8	3.77
b	Minimum breaking load of the strand after stranding (kN)	0.92	1.44	2.29	3.34	4.18	2.66	3.58
c	Maximum DC resistance of strands at 20deg C (ohms/km)	10.653	6.845	4.29	2.938	2.345	3.677	2.746
d	Mass (kg/km)	8.482	13.25	21.04	30.78	38.48	24.51	32.92
e	Diameter							
i	Nominal	2.0	2.50	3.15	3.81	4.26	3.40	3.94
ii	Maximum	2.02	2.53	3.18	3.85	4.30	3.43	3.98
iii	Minimum	1.98	2.47	3.12	3.77	4.22	3.37	3.90

PCC Poles

As per State Practice.

2. Tubular Steel Poles for Overhead Lines

1 SCOPE:

This specification covers the general requirements towards design, manufacture, testing at manufacturers works, supply and delivery for tubular steel poles of circular cross section (swaged type) for overhead lines.

2 STANDARD:

The tubular steel poles shall conform to the latest edition of Indian Standard specification IS: 2713 (Part – I, III): 1980 or any other authoritative standards (as amended up-to- date) except where specified otherwise in this specification.

3 Topography and Climatic Condition:

The materials offered, shall be suitable for operation in tropical climate and will be subjected to the sun and inclement weather and shall be able to withstand wide range of temperature variation. For the purpose of design, average atmospheric temperature may be considered to be 50°C with humidity nearing saturation.

4 Materials:

4.1 The materials used in construction of tubular steel poles shall be of the tested quality of steels of minimum tensile strength 540 MPa (: 55 Kgf/mm²).

4.2 The materials, when analysed in accordance with IS: 228 (Part-III: 1972) and IS : 228 (Part-IX) shall not show sulphur and phosphorous contents of more than 0.060 percent each.

5 Types, Size and construction:

5.1 Tubular Steel Poles shall be swaged type.

5.2 Swaged poles shall be made of seamless or welded tubes of suitable lengths swaged and jointed together. No circumferential joints shall be permitted in the individual tube lengths of the poles. If welded tubes are used they shall have one longitudinal weld seam only: and the longitudinal welds shall be staggered at each swaged joint.

5.3 Swaging may be done by any mechanical process. The upper edge of each joint shall be chamfered if at an angle of about 45°. The upper edge need not be chamfered if a circumferential weld is to be deposited in accordance with clause No. 5.3 2 of IS: 2713 (Part-I):1980.

5.4 The length of joints on swaged poles shall be in accordance with clause No. 5.4 of IS: 2713 (Par-I): 1980.

5.5. Poles shall be well-finished, clean and free from harmful surface defects. Ends of the poles shall be cut square. Poles shall be straight, smooth and cylindrical. The weld joints, if any, shall be of good quality, free from scale, surface defects, cracks, etc.

5.6. Tolerances for outside diameter, thickness, length, weight and straightness shall be in accordance with IS: 2713 (Part-I) : 1980.

- 5.7. The poles shall be coated with black bituminous paint conforming to IS: 158-1968 throughout, internally and externally, upto the level which goes inside the earth. The remaining portion of the exterior shall be painted with one coat of red oxide primer as specified in IS: 2074-1979.
- 6 Earthing Arrangements:
- For earthing arrangement a through hole of 14mm diameter shall be provided in each pole at a height of 300mm above the planting depth.
- 7 Tests and Test Certificates:
- 7.1 The following tests shall be conducted on finished poles :
- A. Tensile test and chemical analysis for sulphur and phosphorous,
 - B. Deflocation test,
 - C. Permanent set test, and
 - D. Drop test.
- 7.2 In addition to above verification of dimensions as per IS: 2713 (Part-III) : 1980 shall be carried out during acceptance lots.
- 7.3 Number of poles selected for conducting different tests shall be in accordance to clause No. 10.1.1 and No. 10.1.12: of IS: 2713 (Part-I) 1980.
- 7.4 Tests shall be carried out before supply of each consignment at the manufacturers works and test certificates should be submitted to the purchaser for approval prior to delivery.
- 7.5 Re-tests, if any, shall be made in accordance with IS: 2713 (Part-I) 1980.
- 7.6 Purchaser reserves the right to inspect during manufacturing and depute his representative to inspect/test at the works.
- 7.7 If any extra cost is required for carrying out the above specified tests, the same shall be borne by the manufacturer.
- 8 Marking:
- 8.1 The poles shall be marked with designation, manufacturer's identification, year of manufacture and name of the purchaser: Employer Name; DDUGJY
- 8.2 The poles may also be marked with the ISI certification mark.
- 9 Guaranteed technical particulars:
- 9.1 The manufacturer shall furnish all necessary guaranteed technical particulars in the prescribed Performa enclosed hereinafter.
- 10 Performance:-
- 10.1 The manufacturer shall furnish a list of the major supplies effected during the last 3 (three) years indicating the volume of supply and actual delivery dates.

10.2 Manufacturer may not be considered if the past manufacturing experience is found to be less than 3 (three) years.

11 Deviation:-
Any deviation in technical specification shall be clearly indicated with sufficient reasons thereof. Purchaser shall however reserve the right to accept and/or reject the same without assigning any reasons whatsoever.

ANNEXURE –‘A’

SPECIFIC TECHNICAL REQUIREMENTS FOR
TUBULAR STEEL POLES : SWAGED TYPE

	9 meters long	11 meters long	13 meters long	12 meters long
1) Standard	IS: 2713 (Pat-I and III): 1980 as amended upto date			
2) Type of Pole	Swaged Type			
3) Designation	540 SP 28	540 SP 52	540 SP 72	410 SP 60
4) Overall Length	9 meters	11 meters	13 meters	12 meters
5) Planting depth	1.5 meters	1.8 meters	2.0 meters	2.0 meters
6) Height above ground	7.5 meters	9.2 meters	11.0 meters	10.0 meters
7) Effective length of Each section.				
a) Bottom	5.0 meters	5.6 meters	5.80 meters	5.80 meters
b) Middle	2.0 meters	2.7 meters	3.60 meters	3.10 meters
c) Top	2.0 meters	2.7 meters	3.60 meters	3.10 meters
8) Outside diameter and Thickness of each Section.				
a) Bottom	139.7x 4.50 mm	165.1x4.50 mm	219.1x5.90 mm	165.1x5.40mm
b) Middle	114.3x3.65 mm	139.7x4.50 mm	193.7x4.85 mm	139.7x4.50 mm
c) Top	88.9x3.25 mm	114.3x3.65 mm	165.1x4.50 mm	114.3x3.65 mm
9) Joint Length (in cm.):				
a) Bottom (J2)	30 cm.	35 cm.	45 cm.	35 cm.
b) Top (J1)	23 cm.	30 cm.	40 cm.	30 cm.
10) Approximate weight of Pole	113 Kg.	175 Kg.	343 Kg.	208 Kg.
11)Point of application of load below/top (mtr.)	0.3 mtr.	0.6 mtr.	0.6 mtr	0.6 mtr
12) Breaking load (inKgf)	478	567	1084	469
13) Working load with factor of Safety : 2.5 (in Kgf)	191	227	435	188
14) Crippling load (inKgf)	339	403	770	333
15) Load for permanent set Not exceeding 13mm (in Kgf)	232	276	527	228
16) Load for Temporary Deflection of 157.5 mm (in Kgf)	76	74	121	61
17) Tolerance	As per IS : 2713 (Part-I & Part-III): 1980			
18) Finish	-do-			
19) Manufacturing clause	-do-			

3. Hot Rolled Steel Beams (Joists)

1. SCOPE :-

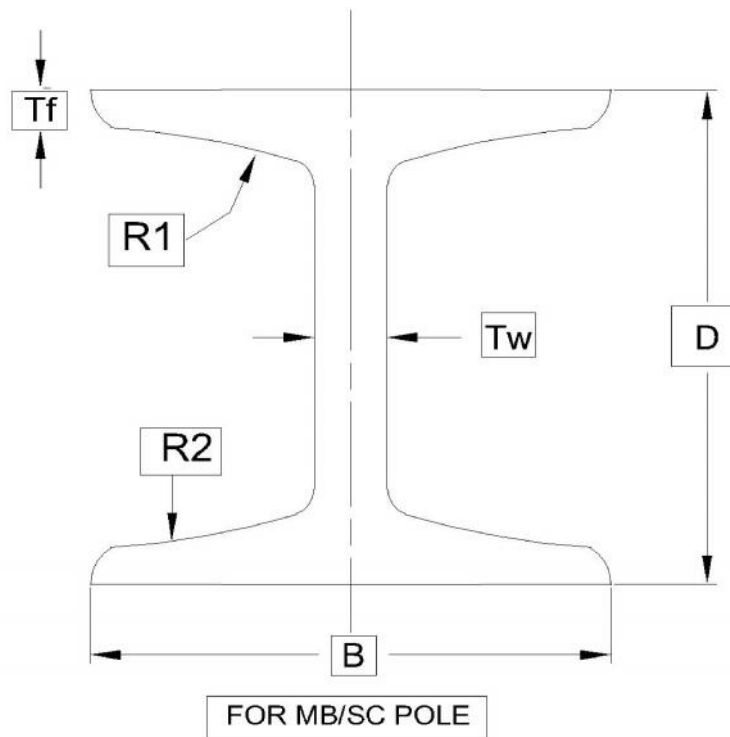
Specification covers the manufacture, testing at works and supply of various sizes of Hot rolled steel beams.

2. APPLICABLE STANDARDS:

The Mild shall be conforming to IS:2062 – 1992 GRADE ' A ' modified upto date or its equivalent international standard for steel materials, document for which shall be made available at the time of inspection to the Employer's representative. The dimensions of Hot Rolled Steel Beams shall be conforming to IS: 808 / 1989 amended upto date and tolerance as per IS : 1852 modified upto date.

3. GENERAL REQUIREMENTS :

Material shall be supplied as per the sizes and technical details as per following requirements and drawing.



Note: 1) All Dimensions are as per annexure-I
2) Drawing is not to the scale

ANNEXURE-I

Sr.No.	Particulars	Requirement as per Specification	
		MB	SC
1	Designation (DxB) (mm x mm)	175X85	152X152
2	Length of joist-Meter with +100 mm tolerance	9m	11m / 13m
3	Weight (kg/M)	19.6	37.1
4	Sectional area (A) (Sq.cm.)	25.0	47.4
5	Depth of section (D) (mm)	175	152
6	Width of flance (B) (mm)	85	152
7	Thickness of flance (Tf) (mm)	9	11.9
8	Thickness of Web (Tw) (mm)	5.8	7.9
9	Radius of fillet or root (R1) (mm)	10	11.7
10	Radius of tow (R2) (mm)	5	3
11	Moment of Inertia		
	(i) I xx (cm ⁴)	1260	1970
	(ii) I yy (cm ⁴)	76.7	700
12	Radius of Gyration GR xx (cm)	7.13	6.45
13	Modulus of Section		
	(i)Z xx (cm ³)	144	259
	(ii)Z yy(cm ³)	18	91.9
14	Tolerance in dimensions plus/minus	-----As per IS: 1852-----	

4. Mild Steel Channel, Angle And Flat

1) APPLICABLE STANDARDS:

The mild steel shall conform to IS: 2062 grade 'a' modified upto date or equivalent international standard for steel materials, documents for which shall be made available at the time of inspection to the owner's representative.

2) GENERAL REQUIREMENTS:

Material shall be supplied as per the following sizes:

100x50 ISMC channel conforming to IS: 2062 grade 'a' modified upto date or its equivalent International Standard having length ranging from 5.5 to 13.5 meters. 75x40 ISMC channel conforming to IS: 2062 grade 'a' modified upto date or its equivalent International Standard having length ranging from 5.5 to 13.5 meters.

50x50x8 mm or 6 mm ISA angles conforming to IS: 2062 grade 'a' modified upto date or its equivalent international standard having length ranging from 5.5 to 13.5 meters.

45x45x5 mm ISA angles conforming to IS: 2062 grade 'a' modified upto date or its equivalent international standard having length ranging from 5.5 to 13.5 meters.

60x65x6 mm ISA angles conforming to IS: 2062 grade 'a' modified upto date or its equivalent international standard having length ranging from 5.5 to 13.5 meters.

25X3mm, 50X6mm, 50x8mm, 75X8mm and 80X8 flats conforming to IS: 2062 grade 'a' modified upto date or its equivalent international standard having length ranging from 5.5 to 9.5 meters.

3) GALVANISATION:

All above steel members shall be fabricated as per approved drawing having smooth edge, drilled circular/elliptical holes of suitable measurements.

All structural steel members and bolts shall be galvanized as per IS:4759 and zinc coating shall not be less than 610gm/sq. meter for all structural steel members. All weld shall be 6mm filled weld unless specified otherwise. All nuts and bolt shall be of property class 5.6 of IS 1367. Plain washers shall be as per IS 2016 and spring washers shall be IS:3063

4) INSPECTION:

All inspection/test will be carried out by representative of owner.

All tests and inspection shall be made at the place of manufacturer unless otherwise specially agreed upon by the manufacturer and the owner. The manufacturer shall provide all reasonable facilities, without charge to satisfy him that the material is being supplied in accordance with the specification.

5. 11 & 33 KV Outdoor Type Current Transformer

4.1 INTRODUCTION

This section covers the specification of 33 kV and 11kV Current Transformer suitable for outdoor service. Any other parts not specifically mentioned in this specification but otherwise required for proper functioning of the equipment should be included by the tender in the offer. The CTs should normally be installed above VCB. The VCB & CT should be installed on common mounting structure. In places, where VCB are not provided in the Substation separate CT mounting structure shall be provided with CTs.

4.2 APPLICABLE STANDARDS

Unless otherwise modified in this specification, the Current Transformer shall comply with the latest version of relevant standards (IS 2165, IS 2705(I-IV), IS 2099, IS 5621, IS 2071, IS 335, IS 13947(part I), IEC 185, IEC 270, IEC 44(4), IEC 171, IEC 60, IEC 8263, IEC 815, Indian electricity Rules 2003) or better international standards. This list of standards is for guidance only. The contractor shall be solely responsible to design & manufacture the CT suitable for 33kV & /11 kV systems.

4.3 AMBIENT CONDITIONS

The CT supplied against these specifications shall be suitable for satisfactory continuous operation under the tropical conditions. The detail condition is mentioned in General Technical requirement.

4.4 SYSTEM PARTICULARS

a)	Nominal System Voltage	33kV & 11kV
b)	Highest system Voltage	36kV & 12kV
c)	Rated Frequency	50Hz & 50Hz
d)	No of phases	Three & Three
e)	System neutral earthing	-Solidly Earthed-
f)	One minute Power Freq. withstand voltage (rms)	70kV & 28kV
g)	Lighting Impulse withstand Voltage	170kVp & 75kVp
i)	System fault level	-25kA for 3sec-

4.5 TECHNICAL PARAMETERS OF CT

a)	Type	Single phase, dead tank, outdoor, oil filled & hermetically sealed
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b)	Type of mounting	Pedestal type	
c)	Rated primary current	As per BPS	
d)	Rated Continuous thermal current Primary current	120 % of rated	
e)	Rated short time withstand Requirement for sec. Winding	As per IS 2705 Pt. I	
f)	Rated short time withstand Current	25kA(RMS)	
	i) Duration (for primary current of 150amps and above)	3Sec	
	ii) Duration (for primary current below 150amps)	1Sec	
g)	Rated dynamic withstand Current (KA rms)	62.5	
h)	Max temp rise	As per IEC-185/ IS 2705	
i)	Minimum creepage distance of porcelain housing(mm)	25 mm /KV	
j)	One minute power frequency Withstand voltage between Secondary terminal & earth	3 kV	
k)	Detail of Secondary Cores	Metering	Protn.
	Current ratio	(As per BPS)	
	Accuracy class	0.5	5P10
	Burden (VA)	30	30
	Instrument security Factor	5	-
	Accuracy Limit Factor	-	≥10

Note: The ratings indicated for instrument transformer are tentative only and may be changed to meet the requirements.

4.6 PORCELAIN HOUSING

It shall be single piece of homogeneous, vitreous porcelain of high mechanical & dielectric strength. It will be glazed with uniform Brown or Dark brown colour with smooth surface finish. The creepage distance for the porcelain housing shall be at least 25 mm per kV.

4.7 WINDING

1 PRIMARY WINDING

It shall be made of high conductivity rigid copper wire. The primary winding current density shall not exceed the limit of 1.6 Amp per sq. mm for normal rating.

The design current density for short circuit current as well as conductivity of metal used for primary winding shall be as per IS 2705. The calculation for the selection of winding cross section shall be furnished by contractor.

The primary terminal shall be of standard size of 30 mm dia x 80 mm length of heavily tinned (min. thickness 15 micron) electrolytic copper of 99.9 % conductivity.

2 SECONDARY WINDING

shall be made of insulated copper wire of electrolytic grade. Type of insulation used shall be described in the offer. For multi ratio design, the multi ratio will be achieved by reconnection of the primary winding or secondary winding. The excitation current of the CT shall be as low as possible. The contractor shall furnish the magnetization curves for all the cores.

The terminal box shall be dust free & vermin proof. The size of the terminal box shall be big enough to enable easy access and working space with the use of normal tools.

The secondary terminals studs shall be provided with at least 3 nuts and two plain washers, these shall be made of brass duly nickel plated. The min. stud outer dia shall be 6 mm & length 15 mm. The min spacing between the centres of the adjacent studs shall be 1.5 time the outer dia of the stud.

3 POLARITY

The polarity shall be marked on each CT at the primary and secondary terminals.

4.8 TANK & HARDWARES

The CT will be dead tank type. The tank shall be fabricated of MS steel sheet of min. 3.15 mm for sides & 5 mm for top & bottom. The tank will be finished with min. 2 coats of zinc rich epoxy paint externally. The inner surface shall be painted with oil resistance white enamel paint.

All ferrous hardwares, exposed to atmosphere shall be hot dipped galvanized.

4.9 INSULATION OIL

The first filling of oil in CT shall be in contractor's scope. The oil shall be as per IS 335.

To ensure prevention of oil leakage, the manufacturer will give following details supported by drawings:

- i) Location of emergence of Primary & Secondary terminals
- ii) Interface between porcelain & metal tanks
- iii) Cover of the secondary terminal box

Any nut & bolt and screw used for fixation of the interfacing porcelain bushing for taking out the terminals shall be provided on flanges cemented to the bushings & not on the porcelain.

If gasket joints are used, Nitrite Butyl Rubber gasket shall be used. The grooves shall be machined with adequate space for accommodating gasket under pressure.

The CT shall be vacuum filled with oil after processing. It will be properly sealed to eliminate breathing & to prevent air & moisture from entering the tank. The sealing methods/arrangement shall be described by the contractor & be approved by the owner.

4.10 OIL LEVEL INDICATOR

The CT shall be fitted with prismatic type oil sight window at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level.

To compensate oil volume variation due to temperature variation, Nitrogen cushion or the stainless steel bellows shall be used. Rubber diaphragms are not permitted for this purpose.

4.11 EARTHING

Two earthing terminals shall be provided on the metallic tank of size 16 mm dia & 30 mm length each with one plain washer & one nut for connection to the station earth mat

4.12 Junction Box

The junction box shall be of MS sheet having thickness of 2mm, synthetic enamel painted as per procedure mentioned in General Technical Requirement (Min. thickness 55 micron). The shade of junction box shall be 697 of IS: 5. Disconnecting type terminal blocks for CT secondary lead shall be provided. The junction boxes shall be weather proof type with gaskets, as per section-I (Introduction and general technical requirements) conforming to IP-55 as per IS-13947 (Part-I).

4.13 LIFTING & MOUNTING ARRANGEMENT

The CT shall be provided with two lifting eyes to lift the CT. This shall be so positioned so as to avoid any damage to the CT during lifting for installation or transportation purpose. This shall be detailed in General Arrangement drawing.

The CT shall be of pedestal mounting type suitable for outdoor installation on steel/cement concrete structures. All the clamps, bolts, nut and washers etc. required for mounting the CT on the structure shall be supplied along with the CT and shall be galvanized. The contractor shall supply all the terminal connectors etc. required for connection to the CT.

4.14 TESTING

All Type and Routine Tests shall be as per relevant IS and/or IEC.

6. 33 & 11 kV Outdoor Type Potential Transformer

1 INTRODUCTION

This chapter covers specification of 33kV and 11kV Potential Transformer suitable for outdoor service. Any other parts not specifically mentioned in this specification but otherwise required for proper functioning of the equipment should be included by the tender in the offer.

2 APPLICABLE STANDARDS

Unless otherwise modified in this specification, the Potential Transformer shall comply with the latest version of relevant standards (IS 3156, IS 2099, IS 5621, IS 335, IS 13947(Part I), IEC 186, Indian electricity Rules 2003, IEC 815) or better international standards. This list of standards is for guidance only. The contractor shall be solely responsible to design & manufacture the PT suitable for 33 kV/11kV systems.

3 AMBIENT CONDITIONS

The PT supplied against this specification shall be suitable for satisfactory continuous operation under the tropical conditions as detailed in general technical requirement.

4 SYSTEM PARTICULARS

a)	Nominal System Voltage	33kV	11kV
b)	Highest system Voltage	36kV	12kV
c)	Rated Frequency	50Hz	50Hz
d)	No of phases	Three	Three
e)	System neutral earthing	---Solidly Earthed--	
f)	One minute Power Freq. Withstand voltage (rms)	70kV	28kV
g)	Lighting Impulse withstand Voltage	170kVp	75kVp
h)	System fault level	---25 kA for 3sec---	

5 TECHNICAL PARAMETERS OF PT

a)	Rated primary Voltage	36 KV	12 KV
b)	Type	Single phase potential transformer	
c)	Voltage/ Ratio(kV)	33/0.11	11/0.11
d)	Rated voltage factor	1.2continuous	1.5 – 30seconds-
e)	One minute power freq. Withstand voltage for Primary Terminals	70 kV(rms)	28 KV

	Secondary winding	36 kV	12 KV
f)	Min. Creepage Distance	25 mm/kV of Highest System Voltage	
g)	Detail of secondaries	Core I	Application Metering
	Accuracy	0.5	0.5
	Burdan (VA)	100	100

Note: The ratings indicated for instrument transformer are tentative only and may be changed to meet the requirements.

6 PORCELAIN HOUSING

It shall be single piece of homogeneous, vitreous porcelain of high mechanical & dielectric strength. It will be glazed with uniform Brown or Dark brown colour with smooth surface finish. The creepage distance for the porcelain housing shall be at least 25mm per kV.

The contractor shall clearly detail in his bid the details of attaching the metallic flange to porcelain, pressure release valve and also how primary & secondary terminals shall be brought out.

7 WINDING

PRIMARY WINDING

It shall be made of insulated electrolytic copper wire. The neutral end of the winding shall be brought outside for earthing.

The primary terminal shall be of standard size of 30 mm dia x 80 mm length of heavily tinned (min. thickness 15 micron) electrolytic copper of 99.9 % conductivity.

SECONDARY WINDING

It shall be made of insulated copper wire of electrolytic grade. The terminal box shall be dust free & vermin proof. The size of the terminal box shall be big enough to enable easy access and working space with the use of normal tools.

The secondary terminals studs shall be provided with at least 3 nuts and two plain washers. These shall be made of brass duly nickel plated. The min. stud outer dia shall be 10 mm & length 15 mm. The min spacing between the centres of the adjacent studs shall be 1.5 time the outer dia of the stud.

POLARITY

The polarity shall be marked on each PT at the primary and secondary terminals.

8 TANK & HARDWARES

It shall be fabricated of MS steel sheet of min. 3.15 mm for sides & 5 mm for top & bottom. The tank will be finished with min. 2 coats of zinc rich epoxy paint externally. The inner surface shall be painted with oil resistance white enamel paint.

All ferrous hardwares, exposed to atmosphere shall be hot dipped galvanized.

9 INSULATION OIL

The first filling of oil in PT shall be in contractor's scope. The oil shall be as per IS 335. To ensure prevention of oil leakage, the manufacturer will give following details supported by drawings:

- i) Location of emergence of Primary & Secondary terminals
- ii) Interface between porcelain & metal tanks
- iii) Cover of the secondary terminal box

Any nut & bolt and screw used for fixation of the interfacing porcelain bushing for taking out the terminals shall be provided on flanges cemented to the bushings & not on the porcelain.

If gasket joints are used, Nitrite Butyl Rubber gasket shall be used. The grooves shall be in machined with adequate space for accommodating gasket under pressure.

The PT shall be vacuum filled with oil after processing. It will be properly sealed to eliminate breathing & to prevent air & moisture from entering the tank. The sealing methods/arrangement shall be described by the contractor & be approved by the owner.

10 OIL LEVEL INDICATOR

The PT shall be fitted with prismatic type oil sight window at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level.

To compensate oil volume variation due to temperature variation, Nitrogen cushion or the stainless steel bellows shall be used. Rubber diaphragms are not permitted for this purpose.

11 EARTHING

Two earthing terminals shall be provided on the metallic tank of size 16 mm dia & 30 mm length each with one plain washer & one nut for connection to the station earth mat

12 Junction Box

The junction box shall be of MS sheet having thickness of 2mm, synthetic enamel painted as per procedure mentioned in General technical Requirement (Min. thickness 55 micron). The shade of junction box shall be 697 of IS: 5. Disconnecting type terminal blocks for PT secondary lead shall be provided. The junction boxes shall be weather proof type with gaskets as per section-I (Introduction and general technical requirements) conforming to IP-55 as per IS-13947 (Part-I).

One junction box shall be provided for 3 numbers of single phase CT's and PT's.

13 LIFTING & MOUNTING ARRANGEMENT

The PT shall be provided with two lifting eyes to lift the PT. This shall be so positioned so as to avoid any damage to the PT during lifting for installation or transportation purpose. This shall be detailed in General Arrangement drawing.

The PT shall be of pedestal mounting type suitable for outdoor installation on steel/cement concrete structures. All the clamps, bolts, nut and washers etc. required for mounting the PT on the structure shall be supplied along with the PT and shall be galvanized. The contractor shall supply all the terminal connectors etc. required for connection to the PT.

14 TESTING

All Type and Routine Tests shall be as per relevant IS and /or IEC.

7. 11 kV AND 33 kV Vacuum Circuit Breakers

1) SCOPE

This specification covers design, manufacturing, testing at manufactures works, supply of 11KV and 33 KV Vacuum Circuit Breakers complete with all accessories required for their satisfactory operation for the sub-transmission system. The Breakers shall be used for Transformer protection or Feeder Control, in the system.

2) TYPE AND RATING

The circuit breakers shall be suitable for outdoor operation under the climatic conditions, as specified in Tender specification, without any protection from sun and rain.

The circuit breakers shall have the following rating:-

S.No.	PARTICULARS	33 KV	11 KV
i)	Number of Poles	3 Nos.	
ii)	Frequency	50 Cycles	
iii)	Nominal System Voltage	33 KV	11 KV
iv)	Highest System Voltage	36 KV	12 KV
v)	Interrupting Capacity at nominal system voltage	1500 MVA	1500 MVA
vi)	Rated Continuous Current	1250 Amps	1250 Amps
vii)	Short-time Current Rating for 3 Secs.	25 KA	25 KA
viii)	Basic Insulation Level	170 KV	75 KV
ix)	Power Frequency Withstand Voltage for one Minute	70 KV	28 KV
x)	Total Break-time for any Current up to the rated breaking current	5 cycles (max.)	
xi)	Control Circuit Voltage	30 Volt D.C.	
xii)	Operating duty for gang operation	O – 0.3 Sec – CO – 3 Min – CO	
xiii)	The VCBs shall be suitable for one reclosing followed by one delayed reclosing and lock out		
Minimum clearances			
a)	Between Phases	430 mm	280 mm
b)	Between Live Parts & Ground	3700 mm	2750 mm
c)	Creepage Distance	900 mm	300 mm

The above are our minimum requirements. The manufacturers may offer their standard design, keeping in view our minimum requirements.

3) STANDARDS

The circuit breakers shall comply with the requirements of IEC 56 or IS 13118 (1991) with latest amendment thereof, except wherein specified otherwise. Equipment, meeting any other authoritative standard, which ensures equal or better quality than the standard mentioned above, would also be acceptable. The bidders shall clearly indicate the applicable standards to which their equipments complies-with. A copy of such standard may also be enclosed.

4) GENERAL

The circuit breaker shall be of porcelain clad vacuum type. The breaker, complete in all respect, shall be supplied with all accessories in-place and all internal wiring installed and terminated in the mechanism housing and the equipment shall be complete in all respects.

The circuit breakers shall provide rapid and smooth interruption of current under all conditions, completely suppressing all undesirable phenomena, even under the most severe and persistent short-circuit conditions or when interrupting small currents or leading/ lagging reactive currents. The details of any device incorporated to limit or control the rate of rise of Restriking voltage across the circuit breaker contacts shall be stated. The over voltage caused by the circuit breaker switching on inductive or capacitive load shall not exceed 3.2 times the normal phase to neutral voltage. The total break-time for the circuit breaker, throughout the range of breaker operating duty, shall be stated in the tender and shall be guaranteed. The breaker shall be fit for capacitor switching for 5 MVAR Bank.

The breakers shall be provided with trip free mechanism.

The circuit breakers shall be suitable for mounting on steel structures. The cost of necessary frames for mounting the circuit breakers shall be included in the offered prices. Strongly supported bracket or frame, for mounting associated 3 nos.11 KV / 33 KV CTs, shall also be provided. All the structures shall be hot dip galvanized with 3 dips. Please note that cantilever type supports for mechanism box are not acceptable. The mechanism box shall have firm supports from bottom. This is necessary to minimize vibration of mechanism box, which in turn may disturb various settings. The agency shall indicate clearly the vibration level of the breaker during fault / normal ON OFF operations in all three directions.

The owner intends to operate 11 KV and 33 KV feeders with automatic reclosing scheme, the arrangement envisaged is as under:-

On the occurrence of a fault the concerned protective relay will open the circuit breaker as per its own characteristic. Thereafter, the breakers shall re-close but after pre-set time delay, which shall be adjustable (say range 4 – 10 sec. or near about). There shall be no further automatic reclosing. A simple type of reclosing relay (reputed make) for this purpose shall be provided under this kind of operation. It is also necessary that the breaker shall be suitable for this reclosing duty. The auto-recloser relay is to be installed in respective indoor control panels.

5) SPECIFICATION FOR CIRCUIT BREAKERS

The circuit breakers shall consist of three identical phase units with a common operating mechanism. While offering the circuit breaker, the following details should be confirmed and furnished with the tender:-

- i) Complete construction details of the equipment offered. It should be noted that the breakers should be suitable for out-door duty. Indoor breakers accommodated in out-door kiosks are not acceptable.
- ii) Type, make & source of vacuum bottles with relevant details shall be indicated in the offer, clearly.
- iii) The capacity of breaker to interrupt inductive and capacitive currents shall be indicated in the offer (rating of capacitor bank should be stated and type test report shall be furnished).
- iv) Spare availability of vacuum interrupter should be confirmed by the bidder for the designed expected life of the breakers being offered.

6) VACUUM INTERRUPTER

The design of the vacuum interrupter shall be such that it gives trouble free operation under normal load and fault conditions throughout the life of the equipment. As the efficiency of the breaker depends on the degree of vacuum inside the interrupter, manufacturer shall ensure that the same is maintained consistently during service. To know the residual life of vacuum interrupter, an indicator to indicate the status of contact erosion shall be provided.

The insulating ceramic body of the interrupter should have high mechanical strength and it should be capable of withstanding high temperature without any significant deterioration in its mechanical and electrical properties

The metal/ alloy used for the fixed and moving contacts shall have very low resistivity and low gas content. They should be resistant to arc erosion and the contact should have no tendency to get cold-welded under the high vacuum in the interrupter.

The interrupter design should ensure rapid de-ionization of the gap so that normal electrical strength of the gap is restored instantaneously.

The metallic bellow or any other similar vacuum sealing arrangement should be provided at the moving contact and should have a long fatigue life.

Manufacturer's catalogue on vacuum bottle, indicating all the details shall essentially be submitted with the tender.

7) MOUNTING OF 11 KV / 33 KV CTs

The offered steel structures for breakers to be supplied by the bidders should have provision and adequate strength to accommodate 3 nos. 11 KV / 33 KV CTs on it after provision of suitable supports from ground.

8) TEMPERATURE RISE

The maximum temperature attained by any part of the equipment, when in service at site, under continuous full load conditions, exposed to the direct rays of the sun, shall not exceed 45° Centigrade, above ambient temperature. The limits of temperature rise shall be as per relevant standards. The corrections proposed shall be stated in the tender and shall be subject to approval of the owner.

9) INSULATION OF THE CIRCUIT BREAKER

The insulation to ground, the insulation between open contacts and the insulation between phases of the completely assembled circuit breaker shall be capable of withstanding satisfactorily di-electric test voltage corresponding to specified basic insulation level in the standard.

10) INSULATORS

The basic insulation level of the Insulator and insulating porcelains shall be as specified and porcelain shall be homogenous and free from cavities and other flaws. They shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation under conditions specified above. All insulators of identical ratings shall be inter-changeable. The puncture strength of the insulators shall be greater than the flash over value. The insulators shall be type tested from independent Govt. Laboratory as per relevant standards or at any recognized and reputed international laboratory or testing institutions.

11) OPERATING MECHANISM

The circuit breakers shall be designed for remote control from the control room and in addition there shall be provision for manual operation of circuit breakers during maintenance and for local tripping and closing by the normal means.

The circuit breakers shall have operation control and mechanical "open" "close" indicator, in addition to facilities for remote electrical indication.

The operating mechanism shall be of the spring charging type, by electric control under normal operation. The mechanism shall be trip free electrically and mechanically. The mechanism shall be capable of performing satisfactorily, the reclosing duty cycles indicated above, within the time specified. All working parts in the mechanism shall be of corrosion resistant material and all bearings, which require greasing, shall be equipped with pressured grease fittings. The mechanism shall be strong positive quick in action and shall be removable without disturbing the other parts of the circuit breaker. The mechanism and breaker shall be such that the failure of any spring will not prevent tripping and at the same time will not cause any false tripping or closing. The operating Mechanism should be motor operated spring charged type preferably without chain drive. The motor for spring charging shall be suitable to perform satisfactorily for input supply voltage of 230 Volt A.C. 50 Hz with a variation of plus 10 and minus 20 percent. The A.C. Motor should have overload protection. Provision should also be made for mounting of mechanism box at an adequate height and gear ratios shall be so chosen that one man should be able to charge the spring, without any additional efforts.

12) CONTROL CUBICLE

A common control cubicle shall be provided to house electrical, controls, monitoring devices and all other accessories, except those which must be located on individual poles. The cubicle shall be gasketed and shall have weather-proof construction, fabricated from sheet steel of minimum 2.5 mm thickness. The type test report on degree of protection test (IP-55) shall also be furnished.

The cubicle shall have front access door with lock and keys, space heater, internal illumination lamp, 3 pins 5 Amp socket with individual ON-OFF switches shall be provided in the cubicle.

For local operation following shall be provided:-

- a) LOCAL / REMOTE selector switch

- b) TRIP / NORMAL / CLOSE control switches with pistol grip handle

The control circuits shall be designed to operate on 30 Volt DC, as indicated in the schedule and it shall be possible to adopt to work on other voltages by simply changing the operating coils. The shunt tripping coils shall be designed to operate satisfactorily within 110% and 70% of the rated DC supply voltage and the shunt closing coils should operate up to 85% of the rated DC voltage. These checks shall be repeated during pre-commissioning checks at site before putting the breakers in service.

AC Power supply for auxiliaries will be available at 230 Volt (+/- 10% variation) single phases 50 C/s at substation. The agency shall be required to extend this supply, using proper protection, to desired location through cable.

Necessary double compression type cable glands for the cables of the operating mechanism shall be provided. The cables used for operation are all un-armoured 2.5 sq. mm copper control cables of 1100 V grade. The cable glands shall be suitable for 1 no. 8 core and 2 nos. 4 core cables and cables as per site requirements. The gland plate should be made of non-magnetic materials and suitably drilled at site to suit the cable entry.

The Circuit breaker shall be provided with trip free Mechanism so that tripping instructions could over-ride the closing instructions. An additional tripping coil shall also be provided in the trip circuit. The second coil shall have separate tripping lever arrangements in the mechanism, so as to avail full advantage of second trip coil. Also the two trip coils shall have separate fuses in the DC circuit, so that in the event of any short circuit/damage in any one of the trip coils, the supply is available to the other one.

The circuit diagram of Control circuit of VCB along with operating instructions (DOS/ DON'T) shall be embossed on metallic plate duly laminated and the same shall be fixed on the rear door of the control cubicle from inside.

13) WIRING

Wiring shall be completed in all respects to ensure proper functioning of the control, protection, monitoring and interlocking schemes.

All the wiring shall be carried out with 1100 V grade, PVC insulated stranded copper conductor of 2.5 sq. mm as per IS: 1554.

Each wire shall be identified at both ends with permanent markers bearing wire numbers as per wiring diagram.

Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

All spare contacts of auxiliary switches etc. shall be wired up to terminal blocks in the control cubicle.

14) TERMINAL BLOCKS

Terminal blocks shall be of 1100 V grade, box clamp type ELMEX 10 sq. mm or approved equivalent. Not more than two wires shall be connected to any terminal. Spare terminals, equal in number to 20% of active terminals, shall be provided.

Terminal block shall be such located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

15) TERMINAL CONNECTORS

6 Nos. Terminal bi-metallic connector suitable for Dog conductors shall be supplied with each breaker. For ensuring quality and uniformity, the owner may decide to specify the design of terminal connector, the material of terminal connector and thickness of clamps. Further compliance of which will have to be done by the agency without any extra cost. Suitable earth connector for earthing connections shall also be supplied. The connector drawing shall be got approved from the owner.

16) AUXILIARY CONTACTS

Eight numbers each of auxiliary contacts both of the normally open and normally closed types shall be provided in each circuit breaker for use in the remote indication and control scheme of the circuit breaker and for providing safety interlocking. Special contacts for use with trip coils, which permit for relative adjustment with respect to the travel of the circuit breaker contact, shall also be provided, wherever required. There shall be provision to add more auxiliary contacts at a later date, if required.

17) ACCESSORIES

The vacuum circuit breaker shall be supplied as a complete unit with internal wiring installed and terminated in mechanism box and equipped with the following accessories:

1	Motor operated spring charged mechanism (Motor voltage – 230 V AC)	1 No.
2	Trip coil suitable for 30 V DC	2 Nos.
3	Closing Coil suitable for 30 V DC	1 No.
4	Pistol grip C.B. Control switch having Trip/ Normal/ Close position	1 No.
5	Local/ Remote selector switch	1 No.
6	Spring Charged indicator	1 No.
7	Manual operating handle for maintenance	1 No.
8	Facility for manual charging of spring	1 No.
9	Operation counter	1 No.
10	Auxiliary contacts (8 NO-8 NC)	1 Set
11	Anti-pumping device suitable for 30 V DC	1 No.
12	Terminal connectors suitable for connecting Dog Conductor	6 Nos.
13	Cubicle illuminating lamp with cage and switch	1 No.
14	Spare terminals connectors	20% of Total Terminals

15	Mechanical ON/OFF Indicator	1 No.
16	MCB for both AC and DC supply	1 No. each
17	Space heater and ON-OFF switch in the mechanism box	1 No.
18	Power Type 3 Pin Socket with ON-OFF switch	1 Set
19	Earthing Terminals	2 Nos.
20	LED indicating lamps	Complete set

Indicating Bulbs: The indicating lamps should be supplied with Low Voltage protection Circuit (LVGP) and surge suppressor circuit having LED indication. Lamp assembly should be of fire – retardant glass epoxy PCB, industrial heat resistant, fire resistant, non- Hygroscopic DMC material , chrome – plated corrosion resistant solid brass bezel , polycarbonate lens in desired colour shades of Red , Green, Amber, Yellow etc. the intensity of light should be minimum 100 mcd at 20 mA . Indication lamp should be suitable to operate on 30 V Direct Current supply source.

18) TYPE TESTS

Type test certificates on VCB for the following tests, strictly as per IS 13118, with latest amendment thereof, from any of the independent Govt. Laboratory, or at any recognized and reputed international laboratory or testing institution, shall invariably furnished :-

- Short Circuit Duty Tests
- Short Time Current Rating Tests
- Mechanical Endurance Test
- Temperature Rise Test
- Lightning Impulse Voltage withstand Test
- Capacitor Switching Duty Test for Single Bank of 5 MVAR capacity
- Power Frequency withstand Voltage Test dry & wet
- Degree of protection IP-55 for control cubicle

The above type test certificates must accompany drawing of type tested equipment, duly signed by type testing authority.

The above tests must not have been conducted on the equipment earlier than 5 years from the date of opening of bids.

In case of any change in design/type of Breaker already type tested and the one offered against this specification, the owner reserves the right to demand repetition of type tests, without any extra cost.

19) ACCEPTANCE AND ROUTINE TESTS

All acceptance and routine tests, as stipulated in relevant standards, shall be carried out by the manufacturer, in presence of owner's representative

Immediately after finalization of the programme of type testing, the manufacturers shall give, fifteen days advance intimation to the owner, to enable him depute his representative for witnessing the tests.

20) RATING PLATES

The detailed rating plate shall be as per IS and in addition, shall indicate serial number of the equipment, manufacturer's name, our order number and date.

21) EXPERIENCE

Minimum 3 years' experience in the field of design and manufacture of the equipment offered is essential for the bidder. Details in this regards shall be clearly stipulated in the offer.

8. 11 kV 350MVA 1250 AMP VCB Switchgear Panels (MC VCB) - Indoor

1.1. INTRODUCTION

- 1.1.1. The section covers the specification of metal clad indoor vacuum type switchgear unit with horizontal draw out circuit breaker as per IS 13118 [1991] / IEC 62271-100 or latest amendment thereof.
- 1.1.2. All the equipments shall be suitable for satisfactory operation in tropical climates and dry dust laden atmosphere prevailing in the location where it shall be used against the Contract. The equipment shall be able to with stand a wide range of temperature variation in the required location
- 1.1.3. All the plant/apparatus/equipment supplied shall comply in all respect with the requirement of Indian Electricity Act 2003 and Indian Electricity Rule 2003/IS and latest amendment thereof during the execution of contract where-ever applicable

1.2. STANDARDS.

The circuit Breaker shall confirm to the latest revision with amendment available of relevant standards, rules, and code. Some of which are listed herein for ready reference.

Sl. No.	Standard	Item
1.	IEC- 62271-100 /IS-13118(1991)	Switchgear
2.	IS-2705 (1992)	Current Transformer
3.	IS-3156 (1992)	Voltage Transformer
4.	IS-3231 (1987)	Relays
5.	IS-1248	Ammeter & Voltmeter
6.	IS-375	Arrangement of Breakers Bus Bars main connection and auxiliary wiring.
7.	IEC-60687/CBIP REPORT NO-88 (JULY) 1996)	Tri vector meter

1.3. CONSTRUCTION

- 1.3.1. The switchgear shall be of CRCA steel construction with sheet not less than 3mm thickness for load bearing section and not less than 2 mm thickness for non-load bearing and shall totally dust and vermin proof. However, if vendor has standardized the thickness of enclosure other than above mentioned and it meets the performance requirements and the design has been established through type test, the same shall be accepted. The panels shall be rigid without using any external bracings. The switchboard panels should comply with relevant IS/IEC and revision thereof and shall be designed for easy operation maintenance and further extension. Bus bar, metering circuit breaker chamber, cables and cable box chamber should have proper access for maintenance, proper interlocks should be provided. All instruments shall be non-draw out type and safe guard in every respect from damages and provided with mechanical indicator of connection and disconnection position. The switchgear shall be completed with all necessary wiring fuses, auxiliary contacts terminal boards etc.

- 1.3.2. The arcing contacts and bus bar should be rated for 350 MVA for 3 seconds. Bus bars shall be capable of connecting one switchgear panel to other through proper insulated arrangement, which does not decrease the insulation strength of the bus bar at the point of connection between two panels. The panels shall be modular in design.
- 1.3.3. The breakers should be able to be drawn out in horizontal position at ground level [with vertical/horizontal isolation] when breaker is drawn out in horizontal position none of the live components inside the 11 KV switchgear panel should be accessible. The safety shutters shall be robust and shall automatically cover the live components when the breaker is drawn out. The switchgear shall have complete interlocking arrangements at the fully inserted and fully drawn out and test positions. Withdrawal of the breaker should not be possible in ON position, it should not be possible to close the circuit breaker in service unless the entire auxiliary and control circuit are connected.
- 1.3.4. Breaker should have three distinct positions inside the cubical; i.e. service, test and isolated.
- 1.3.5. Built-in/separate trolley mounted earthing switches for incomer and outgoing shall be provided.
- 1.3.6. All the high voltage compartments must have pressure discharge flap for the exit of gas due to internal arc to insure operator safety. All the HV compartment design ensures conformity to IEC-60298 and must be type tested for Internal Arc Test.
- 1.4. **BUS BARS AND CONNECTORS**
- 1.4.1. Bus bars and all other electrical connection between various components shall be made of electrolytic copper of rectangular cross sections. The bus bars section shall be ample capacity to carry the rated current of minimum 1250 Amp continuously without excessive heating and for adequately meeting the thermal and dynamic stresses in the case of short circuit in the system up to full MVA rating specified in Para 3.2 above.
- 1.4.2. All bus bars connections shall be firmly and rigidly mounted on suitable insulators to withstand short circuit stresses and vibrations.
- 1.4.3. Adequate clearance between 11 KV point and earth and between phase shall be provided to ensure safety as per provision in Indian Electricity Rule 2003 and its amendment thereof and also in accordance with the relevant Indian standard specification and the same shall be capable of withstanding the specified high voltage tests as per IS-13118/ IEC 62271-100 and amendment thereof.
- 1.4.4. Sharp edges and bends either in the bus bars or bus bar connections shall be avoided as far as possible. Wherever such bends or edges are un-avoidable, suitable compound or any other insulation shall be supplied to prevent local ionization and consequent flashover.
- 1.5. **CIRCUIT BREAKER**
- 1.5.1. The vacuum circuit breaker shall be draw out type suitable for installation in the switchgear cubicles (indoor). The breaker shall comply with IS-13118 (1991)/ IEC 62271-100 and latest amendment thereof. Construction of breaker shall be such that the points, which require frequent maintenance, shall be easily accessible.
- 1.5.2. The circuit breakers shall be spring operated, motor/manually charging of the spring feature, manually released. VCB shall have spring closing mechanism for 3 pole simultaneous operation. The speed of closing operation shall be independent of the speed of hand operating level. The indication device shall show the OPEN and CLOSE position of breaker visible from the front of cubical.
- 1.5.3. The breakers shall be capable of making and breaking the short time current in accordance with the requirement of IS 13118(1991)/ IEC 62271-100 and latest amendment thereof and shall have three phase rupturing capacity of 350MVA for 3 second at 11 KV. The continuous current rating of breaker shall not be less than 1250 Amp for all items. The total break/make time shall be not more than 4 cycles for break and 6 cycles for make time for all breakers.

- 1.5.4. The vacuum circuit breakers shall ensure high speed extinction and adequate control of pressure during breaking of current and also designed to limit excessive over voltages.
- 1.5.5. Comprehensive interlocking system to prevent any dangerous or inadvertent operation shall be provided. Isolation of circuit breaker from bus bar or insertion into bus bar shall only be possible when the breaker is in the open position.
- 1.5.6. Vacuum Circuit Breaker shall have completely sealed interrupting units for interruption of arc inside the vacuum. The vacuum bottle sealed for life shall be provided with contact wear indicator.
- 1.5.7. Vacuum interrupter should have an expected life of 10000 operations at rated current and should be capable for operating more than 100 times at rated short circuit current.
- 1.5.8. Vacuum interrupter technical data particularly provided by the manufacturer should also be provided with Bid.

1.6. PROTECTION RELAYS

- 1.6.1. All relays shall conform to the requirements of IS:3231/IEC-60255 or other applicable standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear. The relay for entire project shall be of same type. The protective relay shall be numerical type. Composite relay unit having O/C, E/F & directional element etc shall be preferred.
- 1.6.2. The protective relays mounted on the panels shall be of the draw out type. The relays must be capable of resetting with out necessity of opening the case. The relays shall be provided with flag indicators. Each functional element of a relay shall be provided with its own flag indicator to enable the type of fault condition to the identified.
- 1.6.3. Each of the incomer/outgoing switchgear units shall be provided with 3 elements of 5 Amp Non-directional, over current relays and 1 element non-directional, earth fault relay with self/hand reset contacts. The O/C element shall have setting of 30 to 120% in seven steps and E/F element shall have setting of 10 to 40% in seven steps. However, final decision regarding selection of steps and setting of relay shall be decided during detail Engg. for proper co-ordination of protection system.
- 1.6.4. High set instantaneous element of low transient over reach not exceeding 5% should be incorporated in the O/C and Earth Fault relays for all the outgoing feeder panels capable of adjusting the setting from about 5 to 20 times normal rating in the O/C relays and 2 to 8 times in Earth Fault relays.
- 1.6.5. During detail engineering provision for shunt trip or series trip relays shall be decided by Employer for which contractor should not have any objection. Further, in this case, the series trip relays auxiliary unit contracts in the tripping circuit should be designed to handle current up to 150 Amp. and like wise trip coil voltage which appears across open contact of the series-tripping unit, be limited to 150 volts.
- 1.6.6. With CTs used as per Para 7.1 and taking into account the trip coil impedance of breaker with the plunger DOWN and with plunger UP position, the VA burden of relays offered etc. should be duly coordinated, so that the protection operates without errors at fault current corresponding to the fault MVA of 350 for all the tap position of the relays and the values of the impedance of the choke and resistance which may be required should also be determined and incorporated
- 1.6.7. The protective relays shall withstand 20 times the maximum current for 3 second on any tap setting. The over shoot time on removal of current setting shall not be greater than 0.05 seconds.

1.7. CURRENT TRANSFORMERS:

- 1.7.1. The requirement of ratio, VA capacity, class or accuracy, limit factor etc. for resin cast CTs installed in different type of units are tabulated below:

Item	Core/CT	Ratio	VA Burden	Knee Point	ALF	Class of accuracy

			(min)	Voltage		
Incoming Panel	Protection	600-300/1A	15	300 at 600/1A tap	10	PS
	Protection	600-300/5A	15	.....	10	5P
	Metering	600-300/5A	2.5	.....		0.5
Outgoing Panel	Protection	600-300/5A	15	.....	10	5P
	Metering	600-300/5A	2.5	.....		0.5

- 1.7.2. Short time rating of CTs shall be 18.4 KA for 3 second. CTs shall be double core and dual ratio. Saturation factor for metering core shall not exceed 2.5.
- 1.7.3. The designed accuracy should be available even at the lowest ratios and all CTs shall withstand fault current corresponding to 350 MVA for 3 sec.
- 1.7.4. The secondary terminal of the current transformers shall be such that effective and firm wire terminations are possible. Shorting links of adequate capacity shall be provided at the terminal blocks for sorting of the leads from secondary terminals of current transformers. The secondary terminal of the CTs shall be earthed at one point.
- 1.7.5. The secondary winding resistance of CTs shall be as low as possible but not greater than 0.2 ohms per 100 turns.
- 1.7.6. CTs shall conform to IS 2705 with latest amendment, if any in all respect and will be subjected to all routine and type test specified in the IS.
- 1.8. CABLE GLANDS AND CLAMPING ARRANGMENT FOR HOLDING SUITABLE CABLE BOXES
 - 1.8.1. Two nos, brass-wiping glands for each incomer and one no. Brass wiping gland for each outgoing panel of adequate dimension for XLPE cable of 3 cores up to 400 sq. mm size shall be supplied along with panels. For bus coupler no cable glands should be provided.
 - 1.8.2. Suitable cable boxes as per requirement of cable shall be arranged by the purchaser at his end. The panel shall however provide a flat of size 50X6 mm² with suitable clamp made of 50X6 mm² flat along with Nuts Bolts and Washers for holding the cable boxes. The flat should be fitted at a suitable height with allotted arrangement for adjustment of height from 300mm to 500mm at site. The clamp and flat shall have suitable stud type arrangement for earthing cable and cable box.
 - 1.8.3. All control cable/wire entries shall be by means of suitable cable glands, such glands shall be of brass and tinned.
- 1.9. AUXILIARY/CONTROL WIRING

All the secondary wiring in the panel shall have high quality PVC insulation and the same shall have conductor size of not less than 2.5 mm² of copper. Colours of the secondary/auxiliary wiring should conform to IS 375/1963 and latest amendment thereof if any. All wiring shall be neatly run and group of wiring shall be securely fixed by clips so that wiring can be checked without necessity of removing the clamps. Wiring between fixed and moving portion of the panel shall be run in flexible tubes and the same shall be so mounted to avoid any damage to them due to mechanical movements. Ferrules with number shall be provided on both end of the wiring.

1.10. MARKING OF PARTS

For facilitating the erection, the several parts of the plant and equipment shall be suitably marked.

1.11. NAME PLATE AND DIAGRAM PLATES

All equipment shall have weather proof and non corrosive metal plates fixed in suitable position with full particulars engraved thereon with white letters against black background.

The firm shall affix a name plate on each Switchgear panel having following information:

1. Manufacturer's name and trade mark.
2. Unique No.
3. Type of Panel.
4. CT Ratio.
5. Rated Voltage.
6. Rated Insulation Level
7. Rated Frequency
8. Rated Normal Current
9. Rated Short Circuit Breaking Current.
10. Weight
11. Specification No.
12. Order No. and Date
13. Year of supply.
14. Property of SEBs

1.12. PAINTING

All metallic surface [except enameled and bright parts] exposed to weather shall be given suitable primer coat and two coats of first quality paint of approved colour. The supplier shall also supply adequate quantities of paints, Varnish etc. for use of finished cost and for use of patching up any scratches received during transport, handling erection testing and commissioning.

Instead of above proper powder coating after proper pre treatment is acceptable and in that case earlier condition will not applicable.

1.13. DETAILED FITTING AND MOUNTING

Detailed fittings and mountings of equipments in various switchgear panel shall be as follows

1.13.1. ITEM NO. 1 – INCOMING PANELS RATING; 1250 AMP WITH CT RATIO 600-300/5A or 600-300/1A

Each unit shall have the fittings and equipments as follows:

- ❖ 1 No steel totally enclosed, fully interlocked, indoor industrial pattern, metal clad, horizontal draw out, vertical/horizontal isolation floor mounting switch unit complete with transportation truck having integral mechanism and all necessary supports each equipped as under:
- 1 No Fabricated sheet steel housing.

- 1 No. Complete set of mechanical interlocks.
- 1 No. Set of isolating plugs and sockets [6 nos. rated for 1250 Amp. With automatic safety shutters and pad locking arrangements. Facilities shall be provided for proper opening of the safety shutter for cleaning, inspection and testing.
- 1 No. 1250 Amp triple pole VCB fitted with isolating sockets, spring operated, manually as well motor charged, manually/ electrically released spring closing mechanism with mechanical ON/OFF indicators suitable for a rupturing capacity of not less than 350 MVA at 11 kV for 3 seconds and fitted with one set of direct acting trip coils suitable for operation with AC series trip relays.
- 1 No. Auxiliary switch with minimum four normally closed and four normally opened contacts. The contact terminals shall be brought out and terminated at Terminal Board irrespective of whether terminals are used or not.
- ❖ 3 Nos. 600-300/5-5 A ratio double core resin cast current transformer of required Accuracy, for protection and metering as per Para 4.7.1 of specification. Alternatively single core dual ratio 5 nos., CTs [3 nos. for protection and 2 nos. for metering] shall also be acceptable.
- ❖ 1 No. Ammeter digital static ammeter suitably scaled and must suit CT ratio.
- ❖ 1 No. 3 phase resin cast, draw out type bus bar connected potential transformers of Ratio 11000/110 volts class 0.5 accuracy having minimum 50 VA output per phase to operate the A.C. static H.T. Tri-vector meter, voltmeter etc. and complete with HT fuse and LT MCB with monitoring contacts.
- ❖ 1 No. Voltmeter round flush pattern digital static suitably scaled to suit the PT ratio.
- ❖ 1 No. 3 way and off voltmeter selector switch for reading the voltage between any two phases on the voltmeter.
- 1 No. static digital Tri vector energy meter suitable for three phase 3 wire un-balanced load and CT, PT, ratio mentioned above, 0.5 accuracy class with load, survey and TOD/Tariff and MRI facility. TVM shall be as specification attached with this specification.
- ❖ 1 No. Non directional adjustable IDMT series trip O/C relay with definite minimum 3 seconds at 10 times plug setting. The relay shall be arranged for over current protection with setting from 50 to 200% of 5A on all three over current elements mounted in draw out case tropicalised with flag indicator.
- ❖ 1 No. set of indicating lamps operating at 230V AC single phase one coloured RED and other GREEN to show the closed or open position of circuit breaker.
- ❖ 1 No. 80 watts continuously rated tubular/strip type heater with manual ON/OFF switch working on 230 VAC single phase supply.
- ❖ 1 No. set of copper bus bars of not less than 1250 Amp. Continuous rating.
- ❖ 1 No. multi way plug box for secondary wiring between the fix and moving glands.
- ❖ 1 No. set of independently operated automatic shutters for bus bar cable and voltage transformers orifices, which shall be clearly leveled and individually pad-locked.
- ❖ 1 No. Sheet instruments panel mounted on the front of the unit with hinged access doors and totally enclosed wiring terminals mounted there.
- ❖ 1 No. Complete set of self contained inter connectors, foundation bolts, fine Wiring, wiring terminals board, sundries to complete the unit.

1.13.2. ADDITIONAL FEATURE IN 600-300/ 1A INCOMERS FOR 10 MVA AND HIGHER TRANSFORMERS (Applicable in case of installing 10MVA or above transformer).

This switchgear shall be used with 10MVA, 33/11 KV Transformer having delta in primary and grounded star in secondary, conventionally differential protections is essential for the transformer. For 11 kV side 3 nos. CTs of 600-300/1 A [Class PS and appropriate knee point voltage] and matching inter posting CTs (if required) shall be provided in this switchgear panel. The mounting inter connection and termination etc. for these additional devices/relays shall be covered in scope of supply.

1.13.3. CLARIFICATION

The total requirement of CTs for incomer of ratio 600-300/5A is as follows:

- 3 CTs one for each phase of ratio 600-300/5A to connect to 3 nos., O/C relays.
- 2 nos. CTs one on R phase and other on B phase of ratio 600-300/5 A for metering.

1.13.4. ITEM NO. 2 OUTGOING FEEDER PANEL WITH CT RATIO 600-300 /5A

The fittings and mountings shall be similar to item no. 1 above except the following:

- The CT ratio will be 600-300/5A.
- The voltage transformers voltmeter and voltmeter selector switch shall be deleted.
- 3 nos, CT operated overload releases are to be provided.
- 1 no. non directional triple pole adjustable IDMT, combined O/C and E/F [3 no. O/C and 1 no. E/F] AC series trip relay with instantaneous high set trip feature of low transient over reach not exceeding 5% with definite minimum 3 seconds at 10 times plug setting. The relay shall be arranged for over current protection with setting 30-120 % of 5 Amp. And for earth fault protection with setting 10-40 % mounted on a draw out case tropicalised with flag indicators. High set element of O/C shall have setting range of 5 to 20 times the rated current and the E/F elements shall be 2 to 8 times of rated current.

1.13.5. BUS COUPLER PANEL

Each unit shall have the fittings and equipment as follows:

- 1 No. All steel totally enclosed fully interlocked indoor industrial pattern, metal clad horizontal draw out, horizontal/vertical isolation, floor mounting switch unit complete with transportation truck having integral circuit breaker mechanism and all necessary supports each equipped as under:
- 1 No. Fabricated sheet steel mounting.
- 1 No. Complete set of mechanical interlocks.
- 1 No. Set of isolating plug and sockets [6 nos. Rated for 1250 Amp.] with automatic safety shutters and pad locking arrangement. Facilities shall be provided for proper opening of the safety shutter for cleaning inspection and testing.
- 1 No. 1250 Amp. Triple pole VCB fitted with isolating sockets, spring operated, manually charged, and manually released spring closing mechanism with mechanical ON/OFF indicators suitable for a rupturing capacity of not less than 350 MVA at 11 kV for 3 second.
- 1 No. A set of Red and Green pigmy lamps for indicating opened and closed position of breaker.
- 1 No. 3 way auxiliary switch with 4 normally closed and eight normally open contacts.

- 1 No. 80 watt. 230 VAC heaters with 6 Amp. Rotary cam switch.
- 1 No. Bus bar chamber with 1250 A rated copper Bus Bars.
- 1 No. A set of self aligning horizontal/vertical isolation type auxiliary plug and sockets.
- 1 No. Sheet steel instrument panel mounted on the front of the unit with hinged across doors and totally enclosed wiring terminals mounted there.
- The panel shall be without any metering protection CTs, cable box, series trip coils, and relays.

The HT chambers [adopter chamber] will be gasketed to make it vermin proof. The gasket shall be as specified in Section-I(Introduction and general technical requirements).

NOTE: Separate spring charging handle shall be provided and supplied with each set of the VCB.

1.14. ANNUNCIATION SYSTEM

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 i.e. 30 Volt DC for new substation or as existing DC supply system of the utility (This shall be verified by the successful bidder before submission of the drawing for approval).

Audible annunciation for the failure of DC supply to the annunciation system shall be provided and this annunciation shall operate on 240 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.

A separate voltage check relay shall be provided to monitor the failure of supply (240V 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. This annunciation shall operate on Annunciation DC and buzzer shall sound.

1.15. TESTS

The design of circuit breaker shall be proven through all the routine and in accordance with IS 13118: 1991/IEC 56 and any amendment thereof. Photocopy of all the test reports must be enclosed with the tender. Type test report earlier than 7 year from the date of tender opening shall not be acceptable.

TYPE TESTS:

Each circuit breaker shall comply with requirements of type tests prescribed in IEC publication No.56.

- i. Short time and peak withstand current test.
- ii. Short circuit breaking capacity and making capacity.
- iii. Capacitive current switching test: Cable charging current breaking test (Ur less than or equal to 52 kV).
- iv. Dielectric test i.e., power frequency withstand and impulse withstand test
- v. Temperature rise test.
- vi. Mechanical Endurance Test at ambient temperature.
- vii. Measurement of resistance of the main circuit.

viii. Internal arc test.

1.16. COMMISSIONING CHECKS/TESTS

After installation of panels, power and Control wiring and connect Contractor shall perform commissioning checks. as listed below to proper operation of switchgear/panels and correctness of all respects.

In addition the Contractor shall carry out all other checks and tests recommended by the manufacturers.

1.16.1. GENERAL

- i) Check name plate details according to specification.
- ii) Check for physical damage
- iii) Check tightens of all bolts, clamps and connecting terminal
- iv) Check earth connections.
- v) Check cleanliness of insulators and bushings.
- vi) Check heaters are provided.
- vii) H.V. test on complete switchboard with CT & breaker/ contractor lubricated in position.
- viii) Check all moving Parts are properly lubricated.
- ix) Check for alignment of busbars with the insulators to ensure alignment and fitness of insulators.
- x) Check for inter changeability of breakers.
- xi) Check continuity and IR value of space heater.
- xii) Check earth continuity of the complete switchgear board.

1.16.2. CIRCUIT BREAKER

- i) Check alignment of trucks for free movement.
- ii) Check correct operation of shutters.
- iii) Check slow closing operation (if provided).
- iv) Check control wiring for correctness of connections, continuity and IR values.
- v) Manual operation of breakers completely assembled.
- vi) Power closing/opening operation, manually and electrically at extreme condition of control supply voltage.
- vii) Closing and tripping time.
- viii) Trip free and anti-pumping operation.
- ix) IR values, resistance and minimum pick up voltage of coils.

- x) Simultaneous closing of all the three phases.
- xi) Check electrical and mechanical inter locks provided.
- xii) Checks on spring charging motor, correct operation of limit switches and time of charging.
- xiii) Check vacuum (as applicable).
- xiv) All functional checks.

1.16.3. Current Transformers

- i) Megger between windings and winding terminals to body.
- ii) Polarity tests.
 - a. Ratio identification checking of all ratios on all cores by primary injection of current.
 - b. Magnetization characteristics & secondary winding resistance.
- iii) Spare CT cores, if any to be shorted and earthed.

1.16.4. VOLTAGE TRANSFORMERS

- i) Insulation resistance
- ii) Ratio test on all cores.
- iii) Polarity test
- iv) Line connections as per connection diagram.

1.16.5. CUBICLE WIRING

- i) Check all switch developments.
- ii) It should be ensured that the wiring is as per relevant drawings. All interconnections between panels shall similarly be checked.
- iii) All the wires shall be meggered to earth.
- iv) Functional checking of all control circuit e.g. closing, tripping, interlock, supervision and alarm circuit including proper functioning of component/ equipment .
- v) Check terminations and connections. To check wiring related to CT and PT circuits, carryout primary injection and then check for secondary value at relay and metering instrument terminals.
- vi) Wire ducting.
- vii) Gap sealing and cable bunching

1.16.6. RELAYS

- i) Check internal wiring.

- ii) Megger all terminal body.
- iii) Megger AC to DC terminals
- iv) Check operating characteristics by secondary injection.
- v) Check minimum pick up voltage of DC coils.
- vi) Check operation of electrical/ mechanical targets.
- vii) Check CT connections with particular reference to their polarities for differential type relays.
- viii) Relay settings.

1.16.7. METERS

- i) Megger all insulated portion.

Check CT & VT connections with particular reference to their polarities for power type meter.

9. Control & Relay Panel for 33kV Feeder with Directional or Non-directional O/C and E/F protection and 33/11kV Transformer Panel with & without Differential Protection for various 33/11 kV Sub-Stations

1.0 Scope:

This specification covers design, manufacture, assembly, testing before supply, inspection, packing and delivery and other basic technical requirements in respect of control and relay panels for 33 kV feeders, 33/11kV Power Transformers without differential protection and 33/11kV Power Transformers with differential protection to be installed at various 33/11kV sub-stations. The equipment to be supplied against this specification is required for vital installations where continuity of service is very important. The design, materials and manufacture of the equipment shall, therefore, be of the highest order to ensure continuous and trouble-free service over the years. The Manufacturer has to design the Schematics for protection and Control of all equipments including monitoring indications, visual and audible alarm, interlocking schemes among different equipment. Any other requirement which are not specifically covered here but which are necessary for successful commissioning of the Substations are also within the scope of the Contract.

The equipment manufactured should conform to the relevant standards and of highest quality of engineering design and workmanship. The equipment manufactured shall ensure satisfactory and reliable performance throughout the service life. The Schedule of requirement of the Panel is furnished separately in details.

2.0 Service Conditions:

2.1. System particulars:

Nominal system voltage	33kV & 11kV
Corresponding highest system voltage	36kV & 12kV
Frequency	50 Hz ± 3%
Number of phases	3
Neutral earthing	33kV Grounded through Earthing Transformer 11kV solidly earthed

2.2. Equipments supplied against the specifications shall be suitable for satisfactory operation under the following tropical conditions: -

Max. ambient air temperature	60°C
Max. relative humidity	100%
Max. annual rainfall	1450mm
Max. wind pressure	150kg/sq. m.
Max. altitude above mean sea level	1500mtrs.
Isoceraunic level	50
Reference Ambient Temperature for temperature rise	50 degC
Climatic Condition	Moderately hot and humid tropical climate conducive to rust and fungus growth

- 2.3. The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitable design to work satisfactorily under these conditions.
- 2.4. Auxiliary supplies available at the various sub-stations are as follows:-

3.2.1 Rating:

	A. C. Supply	230volts, with $\pm 10\%$ variation, Frequency 50Hz with $\pm 3\%$
	D.C. Supply	30VDC. DC system is 2 (two) wire with necessary earth fault annunciator scheme. DC supply shall be normally fed from Battery charger. In case of failure of AC supply to Battery Charger, DC supply voltage will be available from Lead Acid Battery.

- 2.5. Unless otherwise specified all equipment and material shall conform to the latest IS applicable standards. Equipment complying with other internationally recognized standards will also be considered if it ensures performance equivalent or superior to Indian standards. In the event of supply of equipment conforming to any international/internationally recognized standards other than the standard listed below.
- 2.6. The equipment provided shall also comply with the latest revisions of Indian Electricity act and Indian Electricity rules and any other applicable statutory provisions, rules and regulations.
- 2.7. All equipment provided under this specification shall generally conform to the latest issue of the following:-

a)	IS 12063/1987	Degree of Protection provided for enclosure of electrical equipment.
b)	IS 5/2004	Colour for ready mixed paints & enamels.
c)	IS 3231/1986 & 1987	Electrical relays for power system protection
d)	IEC 60255	Numerical biased protection relay
d)	IS 8686/1977	Static Protective Relays
e)	IS 1248/2003	Indicating instruments
f)	IS 14697/1999	HT Static Tri vector TOD Energy meter
g)	IS 6875 amended upto date	Control switches
h)	IS 4794/1968 & 1986	Push buttons
i)	IEC 337 & 337-1	Control Switches (LV Switching devices for control and auxiliary circuit)
j)	IEC: 60185	Current Transformers
k)	IEC: 60186	Voltage Transformer
l)	IS 375	Marking and arrangement for Switchgear Bus
m)	IS: 5578/1984	Marking of insulated conductors.

2.8. CT, PTRatio and Transformer Details:-

CIRCUIT	33KVCTRATIO/CLASS
33KvFeeder	400-200/1-1A 0.5,5P20
33kv side of 33/11kv transformer	400-200/1- 1-1A, for 10&12MVA 0.5/5P20/PS and 200-100/1-1A For up to 6.3MVA Tr.0.5/5P20
11KV side CT for 6.3MVA & 10MVA transformer	600-400/1-1-1A, 0.5/5P20/PS at phase side (Indoor Panel)
11KV transformer Bushing CT for REF	600/1A, PS for 10MVA 33/11KV transformer for both Phase & neutral. 400/1A, PS for up to 6.3MVA 33/11KV transformer for only neutral.
33KV PTRATIO	33KV, single phase
Electro-magnetic PTRatio/Class	33KV/ 3, 110V/ 3-110V/ 3,0.5/3P
TRANSFORMER DETAILS	33/11KV, up to 12MVA, Dyn11

3.0 CONSTRUCTIONAL DETAILS:

3.1. CONTROL AND RELAY PANEL

The Control and Relay Panel shall be of Simplex type and the access door shall be provided at the back of each Panel where instruments or relays shall be mounted. The indicating and signaling devices and relays etc. shall be mounted on the front side and the auxiliaries which shall be inside the Panel. The access door shall be at the back side and of double door type of height 1900mm.

In front of Panel where relays and instruments are to be mounted shall be stretcher leveled steel plate 3 mm. thick and side panel, doors and top covers shall be of 2mm. thick steel plate. Light section of structural steel shall be used for panel frame.

The individual panel shall be 2250mm. in height with Channel base, 610mm. in depth and of suitable width limited to 1000mm to accommodate the equipment at a suitable height, suitable gap to facilitate easy workability as specified hereafter. Individual piece of Channel base of C&R Panel is to be provided to obtain the flexibility of inter-changing the Panel, if any.

The complete panel shall incorporate all necessary instruments, meters, relays, auxiliary relays, control switches, indicating lamps, mimic, annunciator, audible alarms, horizontal and vertical wiring trough, wiring supports, interior lighting system, terminal blocks, fuses and link etc.

3.2. CONSTRUCTIONAL FEATURES

- a. The Control and Relay Panel frames shall be suitable for erection off flush concrete floor and secured to it by means of evenly spaced grout bolt projecting through the base channels from members of the frame.
- b. The manufacturer shall ensure that the equipments specified and such unspecified complementary equipment required for completeness of protection/control scheme be properly accommodated in the panels without congestion and if necessary to provide panels with larger width. No price increase at a later date on this account shall be allowed.
- c. Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof for tropical use. The enclosure shall provide a degree of protection not less than IP-41 in accordance with IS-2147. Type test report in this respect shall be furnished with offer.
- d. Panels shall be free standing, floor mounting type and shall comprise structural

frames enclosed completely with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3mm for weight bearing members of panels such as base frame, front sheets and door frames and not less than 2mm for sides, door, top & bottom portions. There shall be sufficient reinforcement to provide level surfaces, resistance to vibration and rigidity during transportation and installation.

- e. Design, material selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent front outside, with all exterior surface true and smooth.
- f. All holes and extension windows in the Panel shall be blanked and access doors shall be lined with compressible liners at the edges. The EMPLOYER will shut off the bottom crevices with cream cement, the Cable Entry holes with weak concrete and the cable trench with present R.C. Slabs or checker plate. All control and supply cables will be laid in a distribution trench running under the panel. The Cable will branch off into each cubicle through entry holes in the concrete floor opening in the bottom cubicles. Necessary Drawings for concrete floor and trench shall be supplied by the manufacturer to enable the EMPLOYER to construct the foundation floor for these panels. The drawings shall show details of the distributing trench, cable entry holes, glands and positions of grouting bolts. The EMPLOYER will prepare foundation with pocket for grouting bolts. The manufacturer shall supply channel base, suitable grouting bolts, locknut and washers.
- g. Control Cable entries to the panel shall be from the bottom. Bottom plates of the panels shall be fitted with detachable gland plates to allow cable entries from the bottom. Gland plates shall be suitable for fixing the cable glands at an elevated height of at least 100mm above the ground level. Terminal Connectors and Test terminal blocks for cables shall be fixed at an elevated height of at least 200mm above the Bottom plate. Side block cutout to be arranged at the top of both sides of panel for inter panel bus wires. Dimensions of the cutout will be 300 mm X 50mm, 255mm from the top.

3.2.1 General:

- a. Materials shall be new; the best quality of their respective kinds and such as are usual and suitable for work of like character. All materials shall comply with the latest issues of the specified standard unless otherwise specified or permitted by EMPLOYER.
- b. Workmanship shall be of the highest class throughout to ensure reliable and vibrations free operations. The design, dimensions and materials of all parts shall be such that the stresses to which they may be subjected shall not cause distortion, undue wear, or damage under the most severe conditions encountered in service.
- c. All parts shall conform to the dimensions shown and shall be built in accordance with approved drawings. All joints, datum surfaces and meeting components shall be machined and all castings shall be spot faced for nuts. All machined finishes shall be shown on the drawings. All screw, bolts, studs and nuts and threads for pipes shall conform to the latest standards of the International Organization for Standardization covering these components and shall all conform to the standards for metric sizes.
- d. All materials and work that have cracks, flaws or other defects or inferior workmanship will be rejected by EMPLOYER.

3.2.2 Assembly: -

Necessary items of equipment shall be assembled in the factory prior to shipment and routine tests shall be performed by the manufacturer as per the requirements of the latest issue of IEC/IS as specified under each equipment in these specifications to demonstrate to the satisfaction of EMPLOYER that the switch gear panels comply with the requirements of the relevant IEC/IS standards.

3.2.3 Casting: -

Castings shall be true to pattern, of workmanlike finish and of uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, shall be satisfactorily cleaned for their intended purpose.

3.2.4 Welding: - Wherever welding is specified or permitted, a welding process, including stress relief treatment as required if necessary, conforming to an appropriate and widely recognized professional standard shall be used. All welders and welding operators shall be fully qualified by such a standard.

4.0 Mounting

9.1 All equipment on and inside the panels shall be mounted and completely wired to the terminal blocks ready for external connection.

9.2 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 markings shall be clearly visible and of permanent nature.

9.3 The manufacturers shall carry out cutout, mounting and wiring of the bought out items which are to be mounted in the panel in accordance with the corresponding equipment manufacturer's drawings.

9.4 The centre line of switches, push buttons and indicating lamps shall be not less than 750 mm from the bottom of the panel. The centre line of relays and meters and recorders shall be not less than 450 mm from the bottom of the panel.

9.5 The centre lines of switches, push buttons and indicating lamps shall be matched to give neat and uniform appearance. Likewise the top of all meters, relays and recorders etc. shall be in one line.

9.6 The control switches for circuit breakers shall be located on the mimic diagram corresponding to their exact position of the controlled equipment in the single lined drawing. The location of the switches shall be within working height from the floor level for easy and comfortable operation.

9.7 No equipment shall be mounted on the doors.

9.8 All the equipment connections and cabling shall be designed and arranged to minimise the risk of fire and damage.

The constructional details and mounting arrangement for various front mounted equipments shall be as per the enclosed drawings. The center lines of any relays, if additionally provided, shall not be less than 450 mm from ground level.

5.0 WIRING

5.1 All wirings shall be carried out with 1100 volts grade single core, multi strand flexible tinned copper wires with PVC insulation which has provided its utility in tropical region against hot and moist climate and vermin (Misc. white ant and cockroaches etc.) Rubber insulated wiring will not be accepted. Wire numberings and colour code for wirings shall be as per IS: 5578/1984. The wirings should be encased in suitable width PVC casing. The wiring diagram for various schematics shall be made on thick and laminated durable white paper in permanent black ink and same should be pasted on the inside surface of the door.

5.2 The sizes of wiring in different circuits shall not be less than those specified below:

TABLE-I

Circuit	Permissible size of wire
Metering and Relaying Circuits connected Current Transformer	2.5mm ²
Potential Circuits for metering and Relaying, Control, Visual Audible Alarms and Signalling Circuit	1.5mm ²

The following colour schemes shall be used for the wiring:

TABLE- II

Circuit where used	Colour of Wire
Red Phase of Instrument Transformer Circuits	Red
Yellow Phase of Instrument Transformer Circuits	Yellow
Blue Phase of Instrument Transformer Circuits	Blue
Neutral connection, earthed or not earthed in the instrument Transformer Circuit	Black
A.C. Control Wiring Circuits using auxiliary supply and	Black
D.C. Control Wiring Circuit using Battery Supply	Grey
Earth Connection	Green

5.3

- a) 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.
- b) Longitudinal troughs extending throughout the full length of the panel shall be used for inter panel wiring. Interconnection to adjacent panels shall be brought out to a separate set of terminal block wires. All bus wiring for inter panel connection shall preferably be provided near the top of the panels running throughout the entire length of the panels.
- c) Wiring connected to the space heaters in the cubicles shall have porcelain beaded insulation over a safe length from the heater terminals.
- d) Wire termination shall be made with solder less crimping type and tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided to all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagrams 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 for any purpose. Termination shall be such that no strand of a conductor shall be left loose or overhanging. Conductor terminations shall be secured to the holding nuts/screws, terminal block etc. with washers interposed between the terminals/holding nuts/screw heads. The terminals shall be so connected that no conductor or ferrule code gets masked due to overlay of conductors.
- e) All spare contacts of relays shall be wired up to terminal blocks.
- f) Each wire shall be continuous from end to end and shall not have any joint within itself individually.
- g) Wires shall be connected only at the connection terminals or studs of the terminal blocks, meters, relays, instruments and other panel devices.

Terminal Ends of all wires shall be provided with numbered Ferrules. At point of inter-connection where a change of number is necessary, duplicate Ferrules shall be provided with the appropriate numbers on the changing end.

- h) At the terminal connection, washers shall be interposed between terminals, wire terminals and the holding nuts. All holding nuts shall be secured by locking nuts. The connection stud shall project at least 6mm from the lock nuts surface. Wire ends shall be so connected at the terminal studs that no wire terminal numbered ferrule gets masked due to succeeding connections. All wires shall be suitable for bending to meet the terminal stud at right angles with the stud axis, and they shall not be skewed.
- i) All studs, nuts, bolts, screws etc. shall be threaded according to the British Standard practice unless EMPLOYER's prior approval to any other practice of threading is obtained.

6.0 TERMINAL BLOCK CONNECTION

Terminal blocks shall be of clip-on design made out of non-trackable insulating material of 1100V grade. All terminals shall be stud type, with all current carrying and live parts made of tinned plated brass. The stud shall be of min 4mm dia brass. The washers, nuts, etc. used for terminal connectors shall also be of tinned plated brass. All blocks shall be shrouded by easily removable shrouds made of transparent die-electric materials.

The terminal connector/block shall be disconnecting type terminal connectors for PT and same with automatic shorting of C.T. secondary terminals shall be provided in CT secondary circuit. All other terminal connectors shall be Non-disconnecting type. Terminals should be shock protected in single moulded piece. Terminal block should have screw locking design to prevent loosening of conductor. Provisions shall be made on each pillar, for holding 10% extra connection (5% incoming + 5% outgoing).

At least 20% spare terminals for each type shall be provided. All terminals shall be provided with ferrules indelibly marked or numbered and identification shall correspond to the designations on the relevant wiring diagrams. The terminals shall be rated for adequate capacity which shall not be less than 10 Amps for control circuit. For power circuit it shall not be less than 15 Amps.

7.0 SPACE FOR CONTROL CABLES AND CABLE GLANDS

Sufficient space for receiving the Control Cables inside the Panel at the bottom of the cubicles and mounting arrangement for the terminal cable glands shall be provided. Removable type separate cable entry plate (may be two) shall be fixed with bottom plate. This specification does not cover supply of control cables and cable glands for which the EMPLOYER will make separate arrangement.

8.0 SPACE HEATERS

240V, 50HZ Tubular Space Heaters suitable for connection to the Single Phase A.C. Supply complete with On-Off Switches located at convenient positions shall be provided at the bottom of the Panel to prevent condensation of moisture. The Watt loss per Unit surface of heaters shall be low enough to keep surface temperature well below sensible heat. A thermostat control unit with variable temperatures shall be installed to control the heater. The 240V AC supply for the heaters shall be controlled by a suitably rated single pole miniature circuit breaker compartment to be mounted on an insulator. One AC Ammeter with 0-1.0 Amp range shall be provided in series with the heater to monitor the current drawal of the Heater.

9.0 DISTRIBUTION AND CONTROL OF FAUX. POWER CIRCUIT

9.1 D.C. CIRCUIT

There shall be only one 30V D.C. for the entire Control and Relay Panel fed from a D.C. Distribution Panel. A continuous D.C. Bus shall be provided in the Control and Relay Panel and D.C. supply for control, protection, indication and supervision of circuit breaker and

otherequipments shall be teed off from D.C. bus through a set of 20 Amp rated H.R.C. Fuse on positive and negative side. D.C. supply to be teed off shall be distributed within the Panel as below:

- (a) Control DC scheme both positive and negative side with 16 Amp fuse
- (b) Close/Trip Ckt1 and Trip Ckt2 without fuse; closing circuit with 10A fuse.
- (c) Indication Circuit through a set of 6 Amp. HRC Fuse both at +ve and -ve side
- (d) Protective relay circuits through 6A fuse both at +ve and -ve side
- (e) Annunciation ckt with 6 Amp fuse on both at +ve and -ve side
- (f) DC Emergency Lamp with 6 Amp fuse both at +ve and -ve side

Three nos. of D.C. operated no-volt auxiliary relay (self reset type) provided with hand reset type flag with inscription 'Main D.C. Fail', 'Control Dc fail' & 'Protection DC fail' with 4NO+4NC in each relay. 2 NC contact for 'DC fail' alarm and Indication, 1NO wired upto SCADA TB and 1NO wired upto spare TB.

One Push button having N/C Contact used in Series with the above relay for 'D.C. Fail Test' purpose.

9.2. A.C. CIRCUITS

230 Volts, Single Phase A.C. Aux. Supply to the Control and Relay Panel will be fed from A.C. Distribution Panel through a 16 Amp MCB provided there. One 16 Amps rated HRC Fuse shall be provided at the Control & Relay Panel for the Incoming A.C. Supply. Two A.C. operated no-volt auxiliary relay (self reset type) rated for 230V shall be provided with hand reset flag with inscription 'A.C. Fail & DC Fail' Accept with 4NO+4NC contacts for each relay. One push button having N/C Contact used in Series with above relay for 'A.C. Fail Test' purpose.

9.3. P.T. SECONDARY CIRCUIT

There may be two nos. 33KV bus PT, one in each bus section. P.T. supply shall be available from selected 33KV Bus P.T. through suitable PT selection scheme by switch. Two sets of Fuse and link of suitable rating shall be provided for the Incoming P.T. supplies and two sets, one for each PT of 3 nos. coloured LED indicating lamps shall be provided for supervision of the Fuse. Lamps shall be connected between respective phases and neutral. The arrangement of distribution of P.T. Secondary Circuit shall be as follows:

- (a) Potential supply to the protective relay circuit for Feeder where necessary shall be fed from selected Bus P.T. supply bus.
- (b) Potential supply to meters, Energy meters and indicating instrument of each panel shall be fed from selected Bus P.T. supply bus.
- (c) Selected P.T. secondary supply to the protective relays of each panel shall be fed through 4 poles MCB and link in neutral line each panel where necessary with two changeover contacts for annunciation.
- (d) Selected P.T. secondary supply for metering and indicating instrument of each panel shall be fed through 4 pole MCB in each phase and link in neutral in each panel of 33KV system voltage.
- (e) Two position (PT-1/PT-2), minimum 4 (four) way PT selector switch (stay put type), minimum 16A ratings shall be provided in each panel for metering ckt. Additional 4 way PT selector switch is required for protection wherever applicable. The no. of way may increase during detailed engineering.

9.4. FUSE AND LINK

Fuses shall be of cartridge type. Carrier and base for the fuse and links for all D.C. and A.C. Circuits shall have imprint of rating, voltage and circuit designation.

9.5. MIMIC DIAGRAMS

a) Provisions shall be made for 10mm. wide painted and over all drawing mimic diagram by the EMPLOYER on the exterior of the front panel to represent the single line arrangement of the station equipment. Provisions shall be made in such a way that centre line of the mimic bus shall be at a suitable height from the bottom of the C&R Panel.

b) Colour scheme for mimic diagrams as follows:-

KV Class	Col our	Shade Index as per ISS
33KV	Brilliant green	221
11KV	Air Craft blue	108
400/230V	Black	309
Earth	White	-
110V	Canary yellow	-

c) In 33KV simplex type C&R panels, Symbol marking for the position indication of isolators, earth switches etc, ON/OFF indication for Circuit breaker, PT supply indication, CB spring charge, auto trip, trip check etc. shall be mounted along the mimic diagram at appropriate location. Non-Discrepancy type control switch for the C.B. shall be mounted within the mimic, indicating the C.B. ON/OFF status.

10.0 Labeling

All front mounted as well as internally mounted items including MCBs shall be provided with individual identification labels. Labels shall be mounted directly below the respective equipment and shall clearly indicate the equipment designation. Labelling shall be on aluminium anodised plates of 1mm thickness, letters are to be properly engraved.

11.0 Earth Bus

Each panel shall be provided with two earth bus of size 25x6mm (min) each. The earth bus shall be of tinned plated copper, and all metallic cases of relays, instruments etc. shall be connected to this earth bus independently for their effective earthing. The wire used for earth connections shall have green insulation.

12.0 Circuit breaker Control Switch:

- 19.1 PISTOLGRIP TYPE Non-discrepancy T-N-C spring return type switch shall be provided for remote operation of circuit breaker to ensure that manual pumping of closing solenoid not possible. The switch shall be mounted in the mimic diagram itself such that the stay-put ('N') position will render the continuity of the mimic. One green LED for 'breaker open' indication and one red LED for 'breaker closed' indication shall also be provided adjacent to the T-N-C switch.
- 19.2 Switches should have fingertouch proof terminals. For the convenience of maintenance, screw driver guides should be from top/bottom of the switch and not from the side. Terminal wire should be inserted from the side of the switch terminal.
- 19.3 Terminal screws must be captive to avoid misplace during maintenance.
- 19.4 Switch shall be with 48 mm x 48 mm escutcheon plate marked with Trip & Close.
- 19.5 Trip-neutral-close, with pistol grip handle must be pushed into spring return to either trip or close position from Neutral position for safety and not just turn to trip.

- 19.6 Onecontactto closein eachpositionofTripand Close.Contactratingshallbe 12Aat 30VDC.
19.7 Onesparecontactisrequiredin off &onposition.

13.0 Local/Remoteswitch:

Local/Remoteswitchshouldbe4-pole,2wayLockableandstayputtype.

14.0 INDICATINGLAMPS &CONTACTMULTIPLIER

i) INDICATINGLAMPS

L.E.D.TypeIndicatingLampsshallbeprovidedontheControlPaneltoindicate the following:

S.No.	Functions	Quantity	Colour of Lamp
1	C.B. Spring charged indication	1 No.	Blue
2	C.B. trip Coil/Circuit healthy indication	2 No.	White
3	C.B. Auto tripped indication	1 No.	Amber
4	Panel D.C. Fail indication	1 No.	Amber
5	P.T. Supply indicating Lamp	2 sets	Red/Yellow/Blue
6	C.B. ON indication	1 No.	Red
7	C.B. OFF indication	1 No.	Green

AllthelampsshallbeconnectedtotheauxiliaryD.C.supplyoftheSub-StationexceptSI.No. (4)&SI.No.(5)whichshouldbeconnected totheauxiliaryA.C.supplyandP.T.Secondary supplyrespectively. TheLampshallbesuitable forPanelpurposeandshallbeLowWatt consumption. Allindicatorsshall havebrightLEDs having longlife.Conventionalbulbsarenot acceptable. TheindicatingLEDswithresistorsshallwithstand120%ofratedvoltageona continuousbasis.However, thispecification ofindicatinglampsmaylikelytobechanged/ modifiedasperrequirementof EMPLOYER.

Lamps for circuit breaker "ON", "OFF", "TRIP CKT HEALTHY" and "AUTO TRIP" indications. LED indicating lamp complete with static circuits and features should be supplied with Low voltage protection circuit (LVGP) and surge suppressor circuit having LED indication. Lamp assembly should be of fire – retardant glass epoxy PCB , industrial heat resistant, fire resistant, non hygroscopic DMC material, chrome – plated corrosion resistant solid brass bezel, polycarbonate lens in desired colour shades of Red, Green , Amber, Yellow etc. the intensity of light should be minimum 100 mcd at 20 mA . Indication lamp should be suitable to operate on 30 V direct current supply source. Acceptable make are BINAY Opto Electronic Private Ltd. or equipment.

ii) ContactMultiplier

230Volts,SinglePhase,50hzA.C..Supplyoperated Contact Multipliertobeprovided, if required.

15.0 TERMINALBLOCK/TTB

- TerminalBlocksforincomingA.Cand D.C.CircuitandC.T.,P.T. &SCADACircuitsshould belocatedon the lefthandsideandTransformersupervision,breakercontrolandsparein right handsideof thewallof thePanelseenfrombacksiderespectively.
- 3-Phase,4-WireLinktypeTestTerminalBlockhavingsealingprovisionshallbeprovidedin MeteringCircuitof eachPanel.

16.0 SAFETY EARTHING

1. Earthing of metallic parts or metallic bodies of the equipment on the Panel shall be done with soft drawn single conductor bare Copper Tail connections shall have minimum area of 16 sq. mm. and the main earthing connection 60 sq. mm. These wires shall be connected by suitable terminals and clamps junction. Soldered connections shall not be employed.
2. The neutral point of star connected LV winding of instrument transformers and one corner of the open delta connected LV side of instrument transformers shall be similarly earthed by tail connected with main earth wire of Panel Earthing System. Multiple earthing of any instrument transformer circuit shall be avoided.

17.0 PANEL LIGHTING

1. The Panel interior shall be illuminated by CFL lamps connected to 230 Volt Single Phase A.C. The illumination of the interior shall be free from shadows and shall be planned to avoid any strain or fatigue to the wireman likely to be caused due to sub-normal or non-uniform illumination. One emergency D.C. light shall be provided for each panel with individual switch with proper identification mark.
2. A toggle switch or door operated switch shall be provided for control of A.C. lighting in each panel.
3. One combined 15 Amps. 3-Pin and 5 Amps. 2-Pin Power Socket outlet together with Plus Pin shall be provided at convenient points in each Panel for A.C. Supply.

18.0 ANNUNCIATOR

A. ELECTRONIC ANNUNCIATOR

1. Suitable Multi-way Microprocessor based electronic Annunciator for the visual and audible alarm on the control panel using bright LED shall be provided in each panel to indicate overcurrent and earth fault protection operated. In addition to above, each electronic annunciator of Transformer Control Panel shall have provision to indicate Transformer trouble trip/alarm function operated. Also one window of the Annunciator shall have to be used for Non-Trip A.C. Fail Alarm Indication and one window for Trip Circuit unhealthy indication. Each Electronic Annunciator shall have provision for connection with accept/reset/lamp test/mute Push buttons for proper functions. Electronic annunciator shall have provision for connection with Electronic Buzzer/Electronic Bell for Trip & Non-Trip Audio Alarm of common annunciation scheme. Electronic Annunciation shall have provision for flashing illuminating display with inscription for operation of respective Protection Relay. The Micro-Processor based Electronic Annunciator should have separate coloured windows for Trip & Non-Trip Annunciation for easy detection.
2. Annunciator fascia units shall have translucent plastic windows for each alarm point.
3. Electronic Annunciator shall have first Fault Indication Facilities & System Watch Dog
4. Annunciator fascia plates shall be engraved in black lettering with respective alarm inscription as specified. Alarm inscription shall be engraved on each window in not more than three lines and size of the lettering shall be about 5mm. The inscriptions shall be visible only when the respective fascia LED will glow.
5. Annunciator fascia units shall be suitable for flush mounting on panels. Replacement of individual fascia inscription plate and LED shall be possible from front of the panel.
6. Unless otherwise specified, one alarm buzzer meant for non-trip alarms and one bell meant for trip alarms shall be provided in each control panel (mounted inside).

7. Each annunciator shall be provided with 'Accept', 'Reset' and 'Test' push buttons, in addition to external IPB.
 8. Special precautions shall be taken by the manufacturer to ensure that spurious alarm conditions do not appear due to influence of external magnetic fields on the annunciator wiring and switching disturbances from the neighbouring circuits within the panels.
 9. In case 'RESET' push button is pressed before abnormality is cleared, the LEDs shall continue to glow steadily and shall go out only when normal condition is restored.
 10. Any new annunciation appearing after the operation of 'Accept' for previous annunciation, shall provide a fresh audible alarm with accompanied visual alarm, even if the process of "acknowledging" or "resetting" of previous alarm is going on or is yet to be carried out.
- B. Provision for testing healthiness of visual and audible alarm circuits of annunciator shall be available.

16 Window Annunciation Scheme for 10 MVA & 12 MVA Transformer (individually controlled) to indicate following functions:-		
1	Differential protection (87) operated	1 no.
2	Non-directional protection (O/C + E/F) operated	1 no.
3	Oil Temp./Winding Temp/MOG Alarm for transformer	1 no.
4	Oil Temp./Winding Temp Trip for transformer	1 no.
5	REF64R (HV side) tripped	1 no.
6	REF164R (LV side) tripped	1 no.
7	Buchholz Alarm for transformer	1 no.
8	Buchholz Trip for transformer	1 no.
9	OLTC Buchholz/Main Tank PRV Trip for transformer	1 no.
10	AC fail	1 no.
11	Trip Circuit/Coil 1 or Trip Circuit/Coil 2 Unhealthy	1 no.
12	Non-directional O/C & E/F Relay Trouble	1 no.
13	Differential relay trouble	1 no.
14	Spare	1 no.
15	Spare	1 no.
16	Spare	1 no.
Mounting		Flush
No. of face windows		16
Supply voltage		30VDC
No. of LEDs per window		2
Lettering on face plate		Properly engraved

12 Window Annunciation Scheme for up to 6.3 MVA Transformer (individually controlled) to indicate following functions:-		
i)	Non-directional protection (O/C + E/F) operated	1 no.
ii)	Oil Temp./Winding Temp/MOG Alarm for transformer	1 no.
iii)	Oil Temp./Winding Temp Trip for transformer	1 no.
iv)	REF64R (HV side) tripped	1 no.
v)	REF164R (LV side) tripped	1 no.

vi)	BuchholzAlarmfortransformer	1 no.
vii)	BuchholzTripfortransformer	1 no.
viii)	OLTCBuchholz/Main TankPRVTripfortransformer	1 no.
ix)	PanelACfail	1 no.
x)	TripCircuit/Coil1orTripCircuit/Coil2Unhealthy	1 no.
xi)	PanelACfail	1 no.
xii)	Non-directionalO/C&E/FRelayTrouble	1 no.
xiii)	Spare	1 no.
Mounting		Flush
No. of faciawindows		12
Supplyvoltage		30 V DC
No. of LEDsperwindow		2
Letteringonfaciaplate		Properly engraved

12WindowAnnunciationSchemeforFeederstoindicatefollowing functions:-		
i)	Non-directionalO/C operated	1 No
ii)	Non-directionalE/F operated	1 No
iii)	PanelD.C.Fail	1 No
iv)	TripCircuitCoil2Unhealthy	1 no.
v)	PanelACfail	1 no.
vi)	TripCircuit/Coil1Unhealthy	1 no.
vii)	Non-directionalO/C&E/FRelayTrouble	1 no.
viii)	PT MCBTripped	1 No
ix)	Spare	1 no
x)	Spare	1 no.
xi)	Spare	1 no.
xii)	Spare	1 no.
Mounting		Flush
No. of faciawindows		12
Supplyvoltage		30 V DC
No. of LEDsperwindow		2
Letteringonfaciaplate		Properly engraved

12 Window Annunciation Scheme for Parallel Feeders to indicate followingfunctions:-		
i)	Directional O/C operated	1 no.
ii)	Directional E/F operated	1 no.
iii)	Panel DC Fail	1 no.
iv)	Trip Circuit/Coil 2 Unhealthy	1 no.

v)	Panel AC fail	1 no.
vi)	Trip Circuit/Coil 1 Unhealthy	1 no.
vii)	Directional O/C & E/F Relay Trouble	1 no.
viii)	PT MCB Tripped	1 no.
ix)	Spare	1 no.
x)	Spare	1 no.
xi)	Spare	1 no.
xii)	Spare	1 no.
	Mounting	Flush
	No. of faciawindows	12
	Supplyvoltage	30 V DC
	No. of LEDsperwindow	2
	Letteringonfaciaplate	Properly engraved

C. PANEL D.C. FAIL ALARM SCHEME

Control & Relay Panel shall have a common Panel D.C. Fail Alarm Scheme operated by 230V Single phase A.C. Aux. Supply for audible as well as visual alarm in case of failure of D.C. incoming supply to the Panel.

Another Single Element Relay without Flag and 1 no. self-reset type N/O & 1 no. N/C contact having inscription 'Panel D.C. fail' alarm accept Relay shall be provided. Besides above, 1 no. Indicating Lamp, 1 no. A.C. Operated Electric Hooter and 2 nos. Push Button, one having 1 no. N/C contact, the other having 1 no. N/O contact shall also be provided for successful operation of the scheme. All auxiliary relays required to render Annunciation System operative and shall be considered to be within the scope of the tender.

AC fail, DC fail schemes shall be operated by relay not contactor.

19.0 INDICATING INSTRUMENT AND METERS

- a. All instruments shall be flush mounted, back connected type and provided with dust tight cases for tropical use with dull black enamel finish. All fixing screws, nuts and threaded parts shall be designed to Indian Standards.
- b. All instruments shall be of class 0.5 type. The calibration of the instruments shall function satisfactorily when mounted on steel panels or alternatively magnetically shielded instruments shall be used.
- c. Instruments shall be capable of indicating freely when operated continuously at any temperature from 0 to 50 degree C.
- d. All circuits of instruments shall be capable of withstanding applied load of 20% greater than the rated capacity for a period of eight hours.
- e. The instruments shall be capable of withstanding the effect of shock vibration and a dielectric test of 2000 Volts r.m.s. to ground for one minute as per relevant ISS.

19.1 Ammeters:

All ammeters shall be provided with direct reading scale. Full Scale Value of the Ammeters shall be 100% of the nominal current of maximum C.T. ratio. The ammeters shall be connected to measuring C.T. Core Ammeters shall be suitable for R.Y.B. Phase measurements. However, the ammeter to be supplied shall be of type DIGITAL . The auxiliary power of the ammeters should be 230VAC.

19.2 Voltmeters

Volt Meters shall be provided with direct reading scale. The maximum value of the volt - scale be 15% in excess of the normal Circuit Voltage. The rated voltage of the Volt Meters shall be 110V A.C. However, the volt meter to be supplied shall be of type DIGITAL . The auxiliary power of the volt meters should be 230VAC.

a. Voltmeter Selector Switch:

One Volt meter selector switch having 7 position 6 way stay-put type shall be provided.

b. PT Selector Switch:

One PT selector switch, 2 position, stay put type shall be provided.

19.3 Energy Meters

Tariff Metering Equipments

(a) Three element Tri-vector Meters shall be supplied by the EMPLOYER. But Panel Wiring for the Meters along with Test Terminal Block and space for the Tri-vector Meters are to be provided for the Panels.

20.0 NAME OF IDENTITY PLATES

a) All instruments, relays and such other similar electrical devices mounted on the control and relay panel shall be provided with name plates bearing the manufacturer's name, serial identifying number and the Electrical rating data.

b) 3mm thick and 25mm X 150mm brass or plastic plates bearing suitable identification marks shall be fixed under the terminal wiring at the test blocks, at the fuse blocks and at the cable terminals. Similar plates shall be fixed on the exterior of the panel in appropriate places to indicate function of control switches, push button etc. such as isolator control switch, breaker control switch, DC fail test, accept reset etc. Suitable identification marks shall be provided for individual casing part of the relays and other equipment. Plates should be screwed and riveted to the Panel.

c) 50mm wide brass or plastic plate bearing suitable circuit description (which will be furnished after order is placed) etched in 30 mms size letters shall be provided for each panel and mounted on the top of both outer of the front panels. These plates shall be removable type.

d) Schematic Diagram of CT, PT, CB circuitry & AC, DC Ckt, Indication and Annunciation Ckt along with protection circuitry giving the terminal nos. and Bus wire detail shall be printed in laminated durable stickers and pasted inside the panel Door page wise of the respective panel.

e) Each unit of control and relay panel shall be provided with a label located at the bottom on the front and shall contain the following details:

- i) Manufacturer's name
- ii) P.O.no. and date
- iii) Drg.ref.no. pertaining to the panel.

21.0 PAINTING

Panel paintings shall be done by the modern process of painting. All unfurnished surface of the steel panel and framework shall be sand blasted or suitably cured to remove rust, scale, foreign adhering matter or grease. A suitable rust resisting primers shall be applied on the interior and exterior surface of steel, which shall be followed by application of an undercoat suitable to serve as base and binder for the finishing coat.

Details of Painting:-

Surface treatment	by seven tank process
Paint type	Powder coated. Pure polyester base grade A structure finish
Paint shade	RAL 7032 for external & internal surface
Paint thickness	Minimum 80 microns

22.0 RELAYS:

A. GENERAL REQUIREMENT

The main protective relays SCADA Compatible Numerical Directional/Non Directional O/C & E/F Relays shall be of panel manufacturers own make. However, multinational company manufacturing panel in India may import required/desired relays from their foreign counterpart with same brand name at their own risk, cost and responsibility without hampering the stipulated delivery schedule as stated in the tender notification.

All numerical relays shall be provided with 'Relay Failure Annunciation contact'.

B. SCADA COMPATIBLE NUMERICAL DIRECTIONAL/NON DIRECTIONAL O/C & E/F RELAYS

The primary requirements of the relays are to protect the respective single circuit or double circuit feeders and 33/11 KV Power Transformers in the event of fault. The Directional/Non Directional E/F relays shall provide suitable sensitivity for limited earth fault current.

The relays should be suitable for substation automation, primary circuit breaker operation through SCADA from remote control room.

THE DETAILED SPECIFICATION OF Non-Directional O/C and E/F RELAY IS AS PER ANNEXURE-I OF SPECIFICATION

THE DETAILED SPECIFICATION OF Directional O/C and E/F RELAY IS AS PER ANNEXURE-II OF SPECIFICATION

C. OTHER PROTECTIVE RELAYS

- Differential relay shall be of numerical type
- REF relay etc. may be of static type.

D. OTHER PARTICULARS RELATED TO ALL RELAYS

- 1) All shall conform to the requirement of IS:3231/IEC255 and shall be suitable for operation within a temperature range 0°C to 55°C and 95% relative humidity. Relays shall be suitable for flush/semi flush mounting on the panel with connections from the rear, protected with dust tight cases for tropical use and with transparent cover removable from the front.
- 2) A.I.A.C. relays shall be suitable for operation at 50 Hz. The current coil shall be rated for a continuous current of 1 amp and the voltage coil for 230V normal. The contacts of the relays shall be properly designed to prevent or minimise damage due to arcs which have to be broken successfully against 30V +/- 10% volt DC. When open, the contacts shall withstand a voltage of 115% of the normal circuit voltage. The relays shall be designed for satisfactory operation between 70% to 110% of rated D.C. voltage of the sub-station. The voltage operated relays shall have adequate thermal capacity for continuous operation.
- 3) Timers shall be of static type. Pneumatic timers are not acceptable.
- 4) The relays shall preferably be provided with suitable Seal-in-Devices. Relays should be immune to all types of external influences like Electro static, Electromagnetic, Radio interference, shock etc.
- 5) All the numerical relays should have provision for setting all the features available in the relay and viewing those settings as well as different other parameters through both built-in display unit as well as through PC. All numerical relays shall have self monitoring feature with watchdog contact. The supply of relay should be inclusive of necessary software and hardware for interfacing with a PC, to be supplied by the manufacturer.

E. PROTECTION SCHEMES

E-1 PROTECTION SCHEMES FOR 33 KV FEEDER

NON-DIRECTIONAL OVERCURRENT AND E/F PROTECTION:

This relay shall be used for 33 KV radial feeder. The relay shall

- a) be three O/C & one E/F element type.
- b) have IDMT characteristics with time current characteristics of 3 sec at 10 times current setting.
- c) have variable current setting of 50% to 200% of rated current and adjustable time setting.
- d) have high set unit with current setting 500%-2000% for protection and 33 KV feeder protection, with very low transient overreach.
- e) Definite Time Sensitive Earth Fault Protection may be in built function of Numerical over-current Relay and shall have a variable current setting range minimum 1% to 40% in very small steps of CT secondary current and wide range of definite time setting range minimum. 0.1 to 10 Sec. This relay shall be used in 33 KV feeder for detection of line to ground fault current of both very low and high magnitude where the 33 KV system is grounded through earthing transformer.
- f) LED indication for numerical relays of different type of faults including phase identification.

E-2 PROTECTION SCHEMES FOR 33 KV PARALLEL FEEDERS AT RECEIVING ENDS

DIRECTIONAL PROTECTION

Directional O/C & Directional Instantaneous E/F Relay shall be required for 33KV parallel feeders as specified in the schedule of requirement. Each Feeder shall be provided with 3 elements IDMT Voltage polarized O/C Relays and single element voltage polarized E/F Relay. The O/C Relay shall be IDMT type with high set element. The E/F Relay shall have directional sensitive E/F setting having wider range of setting (1-40%) & wider range of definite time setting range minimum 0.1 to 10 Sec. The relay shall also have instantaneous unit. The relay shall have necessary P.T. fuse failure monitoring scheme.

Characteristics:-

O/C Element: IDMT with High Set Unit	Current Settings & Operating time	IDMT-50-200%, 0-3sec, Inst.-500-2000% or 400-1600%
MTA	Selectable MTA for Directional Relay should cover 1 st quadrant in a non-effectively grounded system	
Polarized P.T. Voltage	110V A.C.	
E/F Element		
Current Setting	1-40% (minimum.) in very small steps	
Operating Time of Relay	Instantaneous	
Operating Time of Timer	0.1 to 10 Sec in very small steps	
MTA	Selectable MTA for Directional Relay should cover 1 st quadrant in a non-effectively grounded system	
Open Delta P.T. Voltage	63.5V A.C.	

The numerical directional relay shall have in-built feature for derivation of zero sequence voltage internally. If separate IVT is required for derivation of zero sequence voltage for directional earth fault element, the particulars shall be as per following Technical Parameters:-

1	Insulation Level	1.1KV
2	Over Voltage Factor	1.2 Cont./1.9 for 8Hrs.
3	Transformation Ratio	110V/ 3 / 110/ 3
4	V Burden/Phase	7.5
5	Accuracy Class	3P
6	No. of Phase	Single
7	Type	Epoxy Cast Resin Indoor Single Phase Voltage Transformer
8	Formation	3 nos. Single Phase P.T. shall be connected in primary as Star and Secondary as Open Delta with neutral of Primary and one end of Open Delta earthed.

E-3 PROTECTION OF 33KV INDIVIDUAL TRANSFORMERS

For protection of H.V. Side of the Transformers, following main protective relays are required

- i) Numerical O/C protection.
- ii) 2 sets Restricted E/F Relays shall be provided for HV and LV side of individual control transformer panel.
- iii) 1 set Differential Relay in addition to above, shall be provided for 10MVA 33/11KV transformer panel.

Differential Relay shall be

- a) Provided at 33KV panel of the transformer to be protected. It shall be numerical adjustable/variable percentage biased type differential relay.

Necessary software, cables, connectors and other accessories as required for download, analyzed data etc. shall be within the scope of successful manufacturer.
- b) The relay shall be very fast in operation with an operating time less than 40 milliseconds at 5 times setting.
- c) The relay shall be inherently stable for external through fault conditions without affecting the speed of operation for internal faults.
- d) The relay shall have either a built-in facility of ratio and phase angle correction or necessary interposing Auxiliary current transformers of universal type, shall be provided in the respective panel.
- e) The relay shall be provided with 2nd harmonic restraint or any other inrush proof feature to prevent operation due to magnetizing inrush current when the transformer is charged either from HV or LV side. But this shall not affect the speed of operation for internal fault.
- f) It shall be provided with 5th harmonic restraint features to prevent operation due to possible over excitation of the transformer. This shall also not affect the speed of operation for internal fault.
- g) The relay shall have adjustable bias setting range 20% to 50% and adjustable operating setting range of 10% to 50% at zero bias.
- h) It shall have three instantaneous high set over current units for clearing heavy internal fault.
- i) The relay shall be with 2-bias winding.
- j) The relay shall be such that there will not be any necessity of changing the setting of the relay whenever the transformer taps are changed from +5% to -10%.
- k) The manufacturer has to furnish the type test report from CPRI/NABL accredited Govt. recognized Test House and performance certificate from Power Utilities in India.
- l) Differential relay shall have facility for setting, parameterization, downloading the storage data, data captured by disturbance recorder etc. locally through PC. The necessary PC, Windows based Licensed software for establishing the facility to be considered in the scope of the supply by the Manufacturer.
- m) The relay shall have disturbance recording (with timestamping) function with suitable no. of analog and digital channels, Memory size and number of disturbances stored in the relay shall be clearly indicated in the offer. No. of site selectable BI, BO and watchdog contact details, communication port details (front, rear) along with necessary hardware and software details shall be furnished.

E-4 RESTRICTED EARTH FAULT PROTECTION

The above protection shall be provided for 33/11KV transformers at HV and LV side. The Relay shall be:

- a) Single pole type.
- b) Current/voltage operated high impedance type with suitable setting to cover the maximum portion of transformer winding. Necessary calculation to prove the above winding coverage shall be furnished along with the tender.
- c) Tuned to the system frequency.
- d) Have suitable non-linear resistor to limit the peak voltage and stabilizing resistance.
- e) Operating time shall be less than 40 ms.
- f) Shall be stand alone type.
- g) Have suitable stabilizing resistor to prevent maloperation during external faults if necessary.

E-5 A set of D.C. Voltage Operated Aux. Relays with coil cut-off arrangement and 4 NO and 4 NC contacts, hand reset with flag indicator type shall be provided for each Transformer for

- (a) Buchholz Alarm
- (b) Buchholz Trip
- (c) Winding Temp. Trip & winding temp. alarm
- (d) Oil Temp trip & Oil Temp. Alarm
- (e) Low Oil Level Alarm
- (f) Pressure Release Device Trip
- (g) OSR for OLT Trip

Each Transformer Panel shall be provided with a High Speed Tripping Relay with coil cut-off arrangement having 6 NO and 4 NC electrical reset with flag indicator type.

E-6 AUXILIARY RELAYS, TRIP RELAYS and TRIP COIL/CIRCUIT SUPERVISION RELAYS

Auxiliary Relays- D.C. Voltage operated auxiliary relays provided with mechanically operated hand reset indicator and sufficient no. of hand reset contacts shall be provided for protection and supervision against transformer internal trouble/faults. No of elements and number of relays shall be as per requirement of individual transformer.

For Trip Circuit Supervision Relays - All Panels should be provided with D.C. Voltage operated Trip Circuit Supervision Relay having provisions for pre & post close supervision of Trip Circuit with set of self-reset contacts provided for Trip Circuit Healthy Indication and Trip Circuit unhealthy indication & Alarm in respect of Trip Coil/circuit of respective Breakers.

Tripping Relays- All Panels should be provided with D.C. Voltage operated High Speed Tripping Relays having self reset contacts capable to make, carry and break trip coil current. Set of Trip Contacts shall be provided for Inter-tripping function of corresponding 11 KV Incoming Switchgear and closing blocking function of 33KV & 11KV Breakers in respect of Transformer Control Panels. Each set of trip relay shall have minimum two NOs, NO and 1 No. NC contact as SPARES. The operating time of master trip relay shall be less than 40ms and electrical reset type.

E-7 TRIP CIRCUIT/COIL SUPERVISION SCHEME:

Trip circuit supervision scheme shall be such that testing of trip circuit healthiness is possible irrespective of whether the C.B. is in the closed or open position. The Trip Circuit Healthy LED should glow continuously in CB ON Position and on demand in C.B. OFF position. The rating of dropping resistance in series with Trip Circuit Healthy LED shall be such that the Trip Coil should not get damaged because of continuous current flowing through it.

E-8 Principal requirements of protective relays, metering equipments, auxiliary relays breaker

controlswitchesetc.areasfollows:

E-8-1 Ammeter:

Eachcircuitoneammetershallbeprovidedwiththefollowing:

Mounting	Flush
Size	96 x96mm.case
ResponseTime	1second
OperatingTemperature	Upto55°C
DielectricStrength	2 kVRMSfor1minute
AuxiliarySupply	230volt A.C.,50Hz
OperatingCurrent	1AfromCTSecondary.
Type	PanelMountingwith3 ¹ / ₂ DigitalDisplay.

E-8-2 VoltMeter:-

Mounting	Flush
Size	96 x96mm.Case
ResponseTime	1second
OperatingTemperature	Upto55°C
DielectricStrength	2 kVRMSfor1minute
AuxiliarySupply	230V A.C.,50Hz
Frequency	50 Hz
OperatingVoltage	110VfromPTSecondary.
Type	PanelMountingwith3 ¹ / ₂ DigitalDisplay.

E-8-3 Buzzer

OneDCbuzzershallbeprovidedinthepanelfornon-tripalarm.OneDCBellshallbe providedfor Tripalarmandone AC Bellfor PanelDCfailalarm.

E-8-4 Highspeedtripping relayelectricallyresettabletype confirming toIS-3231

Aux. voltage	30Vor 110VD.C tobedecided duringdetailed engineeringstage
Coil rating	30VD.C.,voltage band for satisfactoryoperation: 50to 120%ofrated voltage
OperatingTime	40m. seconds nominal atrated voltage
Burden of relay coil watts(Max)	Lowburden 40Watt atrated voltage
Operatingtemp	-10deg C to55deg C.
Operational indicationfor each element	Mechanicalredcolour Flag: ElectricalResetType
ContactConfiguration	6NO+4 NCcombinationwithadditionalhand resetcoil cutoffcontact(Seal incontact)

Contactratings:

Makeandcarry	A.C. 1250VAwithmax5amp& 660Volts
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	D.C. 1250Wdcwithmax5amp& 660Volts
Make and carry for 3sec.	A.C. 7500VAwithmax30amp& 660Volts D.C. 7500Wdcwithmax 30amp& 660Volts
Break	A.C. 1250VAwithmax5amp& 660Volts D.C. –100Wresistive50 wattinductivewithmax 5 amp&660Volts
Insulation	2 KVRMS,50Hz for1min. 2.5KV/1secbetween all terminals&caseas perIS 3231. 1 KVRMS,50Hz for1min. acrossopen contact
Typeofmounting	Flush

E-8-5 Numericalbaseddifferentialprotectionrelaywithinbuiltcurrentamplitude& vectorgroup compensationfeature&alsowith differentialhigh setelementfortwo windingpowertransformercomplianttoIEC60255.

Aux. voltage	30Vor 110VD.C tobedecided duringdetailed engineeringstage
C.T. secondary	Selectable1amps/ 5ampsfor both HV&LV sides
Onlinedisplayof HV& LV phasecurrents &differentialcurrent	
Adjustablebias setting	10to 50%In.
Operationbasedonfundamentalfrequency	
Programmable HV/LVCTratio ofT/F vector group	
InbuiltREF protection	
InbuiltHV & LVsideovercurrent&earth faultprotection	
Inbuilttransformertroubleauxiliaryrelay	
BacklitLCDdisplay	
Harmonicrestrainfeature	
Storingfacilityof latest5fault eventswith real timeclock	
Passwordprotection	
DC burden	Quiescent condition–approx4watt Undertripcondition–30Volt- approx4watt,110Volt- approx7 watt.
AC burden	Throughcurrentonly–approx0.15VA for1amp&0.30VA for5amp(per bias circuit) Bias &differentialCktonly:2.8VAfor1amp&3.2VAfor5 amp.
Contactarrangements	Twochangeoverself resettrippingcontacts&two annunciationcontacts
Contact rating	Make&carry7500VAfor 0.2sec.withmax30A & 300 V AC or DC carry continuously 5 amp AC or DC break 1250 VA AC or 50 W DC resistive, 25 W L/R – 0.04ssubjectto max. 5amp&300Volts
Current Input	Sixfor differential&onefor REF
Self diagnosis featureforhealthinessof relay	

Flush mounted /drawouttype

23.0 Guarantee:-

The panels shall be delivered to the various consignees of the EMPLOYER and shall be suitably packed to avoid damages during transit.

The C&R Panel with relays with all integral parts of the Equipment will be guaranteed for the period of five years from the date of last dispatch.

In the event of any defect in the Equipment, relay, any integral part of the Equipment arising out of faulty design, materials, workmanship within the above period, the suppliers shall guarantee to replace or repair to the satisfaction of EMPLOYER.

If the supplier fails to do so, within one month of receipt of intimation, EMPLOYER reserves the right to effect repair or replacement by any other agency and recover charges for repair or replacement from the supplier.

24.0 TESTS:

24.1 Type Test:

24.1.1 The Manufacturer should submit the Type test report including functional test for all the protective relays and C&R panels carried out within five years from the due date of submission of tender from CPRI/NABL accredited Laboratory/ Govt. Recognized test house or Laboratory on the tendered items as per relevant Standard & Tender Specification with the purchase order failing which the lot shall be rejected. The Type tests for Numerical Relays are to be submitted as specified in Annexure-I & II of Relay specification.

24.1.2 Test at Factory:

The following Tests shall be carried out 6 copies of Test certificates shall be submitted for approval. The Equipment shall only be dispatched after approval of the test certificates.

1. Checking of wiring of circuits and the continuity.
2. One minute applied voltage test. All Equipment on panels and small wirings shall be tested for withstand voltage of 2000 Volt to earth & between different voltage circuits.
3. Insulation resistance of the complete wiring, circuit by circuit with all equipments mounted on the Board before and after H.V. test mentioned under 2 above.
4. Routine tests according to relevant National Standard are on the Instruments, relays & other devices.

25.0 INSPECTION:

25.1 Acceptance test at manufacturer's works in presence of purchaser's representatives shall be carried out. The suppliers shall give at least 15 days notice of the date when the tests are to be carried out. Purchasers shall give the right to select any quantity of the item wise offered lot for testing, offered for inspection and in the event of failure in test(s), the purchaser shall have the right to reject the offered equipments.

25.2 All relays, meters & annunciators provided in the control & relay panels are to be accepted only after successful hundred percent performance testing at testing department of EMPLOYER.

25.3 The inspection may be carried out by the EMPLOYER at any stage of manufacturing. The successful Manufacturer shall grant free access to the EMPLOYER's representative/s at a reasonable notice when the work is in progress. Inspection and acceptance of any equipment under this specification by the EMPLOYER, shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

- 25.4 The manufacturer shall keep the EMPLOYER informed in advance, about the manufacturing programmes so that arrangement can be made from stage inspection.
- 25.5 The EMPLOYER reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. The suppliers shall keep the EMPLOYER informed, in advance, about such testing programme.
- 26.0 SPARES:
- The manufacturer shall quote item-wise Unit Prices for all type of relays and other consumable spares recommended by him. Such spare shall include Fuse Holders, Fuses, Indicating Lamps, essential spare parts of Relays, Instrument, extra Control Switches etc. EMPLOYER may procure these items from the successful manufacturer.
- 27.0 DRAWING & LITERATURE
- Triplicate copies of the following drawings and literatures shall be submitted along with the order copy:-
- (a) Principal dimension details of each unit cubicles, complete assembly of panel and proposed arrangement of the Panel in a Control Room.
 - (b) Front and rear view of the Panel with instrument and device positions marked.
 - (c) Pictorial view of the Control Switches Terminal Blocks, Indication Instruments, Test Blocks and exploded view of draw out type instructions and Fuse Blocks.
 - (d) Schematic Wing Diagram for Test Terminal Block.
 - (e) Illustrative, descriptive literature, General Technical Data & Specification of Devices.
 - f) make, type, particulars, literatures of each and every relay (protective & auxiliary), meters, annunciators, switches, lamps, TBS, TTBS etc. along with bill of material in line with specification.
- 28.0 CONTRACT DRAWINGS & LITERATURE
- In the event of an order materializing, the Supplier also submit four prints of each drawing for approval of the EMPLOYER along with 2 set of literature as mentioned in the spec. The Contract drawings shall cover the following:-
- (a) Details of construction and dimensions of a cubicle and of the complete Panel.
 - (b) Template for foundation and details of Cable Trench and Cable Entry Holes in the Foundation Platform.
 - (c) Elementary diagrams of all controls, metering, protection annunciation and other circuits. All devices shall be numbered according to ASA or international usage, which shall be separately coded.
 - (d) Cabling and wiring diagram of the cubicles and inter-connections between them. Ferrule numbers, device number and grouping for cable take off shall be distinctly shown.
 - (e) Dimensional outlined drilling diagram and special mounting arrangement if any, of such type of various devices on the Panel.

- (f) Inter-connection diagram between Control Panel and C.B. power and instrument transformer etc.
- (g) Wiring Schedule for Control & Relay Panel.
- (h) Internal wiring diagram of all devices and elementary wiring diagram of relays where internal wiring is in triplicate. Construction details of switches, terminal blocks and test block setc.
- (i) After approval, 10 set of the final contract drawing for each set of Control & Relay Panels are to be supplied by the Manufacturer. One set reproducible tracing of the above drawings in soft format shall also be supplied.

In the event of contract being awarded, 4 copies of the following literatures shall be supplied along with the drawings as mentioned:-

- (a) Literature describing construction, operation, adjustment and rating specifications of all the protective and auxiliary relays, recording instruments, metering instruments and control switches.
- (b) Literature giving rating data, details and adjustments for calibration of the indicating instruments.
- (c) Calibration instruments for the metering instruments.
- (d) List of spare parts, identification number of renewable parts of relays, instruments and switches etc. with the help of which the EMPLOYER will be able to procure spare parts from the manufacturer at any subsequent time.
- (e) It is desired that the complete schematic drawing is provided on a permanently laminated/engraved plate of suitable thickness which has to be bolted/riveted at the four corners on the inside face of rear door. In addition, one more plate of similar type and dimension shall be provided on the outside of the rear door providing guidelines and instructions for operation. The guidelines and schematic to be provided on the plate shall be as per approved drawings.

29.0 DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER:

The manufacturer shall invariably submit the following documents failing which the offers are liable for rejection:-

- 29.1 Bill of Material (schedule- IA/IB/IC).
- 29.2 Documents supporting the qualifying requirements/past performance reports (schedule-III).
- 29.3 Undertakings from relay manufacturer regarding (Schedule-IV):
 - 29.3.1 Non-phasing out of the relays for at least 10 years from the date of supply
 - 29.3.2 For extending technical support and back-up guarantee
- 29.4 Detailed catalogue/technical literature in respect of all components/accessories including bought-out items.
- 29.5 Names of supplier of bought-out item.
- 29.6 List of testing equipment available with the Manufacturer.
- 30.0 QUALITY ASSURANCE PLAN
- 30.1 The Manufacturer shall invariably furnish QAP as specified in Annexure-III along with

his offer for the QAP adopted by him in the process of manufacturing.

30.2 Precaution taken for ensuring usages of quality raw material and subcomponent shall be stated in QAP.

31.0 GUARANTEED TECHNICAL PARTICULARS:

Manufacturers shall furnish Guaranteed Technical Particulars of equipment offered mentioning thereon Make & Technical particulars of each device as per schedule specified. Performance Guarantee will be based on the Guaranteed Technical Particulars.

Schedule-II -- GTP for C & R Panel

Schedule-V -- GTP for Non Directional / Directional IO / C & E / F Relay

Schedule-VI -- GTP for Master Trip Relay

Schedule-VII -- GTP for Differential Protection Relay

The discrepancies, if any, between the specification and the catalogs and/or literatures submitted as part of the offer by the manufacturers, the same shall not be considered and representations in this regard will not be entertained.

32.0 Bus Configuration and Bill of material

32.1 33/11KV delta star individual control transformer panel having HV side control and protection. Single main bus with bus section isolator scheme.

2 nos.	Circuit label engraved suitably at front and inner side
1 no.	Section of painted and overlaid mimic diagram
1 no.	Circuit breaker control switch.
6 nos.	Indicating lamps for circuit breaker ON/OFF, spring charged, trip circuit 1 & 2 healthy and auto trip indication.
2 nos.	Trip circuit supervision relay to supervise the TC 1 & 2 both under pre close and post close condition.
3 nos.	96mm x 96mm meters scaled suitably.
1 no.	voltmeter of 96mm x 96 mm
1 no.	Suitable space and wiring for non-tariff TVM for energy management.
1 set	Three phase 4 wire test terminal block for above.
1 no	Auxiliary relay with test push button for panel DC supervision relay.
16 way	Fascia window type annunciator complete with accept reset and test PB but without audible bell.

1 no	Triple pole, IDMTL, non-directional over current relay with setting range 50%-200% for IDMTL units and 500% - 2000% for high set unit.
2 nos	Restricted Earth Fault Relay current operated having setting range 10% to 40% both for HV & LV side of the Transformer.
1 no	High speed master tripping relay with contacts as required with lockout and coil supervision scheme complete.
1 set	Two bias Transformer differential relay (for 10 MVA only) with Interposing auxiliary CTs (universal type) wherever necessary.
	PT selector switch, two position PT-1/PT-2 switch, stay put type (16A)
1 no.	Space heater with On/OFF switch and thermostat.
1 no.	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for transformer Buchholz trip and Buchholz alarm function. Each element with 4NO + 2NC Contact.
1 no.	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for transformer winding temp. trip and alarm function. Each element with 4NO + 2NC Contact.
1 no.	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for transformer Low Oil Level (Main Tank) and OSR (OLTC) alarm function. Each element with 4NO + 2NC Contact.
1 no.	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for transformer Oil Temp. Trip and alarm function. Each element with 4NO + 2NC Contact.
1 no.	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for transformer Maintank PRV trip and OLTC PRV Trip function. Each element with 4NO + 2NC Contact.
1 no	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for OLTC Buchholz trip and spare. Each element with 4NO + 2NC Contact.
1 no.	DC operated emergency lamp with switch.
1 no.	Cubicle illumination lamp operated from door switch.
1 no.	15A, 3 phase plug & socket with switch.
1 set	Panel accessories as necessary.
1 set	Other equipment, relay etc. as required to fulfill the scheme Requirement.
1 no	Local/Remote switch

32.2 33KV single feeder line C&R Panel with Nondirectional O/C&E/F protection and 33KV parallel feeder line C&R Panel with directional O/C&E/F protection. Single main bus with bus section isolator scheme.

2 no.	Circuit label engraved suitably at front and inside
1 no.	Section of painted and overlaid mimic diagram

1 no.	Circuitbreakercontrolswitch.
6 nos.	Indicatinglampsforcircuitbreaker ON/OFF ,spring charged,tripcircuit1&2healthy andautotripindication.
2 nos.	TripcircuitsupervisionrelaytosupervisetheTC1&2bothunderprecloseandpost closecondition.
3 nos.	ammeterof 96mmx96mmscaledsuitably.
1 no	Voltmeterof 96mmx96 mmscaledsuitably
1 no.	Suitablespaceandwiringfor non-tariffTVMforenergymanagement.
1 no.	Threephase4wiretestterminalblockforabove.
1 no.	Auxiliaryrelaywithtestpushbuttonfor panelDCsupervisionrelay.
12 way	FasciawindowtypepeannunciatorcompletewithacceptresetandtestPBbutwithout audiblebell.
1 no	Triplepole, IDMTL, non-dir-overcurrent relay as per clause 23
1 no.	Single pole definite time sensitive E/F relay current operated having wide setting range for single circuit line.
1 no	Triplepole, IDMTL, directional overcurrent relay with setting range 50%-200% for IDMTL units and instantaneous high set unit -500%-2000% applicable for parallel line feeder as per schedule
1 no	Single pole directional definite time sensitive E/F relay current operated having wide setting range for single circuit line. NECESSARY IPTs ARE WITHIN THE SCOPE OF MANUFACTURER
1 no.	High speed master tripping relay with contacts as required with lockout and coil supervision scheme complete.
1 no.	PT selector switch, two position PT-1/PT-2 switch, stay put type (16A)
1 no.	Space heater with On/OFF switch and thermostat.
1 no.	DC operated emergency lamp with switch.
1 no.	Cubicle illumination lamp operated from door switch.
1 no.	15A, 3 phase plug & socket with switch.

1 set	Panel accessories as necessary.
1 no	Local/Remote switch
1 set	Other equipment, relay etc. as required to fulfill the scheme Requirement.

32.3 Common items: (wherever mentioned)

1 no.	96mmx96mm voltmeters scaled suitably.
3+3 nos.	PT supply Indicating lamps, red-yellow-blue for each PT.
1 no	Voltmeter selector switch, 4-position, RY—YB—BR—OFF.
1 set	Audible bell and hooter for trip and non-trip fascia annunciation.
1 no	AC operated single element, auxiliary relay having only self reset contacts and with reverse flag for incoming AC supply supervision with test push button.
1 no	DC operated, two element, auxiliary relay having only self reset contact and with reverse flag for incoming DC and alarm bus DC fail supervision.
2 nos.	Test push button for above.
1 no	Single element AC operated auxiliary relay having self reset contact only for incoming DC and alarm bus DC fail alarm cancellation.
1 no	Push button for incoming DC and alarm bus DC fail alarm accept.
1 no	Indicating lamp for incoming DC and Alarm bus DC fail indication.
1 no	AC operated buzzer for incoming DC and Alarm bus DC fail audible alarm.

Annexure-IV

Standard Make of Relay and Fittings

1.	Relays	Schneider, ABB, Siemens, Alstom
2.	Breaker Control Switch/Local- Remote switch	Kaycee/Recom/Switron
3.	Ammeter/Voltmeter Selector switch	Kaycee/Recom
4.	Static Ammeter/voltmeter	AE/RISHAV/Secure
5.	Push Buttons	Vaishno/Teknic/Lumen/STS
6.	Indicating Lamps with lens	Vaishno/Teknic/Lumen/STS
7.	Panel wiring	Finolex/Havvells/KEI/R. R. kables
8.	Hooter/Buzzer/Bell	Vaishno/STS/JVS/Bharani
9.	Annunciator	MINILEC/ALAN/INSTALARM/EAPL

Annexure-V

Legend of Devices associated with 33kVC&R Panel

Symbol Reference	Description	Particulars
A1-A2-A3, Ah	Ammeter	As specified
V	Voltmeter	As specified
VS	Manual Voltmeter Selector Switch	As specified
EM	Tri-Vector Meter	As specified
CS	Control switch T-A/T-N-A/C-C spring return type	As specified
L/R	Local/Remote switch	As specified
IL-R	CB, ON" Indication Red lamp	As specified
IL-G	CB, OFF" Indication Green lamp	As specified
IL-W	, Trip /Close signal received from Remote Indication white lamp	As specified
IL-B	"Spring charged" Indication Blue lamp	As specified
IL-A	CB" Auto trip" Indication Amber lamp	As specified
PB	Push Button	As specified
ANN	DC operated electric Buzzer and Microprocessor based Electronic annunciator with built in watch dog and first fault indication facility. The annunciator shall have provision for trip and non trip alarm functions and Accept/Test/Reset/Mute Push buttons	As specified
H, HS, TH	Heater, Heater Switch, Thermostat	As specified
FS	Fuse	As specified
LK	Link	As specified
MCB1	MCB 2 pole 32 A for DC supply	As specified
MCB2	MCB 2 pole 16 A for AC supply	As specified
MCB3	MCB 2 pole for spring charging motor supply	As specified
MVS	Manual IPT selector switch	As specified

IR-I	Remote intertripping contact from 33kV Transformer Control and relay Panel	As specified
TC	Tripping Coil	As specified
CC	Closing Coil	As specified
86	Tripping Relay for Tripping function	As specified
52	Vacuum Circuit breaker	As specified
52a, 52b	NO and NC contacts of Breaker Auxiliary switch respectively	As specified
PT	Potential Transformer	As specified
CT	Current Transformer	As specified
TTB	Test Terminal Block	As specified
51/50 R-Y-B-N	O/C and E/F protection	As specified
67 R-Y-B-N	Directional O/C and E/F protection	As specified
64	Restricted Earth Fault Protection	As specified
87	Differential Protection	As specified

SCHEDULE-IA

(To be submitted, duly filled in, along with the offer) Billof materials for 33KV feeder C&R panels

Sr. No	Description	Quantity	Make, Type & design
1	Circuit label	1 No.	
2	Mimic section (Brilliant green paint to shade No. 221 of IS 5 to be used)	1 No.	
3	T-N-C type control switch for circuit breaker.	1 No.	
4	Indicating LEDs for Spring charge indication (Blue) Trip circuit healthy indication (white) one each for Trip Ckt 1 and Trip Ckt 2 Breaker 'ON' indication (Red) Breaker 'OFF' indication (Green)	1 No. 2 Nos. 1 No. 1 No.	
5	Push button for Trip circuit test Alarm Accept/Reset/Test/Mute	1 No. 4 Nos.	
6	Numerical non-directional IDMT overcurrent and earth fault relay with high set instantaneous trip feature	1 No.	
7	High speed Master tripping relay (Electrically resettable)	1 No.	
8	12 window annunciation scheme with accept, reset and LED test push button with self resetting audible alarm.	1 Set	
9	Ammeter (96mm x 96mm.)	3 Nos.	
10	Voltmeter (96mm x 96mm.) & selector switch.	1 Set	
11	Local/ Remote switch	1 Set	
Internally mounted			
1	Space heater and control switch	1 Set	

2	Cubicalilluminationlampanddoorswitch	1Set	
3	PowerPlug,socketandcontrolswitch	1 set	
4	Alarmbellfortrip	1 No.	
5	Alarmcancellationrelay	1 No.	
6	Alarmbuzzerfornontripwithauto-stop feature(withvariabletimesetting0-60seconds)	1 No.	
7	MCBs	Asrequired	
8	FuseandLinks	Asrequired	
9	Controlwire	Asrequired	

SCHEDULE-IB

Billofmaterialsfor33/11KVTransformerC&Rpanelswithdifferentialprotection

Sr. No	Description	Quantity	Make ,Type anddesign
1	Circuitlabel	1 No.	
2	Mimic section (Brilliant green paint to shade No. 221ofIS5tobeused)	1 Set	
3	T-N-Ctypecontrolswitchforcircuitbreaker.	1 No.	
4	IndicatingLEDsfor		
	Springchargeindication(blue)	1 No.	
	Tripcircuithealthyindication(white)oneeachforTrip ckt1andTripCkt2	1 No.	
	Breaker'ON'indication(Red)	1 No.	
	Breaker'OFF'indication(Green)	1 No.	
5	Push button for Trip Circuit Healthy Test, Alarm accept/Reset/Test/Mute	5 NoS.	
6	TripcircuitHealthytest	1 No.	

7	Numerical non-directional IDMT overcurrent and earth fault relay with high set instantaneous trip feature	1 No.	
8	High speed master tripping relay (electrically resettable)	1 No.	
9	Space for HT Static TOD Tri-vector Energy meter and TTB.	1 No.	
10	Ammeter (96mm x 96mm.)	3 Nos. and 1 No.	
11	Voltmeter (96mm x 96mm.) & selector switch.	1 Sets	
12	Transformer differential numerical relay	1 No.	
13	16 window annunciation scheme with accept, reset and LED test push button with self resetting audible alarm.	1 No.	
14	Auxiliary relay for main tank Buchholz Alarm/trip (2-element)	1 Set	
15	Aux. relay for winding temp Alarm/trip (2-element)	1 Set	
16	Aux. relay for OLTC Buchholz Alarm/trip (2-element)	1 Set	
17	Aux. relay for low oil level alarm (Main Tank) & OSR (OLTC) Trip (2-element)	1 Set	
18	Aux. relay for oil temp alarm/trip (2-element)	1 Set	
19	Aux. relay for Main tank PRV & OLTC PRV Trip (2-element)	1 Set	
Internally mounted			
1	Space heater and control switch	1 No.	
2	Cubicle illumination lamp with door switch.	1 No.	
3	Power plug with control switch	1 No.	
4	MCB.	As required	
5	Fuse and Links	As required	
6	Control wire	As required	

SCHEDULE-IC

(To besubmitteddulyfilledinalongwiththeoffer)

Billofmaterialsfor33/11KVTransformerC&Rpanelswithoutdifferentialprotection.

Sr.	Description	Quantity	MakeandType desig
1	Circuitlabel	1 No.	
2	Mimicsection(Brilliant green painttoshadeNo.221 of IS5tobeused)	1 Set	
3	T-N-Ctypecontrolswitchforcircuitbreaker	1 No.	
4	IndicatingLEDsfor		
	Springchargeindication(blue)	1 No.	
	Tripcircuithealthyindication (white) oneeach forTrip Ckt1andTripCkt2	2 Nos.	
	Breaker'ON'indication(Red)	1 No.	
	Breaker'OFF'indication(Green)	1 No.	
5	PushbuttonforAnnunciationAC/RE/TEST/MUTS&TripCircuitHealthy	5 Nos	
6	Numerical non-directional IDMT over current and earthfaultrelaywithhighsetinstantaneoustrip feature.	1 No.	
7	Highspeedtrippingrelay (electricallyresettable)	1 No.	
8	Spacefor HT TODTri-vectorEnergymeterandTTB.	1 No.	
9	Ammeter(96mmx96mm.)	3 Nos. &1No	
10	Voltmeter(96mmx96mm.)&selectorswitch.	1 Set	
11	16 window annunciation scheme with accept, reset andLED testpush button withselfresetting audiblealarm.	1 No.	
12	Auxiliaryrelayfor maintankBuchholzAlarm/trip(2- element)	1 Set	

13	Aux.relayforwindingtempAlarm/trip(2-element)	1	Set	
14	Aux.relayforOLTCBuchholzAlarm/trip(2-element)	1	Set	
15	Aux. relay for low oil level alarm(Main tank) /OSR(OLTC)Trip(2-element)	1	Set	
16	Aux.relayfor oiltempalarm/trip(2-element)	1	Set	
17	Aux.relayforMaintankPRV/OLTCPRVtrip(2- element)	1	Set	
Internallymounted				
1	Spaceheaterandcontrolswitch	1 No.		
2	Cubicleilluminationlampwithdoorswitch.	1 No.		
3	Powerplugwithcontrolswitch	1 No.		
4	MCBs,fuses,links,controlwiring,etc.	Asrequired		
5	FuseandLinks	Asrequired		
6	Controlwire	Asrequired		

NOTE: THE MANUFACTURERS MUST HAVE TO SUBMIT SEPARATEBILL OF MATERIALFOR DIFFERENT TYPE OF PANELS WITH THE GUIDELINE AS MENTIONED ABOVE, FURNISHINGTHETYPEANDMAKEOFEACHITEM.

SCHEDULE- II

DETAILS OF RELAYS, METERS, EQUIPMENT & DEVICES AS OFFERED IN SCHEDULE OF 33
 KV SIMPLEX TYPE CONTROL AND RELAY PANEL – TO BE FILLED UP BY THE MANUFACTURERS
 ALONG WITH SUBMISSION OF SUPPORTING DOCUMENTS

Sl. No.	Description	Make And Country Of Manufacture	Type (Catalogue to be enclosed)	Brief Description, with CT/PT details, contact configuration, Input/Output details, characteristics, range, suitability etc. for clear perspective.
A	SURFACE MOUNTING DEVICES			
1	Circuit Level			
2	Mimic Diagram			
3	Circuit Breaker Control Switch Spring return lost motion type			
4	Ammeter 96 mm sq. for C.T. Secondary rated Current 1A Scale 0-100/0-200A Scale 0-200A/0-400A			
5	Voltmeter 96 mm Sq. for P.T. Secondary 110VAC (L/L) Scale 0-40 KV			
6	Voltmeter Selector Switch 6 way & off position having break before make contact			
7	Test Terminal block suitable for 3 phase 4 wire system with wire rear connecting stud having provision of sealing arrangement			
8	Multi way micro processor based Electronic Annunciator with building-system watchdog first fault indications and red & yellow coloured windows with inscription for Trip & Non Trip Alarm functions			
9	Indicating Lamps led type 63.5VAC for P.T. Supply indication with RED/YELLOW/BLUE Colours			

10	IndicatingLampLEDtype230VAC for Panel D.C. Fail Common Indication			
11	IndicatingLamp LED type30VDCfor CB ON/OFF AutoupSpringCharge TripCircuitHealthy Indication with RED/GREEN/ AMBER/BLUE Colours			
12	PushButton forPanelDCfailtest			
13	PushButton forincluding ACfailtest			
14	PushButton for nontripPanelDC failAlarmAccept			
15	PushButtonforAnnunciatorAlarm Test/Mute/Accept/Reset			
16	3 Element normal IDMTL over current Relay with instantaneous highsetunit			
17	Single Element Instantaneous sensitive Earth Fault Relay with Timer			
18	Triple Pole Directional Voltage polarized OverCurrent Relaywith Directional High SetUniton all Element			
19	Single Pole Directional Voltage polarized Instantaneous sensitive E/F Relaywithtimer			
20	Hibalancel InstantaneousRestricted EarthFaultCirculatoryCurrentFault Relay (a) HVside ofPower Trf. (b) LVside ofPower Trf.			

21	SingleElementHighSpeedTripping RelaywithelectricallyresetContact &H/Rflag/indicationwithrequired numbersof contracts			
22	Two Element 30 V DC Voltage Actuated AuxiliaryRelay withHR Contacts&HR/LEDFlag/indication forTransformerInternal Trouble functions			
23	Single Element 30V DC Voltage ActuatedAuxiliaryRelay with self ResetContact&ReverseFlag indicationforPanel DC Supplyfail function			
24	Single Element 230V AC Voltage ActuatedAuxiliaryRelay with self ResetContacts&Reverse Flag indication for incoming AC Supply failfunction			
25	30VDCVoltageoperatedRelayfor TripCircuitsupervisionpurposewith self resetcontact			
26	Single Element 230V AC Voltage ActuatedAuxiliaryRelay with self Reset Contacts without Flag indication for panel DC fail Alarm, Accept			
27	Additional Involvement of Single Element 30V DC Voltage Actuated Auxiliary Relay			
28	ExtraInvolvementofAuxiliaryRelay fornothavingsufficientcontactsto achieve requiredfunctions			
29	Space &wiring for housing purchaser's projection mounting type Energy meter(notwithinthe scope ofmanufacturer			
30	Common Electronic DC bell/Buzzer Trip&Non-TripAlarmfunctions			
31	CommonElectronicACBallforPanel DC failAlarmfunctions			

32	Biased differential relay for 10 MVA Trf. Control & Relay Panel			
B	Inside Mounting Devices			
1	230V AC Cubicle illuminating lamp with door operated Switch/Toggle Switch			
2	30V DC Emergency Lamp with Toggle Switch			
3	230V AC 60W space heater with thermostat & Toggle Switch			
4	15A Double VAC Combined 2/3 pin plug and socket with Switch			
5	15A Double Pole MCB for Incoming AC Supply			
6	Fuse			
7	Links			
8	Terminals			
9	Earthing Arrangement			
10	Interposing P.T. for Directional Relay if required			
11	Interposing Universal type CT for Differential Relay if required			

Note:
 All surface mounting devices excepting Energy meter, TT & Bells are flush mounting type as per Schedule requirement.

Schedule-V

GTPfor NumericalFeeder ProtectionRelay

Sl. No.	FeatureandFunction	Supplier'sdetails
1.1	Make,Type,ModelNoandVersionNo andOrderingCode	
1.2	Conformanceto i.IEC255-4	
	ii. IEC 61850	
1.3	No. of CT inputs for O/C and E/F Protection	
1.4	Typetestreportssubmitted(y/n)	
1.5	Relayshall beof Numeric Design	
1.6	Relay designed for bay protection and Control	
1.7	Size of RelayLCDscreen	
1.8	Relayisequipped with CBcloseandopen key/push buttons	
1.9	Relayhas followingprotectionfunctions: a. Threephaseovercurrent b. Earth fault c. Thermaloverloadfunction d. Broken conductorprotectionfunction e. CircuitBreakerMaintenancefunction	

2.	<p>a. One time delayed element and two high set elements</p> <p>b. Setting range and step for IDMT element for both current and Time Multiplier Setting</p>	
	c. Selectable Current/Time Curve for IDMT element	
	d. Setting range and step for high set elements for both current and time delay	
10.	Sampling rate and frequency of analog signal	
11.	Whether remote controllable from SCADA	
12.	<p>a. No. of Digital Inputs</p> <p>b. Voltage rating of Digital Inputs</p> <p>c. Provision of testing without current injection</p>	
13.	Supervision for CB open and Closed status	
14.	No. of programmable LEDs and no. of Latched LEDs	
15.	Analog Measurement and display supported	
16.	Fault Record storage capacity	
17.	Event storage capacity	
18.	Disturbance record storage capacity	
19.	MMI with keypad and LCD provided	

20.	RatedDC Supplyandtolerance	
21.	RatingofCT/PTsecondary	
22.	Ratedfrequency	
23.	a.Operating ambient temperature & humidity	
	b. Withstanding capability of Electromagnetic Interference as per relevantpartof IEC 61850	
24.	Mounting	
25.	Watchdog	
26.	a. NominalFeeder current	
	b. CTRatiosetting	
	c. Earthfaultcurrent withtimedelayIEC Curves, 2 nd stage for instantaneous trip(lessthan 50ms)	
	d. Highsetwith delay	
	e. IECCurvesforallO/CandE/Fhaveuser selectable?	
27.	a. No. of Digital OutputContacts	
	b. Contactrating	

28.	ModeofTimeSynchronization	
29.	TypeofLugs andterminators	
30.	MTBF	
31.	Lifespan	
32.	CompliancetoTypeTest	
33.	CommunicationPort a. Rear port-details b. Frontport-details	
34.	Whether Communication Ports are nativetotheRelay	
35.	ProtocolsupportedforRear Port	
36.	ProtocolsupportedforFrontport	
37.	Startandtripoutputcontactsarefreely programmable	
38.	Cable for connection of Relay to laptop(USB port) along with converter and power supplyif required for relay local setting	

39.	Basic application software for setting change,parameterisation	
40.	CDwithsoftware(licensed)todownload disturbance recorder, event log and evaluationof thoserecords	
41.	GraphicalconfigurationtoolforI/P,O/P and functional building block for protectionandcontrol	
	Any other software required for integrationwith SCADA.	

Schedule-VI

GTP for Master Trip Relay

Sl.No.	Description	Manufacturer's Response
01.	Manufacturer Name	
02.	Type and designation	
03.	Electrical reset	
04.	Mounting	
04.	High Burden relay	
05.	Operating Time	
06.	Rated DC supply and tolerance	
07.	No. of NO Contact	
08.	No. of NC Contact	

Schedule-VII

GTP for Numerical Based Differential Relay

Description	Manufacturer's Response
Manufacturer Name	
Type and designation	
Rated DC supply and tolerance	
C.T. secondary current	
Adjustable bias setting	
Operation philosophy	
Whether Programmable HV/LV CT ratio of T/F vector group provided	
Inbuilt REF protection provided	
Inbuilt HV & LV side over current & earth fault protection provided	
Inbuilt transformer trouble auxiliary relay provided	
Display Type and details	
Whether Harmonic restrain feature available	
Details of Event Recording and storing facility	
Password protection	
DC burden	
AC burden	
Contact arrangements	
Contact rating	
Current Input	
Self diagnosis feature provided	
Mounting Arrangement	
Communication port Details	

ANNEXURE-I

Technical specification for IEC 61850 compliant non-Directional O/C and E/F Relay with Bay control features

Sl. No.	Feature and Function	Technical requirement
1	Purpose and application	<p>It is intended to automate the Switchgear specified in the scope of supply and use Communicable Numerical relays for Protection, Control, Metering and Status monitoring. This specification is based on the understanding that an integrated Automation System along with protection shall be provided and same shall have provisions for Integration with SCADA system. All the feeders shall be remote controlled from EMPLOYER's SCADA and from the local console of the numerical relays.</p> <p>Numerical multifunctional combined Microprocessor based Feeder protection and management relay to protect the 33kV Feeder from all electrical and other faults along with reporting system, Disturbance record for fault analysis. Manufacturers should comply with any special requirement or feature asked for retrofitting the relays. Relays should be IEC 61850 compliant. Relays should have 4 CT input for O/C and E/F protection. There should be option for derivation of E/F internally.</p>
2.	Main Protection Feature	<ol style="list-style-type: none"> 1. Relays should have minimum two group of setting. Setting group changeover required from digital status input. 2. Electrical overload protection with selectable IEC curves with two stage, first stage to be used as Definite Time /IDMT and second stage to be used as high set for short circuit protection. 3. Earth fault protection in two stages with IEC characteristics. First stage to be used as IDMT/Definite Time and second stage to be used as instantaneous elements. Earth fault elements should be suitable for both CBCT and residual type CT connection. 4. Negative phase sequence Protection with IEC Curves. 5. CB Fail Protection & time settable as per user. 6. The relay should be immune to DC switching while carrying current i.e. no spurious trip should be generated if relay DC is made On and Off 7. The relay should conform to the IEC 255-4 or BS 142 for Inverse time characteristics. 8. The relay should have features to monitor for broken conductor and CB opening time
3.	Processor feature	<p>Relay shall be completely Numerical with protective elements having software algorithm based on sampling of Analog inputs. Sampling Rate of Analog Signal: The sampling rate should be 1000Hz for 50Hz signal</p>

4.	Operational Philosophy	The operation of Relay shall be possible both locally from the Switchgear and remote & Local Workstation. The local position shall be displayed in remote/local workstation and remote operations shall be blocked if the switch is in Local. Clear control priorities shall prevent initiation of operation of a single switch at the same time from more than one of the various control levels and there shall be interlocks among various control levels. The priority shall always be with the lowest enabled control level. Relay accuracy shall not be affected by system frequency fluctuation.
5.	Status/Optical Inputs/Digital inputs	<ol style="list-style-type: none"> 1. Minimum 7 number status inputs are required 2. All status inputs should be 30V DC/110V DC (will be mentioned during detailed Engineering as per requirement). 3. Setting group is required to be changed with any Digital input status. 4. Trip circuit supervision with DI status 5. The digital inputs shall be acquired by exception with 1ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state. 6. Relay should have comprehensive self diagnostic feature with remote indication of relay failure and alarm shall be generated without tripping of circuit 7. Provision of Testing output relays without any current injection. 8. No. of programmable LEDs - at least 4 nos. with latching option.
6.	Main measuring and reporting feature	<p>All measurements should be in primary quantities. Minimum following displays are required in alpha numeric:-</p> <ol style="list-style-type: none"> 1. Three phase (Positive sequence) current 2. Neutral (zero sequence) current 3. All the trips should have clear indication on the relay terminals 4. Resetting should be selectable as hand reset or auto reset. 5. The default relay LCD shall be user defined to display primary circuit loading.
7.	Memory and Recording Feature	<ol style="list-style-type: none"> 1. The relay setting and programming should be stored in EEPROM so that during Aux. Power failure the said data is not lost. 2. Relay should have event log, trip log and DR record. All logs should go to history. 3. All tripping of relay should initiate DR in auto without extraneous input. Triggering of DR with binary input should be user configurable.

		<ol style="list-style-type: none"> 4. The last 2 fault DR records should be in flash memory and DR will not erase in case of DC supply fail for more than 2 days. 5. Should be able to record at least 5 Oscillographic disturbances and 5 fault records and 250 event records. 6. Minimum Four no. of latest trip log with cause of trips should be stored in memory along with date and time stamping. The memory should not be lost with the switching off of DC. 7. The relay should have fault-recording feature with current waveform and Digital Input status. The fault waveform should consist of minimum four current waveforms of three phase current and zero sequence current and DI status. Triggering time for Pre and Post should have user selectable. This record should be in flash memory for minimum 7 (seven) days even after switching off the DC supply. 8. The fault should be date and time stamped. 9. Communication protocol IEC 61850.
8.	Auxiliary Supply	30V or 110V DC (will be mentioned during detailed Engineering as per requirement) to -25% to +10%, 2 wire unearthened system. Necessary software shall be in-built for proper shutdown and restart in case of power failure. Auxiliary supply burden will be around 20 Watt.
9.	Rated CT/PT secondary	5/1 Amp (User selectable), CT used to be protection class
10.	Rated frequency	50HZ +/- 5%
11.	Ambient condition	<ol style="list-style-type: none"> 1. Operating ambient temperature up to 55 Deg C 2. Operating Humidity up to 100% 3. Relay shall meet the requirement for withstanding electromagnetic interference according to relevant parts of IEC 61850. Failure of single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.
12.	Module and Mounting	<ol style="list-style-type: none"> 1. Relays should be flush mounted type 2. If module is draw out type then it should have CT shorting facility of make before break type. 3. Mounting in switchgears located in non AC rooms. 4. Galvanic isolation between field connection and relay hardware should be there.
13.	Watchdog and self monitoring	The relay should have facility to monitor the healthiness of its circuits and components by own monitoring system. In case of any problems, the alarm should be generated by one of the output contacts. The alarm as soft signal to be sent to SCADA system as well. Necessary support

		documentation explaining these self diagnostic features shall be furnished with dog contact shall be provided in addition to required 7BI and 7BO.
14.	Settings	<p>Approximate settings possible should be as follows:-</p> <ol style="list-style-type: none"> 1. Nominal Feeder current 2% to 110% 2. CT Ratio setting 10-1000 (approx.) 3. Earth fault current 5 to 40% with time delay IEC Curves, 2nd stage for instantaneous trip (less than 50 ms) 4. Overcurrent trip - 50% to 200% of 1/5 Amp with time delay as per IEC Curves. 5. High set with delay 200% to 2000% 6. IEC Curves for all O/C and E/F have user selectable.
15.	Output Relays	<p>Minimum 7 number output relays are required out of which</p> <ol style="list-style-type: none"> 1. One potential free change over contact should be provided for start inhibit of relay. 2. All o/p contacts should be freely programmable. 3. Rating of trip contacts:- <ol style="list-style-type: none"> a) Contact durability > 10K operation b) 15 Amp make and carry for 3 sec for trip contact c) Make and carry for trip contacts L/R <= 40ms Rating of Alarm contacts:- <ol style="list-style-type: none"> a) 8 Amp make and carry continuously for 5 sec. <p>Testing of Output relay through keypad on relay fascia and relay HMI software. Output relay dwell time shall be user programmable or fixed at 100ms.</p>
16.	Relay software and Man Machine Interface	<ol style="list-style-type: none"> 1. The relay should have native IEC 61850 Communication Protocol. 2. Should have password protected keypad lock. 3. Necessary software for relay setting, retrieving DR, event log, trip log should be supplied by the Manufacturer. Necessary License is to be issued for EMPLOYER, if required. 4. Manufacturer has to supply communication hardware for relay setting, DR downloading from front port. This device should be compatible to USB/Ethernet port. 5. It shall be possible to transfer the data stored in the DFR to computer on IEEE/COMTRADE format. The data format shall be compatible for dynamic protection relay testing on relay test kit. COMTRADE data viewing software to be provided. 6. Multiuser/Corporate license for installation on minimum 7 nos. of PCs.

17.	Date and time	Date and Time stamping with faults and record. The clock should be powered from internal cell and should not require setting after every DC switching. The internal cell life minimum 5 years. Time synchronization by IIRIG-BorSNT. For time synchronization through SNT, it should be provided from clock signal coming from RTU. In case of IIRIG-B, time synchronization will be done with GPS clock signal from GPS receiver located at substation.
18.	Lugs and terminators	All CT and PT terminals shall be provided as fixed (screwed) type terminal on the relay to avoid any hazard due to loose connection leading to CT opening or any other loose connection. Necessary amount of lugs should be supplied along with each relay for CT connection and control wiring.
19.	Manuals, Drawings and Literature	<ol style="list-style-type: none"> 1. The relays should be supplied with manuals with all technical and operating instructions. 2. All the internal drawings indicating the logics and block diagram detail explaining principle of operations should be given at the
20.	Standard documentation per Relay, according to IEC 61850	<ol style="list-style-type: none"> 1. MICS document (model implementation conformance statement) 2. PICS (protocol implementation conformance statement) 3. Conformance Test certificate from KEMA/CPRI. 4. PIXIT document <p>All the above mentioned certificates shall be submitted.</p> <ol style="list-style-type: none"> 5. ICD file 6. SCD file
21.	Extendibility in Future	The Manufacturer shall provide all necessary software tools along with source code to perform addition of bays in future and complete integration with SCADA by the User. These software tools shall be able to configure relay, add analog variable, alarm list, event list, modify interlocking logic etc. for additional bays/equipments which shall be added in future.
22.	Lifespan	<p>The suppliers should mention following:-</p> <ol style="list-style-type: none"> 1. Product maturity: The Manufacturer should mention the time period for which the product is in the market 2. Expected production life 3. Hardware/Firmware change notification process. Upgrade to be provided free of cost within the Guarantee period/5 years whichever is later, if needed. 4. Lifespan of standard tools and processes for relay configuration, querying

23.	Standards	<p>The relays should conform to the IEC 255-5 or equivalent BS/ANSI for following:-</p> <ol style="list-style-type: none"> 1. Overload withstand test 2. Dielectric withstand: 2kV in common, 1kV in differential mode 3. Impulse Voltage: 5kV in common, 1kV in differential mode 4. Insulation resistance > 100M-ohm. 5. Vibration: Shock and bump and Seismic 6. Storing and transportation 7. Radio Interference: IEC 61000 for high frequency disturbance, Transient disturbance, Electrostatic discharge 8. KEMA Certification for the particular model offered with respect to IEC 61850 Protocol.
24.	Communication Port	<ol style="list-style-type: none"> 1. Two nos. IEC 61850 protocol compliant Ethernet RJ45/F. O port for communication with SCADA system through two managed Ethernet Switches operating in redundant mode. The communication shall be made in 1+1 mode between individual IED to Switch, such that failure of one set of LAN shall not affect the normal operation of SCADA. However, it shall be alarmed in SCADA. 2. Functioning of Relays shall not hamper to fault occurring any interconnected relay. 3. One Front port Ethernet RJ45/USB 2.0 for relay parameterization and configuration etc. with the help of PC. In case RS-232 port offered, suitable interfacing cable with one end having RS 232 port and other end USB 2.0 to be provided to connect with PC free of cost. 4. Relays should generate GOOSE message as per IEC 61850 standard for interlocking and also ensure interoperability with third party relays.
25.	Name Plate and marking	<p>Each IED shall be clearly marked with manufacturer's Name, type, serial no. and electrical rating data. Name plates shall be made of anodized aluminium with white engraving on black surface.</p>
26.	Performance Guarantee	<p>Relays will be guaranteed for the period of five years from the date of last dispatch.</p> <p>Any problem in the said period should be attended free of charge inclusive of repair/replacement of relays/component (both H/W, S/W).</p>
27.	Type Test	<ul style="list-style-type: none"> • Dielectric Withstand Test—IEC 60255-5 • High Voltage Impulse Test, class III---IEC 60255-5 (5kV peak, 1.2/50)

		<p>microSec;3 Positiveand3 negativeshotsatintervalof 5Sec.)</p> <ul style="list-style-type: none"> • DC SupplyInterruption----IEC 60255-11 • AC Ripple onDCsupply----IEC 60255-11 • VoltageDips andShortInterruptions--- IEC61000-4-11 • HighfrequencyDisturbance---- IEC60255-22-1,ClassIII • FastTransient Disturbance ---- IEC 60255-22-4, Class-IV • Surgewithstandcapability ---- IEEE/ANSIC37.90.1(1989) • DegreeofProtection • Electromagneticcompatibility • Mechanicalstress/vibrationtest • Temperaturewithstand <p>Typetestreportsforthe abovetests shall besubmitted forthe approvalof EMPLOYERalongwith Tender,failingwhichorder may be rejected.</p> <p>WherevertheabovementionedstandardsandIEC61850overlap,the latterwillprevail.</p>
28.	Training	<p>Suitabletrainingtobeimpartedtoemployerpersonsonthefollowingitem S:-</p> <ol style="list-style-type: none"> 1. Relaysettingandparameterization 2. RelayconfigurationwithrespecttoI/P,O/Pandfunctionalblock for protection. 3. GOOSE configuration. 4. Configuration and Interfacing required for third party SCADA SystemIntegration. 5. Diagnosticfeatures <p>Thedetailsofsyllabustobefinalized withEMPLOYER.</p>
29.	Service Charge for Commissioning Engineer	<p>Firmrateshallbequotedseparatelyforcommissioningandintegrationof RelaywithSCADAasperformat. Thisrateshallbevalidforthreeyears fromduedateofsubmissionoftender.However,theabovecostwillnot beconsidered for evaluation.</p>

Inter-operability test:-

After fulfilment of the above Q.R. inter-operability test of the offered relay (other than Make & Model used in EMPLOYER) with the existing relay in EMPLOYER Network will be tested in EMPLOYER Distribution Testing Department, EMPLOYER for which due intimation for supply of sampled of offered relay will be given to the Manufacturer. The Manufacturer needs to submit the said relay to Distribution Testing Department, EMPLOYER within one week from the said intimation.

The offered relay will only be accepted after fulfilment of above Q.R. & successful inter-operability test at EMPLOYER system.

Checklist for Bill of Material for supply

Sl.No.	Material	
1.	Relay (Model No.)	Qty as per Tender
2.	Lugs suitable for current and control, wiring	Qty as per Tender X Number of TBs in relay + 20% extra.
3.	Cable for connection of Relay to laptop (USB port). Along with converter and power supply if required for relay local setting	10 set
4.	Manual, Hard copy in good quality paper properly bounded	10 set
5.	Copy of Type Test certificate along with manual	With offer
6.	Basic application software for setting change,	10 nos.
7.	CD with software (licensed) to download disturbance recorder, event log and evaluation of those records	10 nos.
8.	Graphical configuration tool for I/P, O/P and functional building block for protection	10 nos.
9.	Any other software required for integration with SCADA.	10 nos.

N.B. All the above tools/Software should be compatible to WINDOWS XP / WINDOWS NT / WINDOWS 7 Operating System.

ANNEXURE-II

Technical specification for IEC 61850 compliant Directional O/C and E/F Relay with Bay control features

Sl.No	Feature and Function	Technical Requirement
1	Purpose and application	<p>It is intended to automate the Switchgear specified in the scope of supply and use Communicable Numerical relays for Protection, Control, Metering and Status monitoring. This specification is based on the understanding that an integrated Automation System along with protections shall be provided and same shall have provisions for Integration with SCADA system. All the feeders shall be remote controlled from EMPLOYER's SCADA and from the local console of the numerical relays.</p> <p>Numerical multifunctional combined Microprocessor based Feeder protection and management relay to protect the 33kV Parallel Feeder from all electrical and other faults along with reporting system, Disturbance record for fault analysis. Manufacturers should comply with any special requirement or feature asked for retrofitting the relays. Relay should be IEC 61850 compliant. Relays should have 4CT input, 3 input for O/C and residual E/F protection will be derived internally. One CT input may be used for unbalanced current protection. Relays should have 4 voltage input, 3 input for VT element for directional O/C protection with internally derived residual voltage for E/F protection. Another VT input will be used for residual voltage protection. Relays should have two stage overvoltage and under voltage protection.</p>
2	Main Protection Feature for directional O/C & E/F relay.	<ol style="list-style-type: none"> 1. Electrical overload protection with selectable IEC curves with two stage, first stage to be used as Definite Time/IDMT and second stage to be used as high set for short circuit protection. 2. Earth fault protection in two stages with IEC characteristics. First stage to be used as IDMT/Definite Time and second stage to be used as instantaneous elements. Earth fault elements should be suitable for both CBCT and residual type CT connection. 3. Negative phase sequence Protection with IEC Curves. 4. CB Fail Protection & time settable as per user. 5. The relay should be immune to DC switching while carrying current. i.e. no spurious trips should be generated if relay DC is made On and Off
		<ol style="list-style-type: none"> 6. The relay should conform to the IEC 255-4 or BS142 for Inverse time characteristics. 7. VT fuse fail detection on NPS current/NPS Voltage or zero sequence current/voltage based logic and blocking of under voltage protection by VT fuse fail detection. 8. Three phase VT fuses fail detection on current based logic. 9. The relay should have features to monitor for broken conductor and CB opening time. 10. The relay shall be designed for application in EMPLOYER's distribution network where the system is non-effectively earthed through earthing transformer emanating at 33kV bus of 132/33kV substation. 11. Relays should have minimum two group of setting. Setting group change over required from digital status input.

3.	Processor feature	Relay shall be completely Numerical with protective elements having software algorithm based on sampling of analog inputs. Sampling Rate of Analog Signal: The sampling rate should be 1000Hz for 50Hz signal or better for each analog channel. Hardware based measurement shall not be acceptable.
4.	Operational Philosophy	The operation of Relay shall be possible from both locally from the Switchgear and remote and Local Workstation. The local position shall be displayed in remote/local workstation and remote operations shall be blocked if the switch is in Local. Clear control priorities shall prevent initiation of operation of a single switch at the same time from more than one of the various control levels and there shall be interlocks among various control levels. The priority shall always be with the lowest enabled control level. Relay accuracy shall not be affected by system frequency fluctuation.
5.	Status/Optical Inputs/Digital inputs	<ol style="list-style-type: none"> 1. Minimum 7 number status inputs are required 2. All status inputs should be 30VDC/110VDC (will be mentioned during detailed Engineering as per requirement) 3. Setting group is required to be changed with any Digital input status. 4. Trip circuit supervision with DI status 5. The digital inputs shall be acquired by exception with 1ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state. 6. Relay should have comprehensive self diagnostic feature with remote indication of relay failure and alarm shall be generated without tripping of circuit 7. Provision of Testing output relays without any current injection. 8. No. of programmable LEDs- at least 4 nos. with latching option.
6.	Main measuring and reporting feature	<p style="text-align: center;">All measurements should be in primary quantities. Minimum following displays are required in alpha numeric:-</p> <ol style="list-style-type: none"> 1. Three phase (Positive sequence) current, Three phase voltage 2. Neutral (zero sequence) current, MW, MVAR, Frequency, Pf, MVA etc. 3. All the trips should have clear indication on the relay terminals 4. Resetting should be selectable as hand reset or auto reset.

7.	Memory and Recording Feature	<ol style="list-style-type: none"> 1. The relay setting and programming should be stored in EEPROM so that during Aux. Power failure the said data is not lost. 2. Relay should have event log, trip log and DR record. All logs should go into history. 3. All tripping of relay should initiate DR in auto without extra binary input. Triggering of DR with binary input should be user configurable. 4. The last 2 fault DR records should be in flash memory and DR will not erase in case of DC supply fail for more than 2 days. 5. Should be able to record at least 5 Oscillographic disturbances and 5 fault records and 250 event records. 6. Minimum Four no. of latest trip log with cause of trips should be stored in memory along with date and timestamping. The memory should not be lost with the switching off of DC. 7. The relay should have fault-recording feature with current waveform and Digital Input status. The fault waveform should consist of minimum four current waveforms of three phase current and zero sequence current and DI status. Triggering time for Pre and Post should have user selectable. This record should be in flash memory for minimum 7 days even after switching off the DC supply. 8. The fault should be date and timestamped. 9. Communication protocol IEC 61850.
8.	Auxiliary Supply	<p>30V or 110V DC (will be mentioned during detailed Engineering as per requirement) to -25% to +10%, 2 wire unearthened system. Necessary software shall be in-built for proper shutdown and restart in case of power failure. Auxiliary supply burden will be around 20Watt.</p>
9.	Rated CT/PT secondary	<p>5/1 Amp (site selectable), CT used to be protection class. 3PT input rated 110 Volt (L-L)</p>
10.	Rated frequency	50HZ +/- 5%
11.	Ambient condition	<ol style="list-style-type: none"> 1. Operating ambient temperature upto 55 Deg C 2. Operating Humidity upto 100% 3. Relay shall meet the requirement for withstanding electromagnetic interference according to relevant part of IEC 61850. Failure of single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.
12.	Module and Mounting	<ol style="list-style-type: none"> 1. Relay should be flush mounted type 2. If module is draw out type then it should have CT shorting facility of make before break type. 3. Mounting in switchgears located in non AC rooms. 4. Galvanic isolation between field connection and relay hardware should be there.

13.	Watchdogandself monitoring	<p>The relay should have facility to monitor the healthiness of its circuits and components by own monitoring system. In case of any problems, the alarm should be generated by one of the output contacts. The alarm as soft signal to be sent to SCADA system as well. Necessary support documentation explaining the self diagnostic feature shall be furnished. Watchdog contact shall be provided in addition to required 7BI and 7BO.</p>
14.	Settings	<p>Approximate settings possible should be as follows:-</p> <ol style="list-style-type: none"> 1. Nominal Feeder current 2% to 110% 2. CT Ratio setting 10-1000 (approx.) 3. Earth fault current 5 to 40% with time delay IEC Curves, 2nd stage for instantaneous trip (less than 50 ms) 4. Overcurrent trip - 50% to 200% of 1/5 Amp with time delays as per IEC Curves. 5. High set with delay 200% to 2000% 6. IEC Curves for all O/C and E/F have user selectable. 7. Selectable MTA for Directional features for O/C relay should cover 1st quadrant for effectively grounded system / impedance grounded system / solid grounded system.
15.	Output Relays	<p>Minimum 7 number output relays are required out of which</p> <ol style="list-style-type: none"> 1. One potential free change over contact should be provided for start inhibit of relay. 2. All o/p contacts should be freely programmable. 3. Rating of trip contacts:- <ol style="list-style-type: none"> a) Contact durability > 10K operation b) 15 Amp make and carry for 3 sec for trip contact Make and carry for trip contacts L/R <= 40ms Rating of Alarm contacts:- <ol style="list-style-type: none"> d) 8 Amp make and carry continuously for 5 sec. <p>Testing of Output relays through keypad on relay fascia and relay HMI software. Output relay dwell time shall be user programmable or fixed at 100ms.</p>

16.	Relays software and ManMachine Interface	<ol style="list-style-type: none"> 1. The relay should have native IEC 61850 Communication Protocol. 2. Should have password protected keypad lock. 3. Necessary software for relay setting, retrieving DR, event log, trip log, and downloading waveform should be supplied by the Manufacturer. Necessary License is to be issued for EMPLOYER, if required. 4. Manufacturer has to supply communication hardware for relay setting, DR downloading from front port. This device should be compatible to USB/Ethernet port. 5. It shall be possible to transfer the data stored in the DFR to computer on IEEE/COMTRADE format. The data format shall be compatible for dynamic protection relay testing on relay test kit. COMTRADE Data viewer software is to be provided. 6. Multiuser/Corporate license for installation on minimum 7 nos. of PCs.
17.	Date and time	<p>Date and Time stamping with faults and record. The clock should be powered from internal cell and should not require setting after every DC switching. The internal cell life minimum 5 years. Time synchronization by IRIG-B or SNTP. For time synchronization through SNTP is to be provided from clock signal coming from RTU. In case of IRIG-B, time synchronization will be done with GPS clock signal from GPS receiver located at substation.</p>
18.	Lugs and terminators	<p>All CT and PT terminals shall be provided as fixed (screwed) type terminals on the relay to avoid any hazard due to loose connection leading to CT opening or any other loose connection. Necessary amount of lugs should be supplied along with each relay for CT connection and control wiring.</p>
19.	Manuals, Drawings and Literature	<ol style="list-style-type: none"> 1. The relays should be supplied with manuals with all technical and operating instructions. 2. All the internal drawings indicating the logics and block diagram detail explaining principle of operations should be given at the time of supply. 3. Mapping details shall be submitted in IEC format.
20.	Standard documentation per Relay, according to IEC 61850	<ol style="list-style-type: none"> 1. MICS document (model implementation conformance statement) 2. PICS (protocol implementation conformance statement) 3. Conformance Test certificate from KEMA/CPRI. 4. PIXIT document <p style="padding-left: 20px;">All the above mentioned certificates shall be submitted along with Order copy</p> <ol style="list-style-type: none"> 5. ICD file 6. SCD file

21.	ExtendibilityinFuture	<p>The Manufacturer shall provide all necessary software tools along with sourcecode to perform addition of bays in future and complete integration with SCADA by the User. These software tools shall be able to configure relay, add analog variable, alarm list, event list, modify interlocking logics etc. for additional bays/ equipments which shall be added in future.</p>
22.	Lifespan	<p>The suppliers should mention following:-</p> <ol style="list-style-type: none"> 1. Product maturity: The Manufacturer should mention the time period for which the product is in the market 2. Expected production life 3. Hardware/Firmware change notification process. Upgrade to be provided free of cost within the Guarantee period/5 years whichever is later, if needed. 4. Lifespan of standard tools and processes for relay configuration, querying and integration.
23.	Standards	<p>The relays should conform to the IEC 255-5 or equivalent BS/ANSI for following:-</p> <ol style="list-style-type: none"> 1. Overload withstand test 2. Dielectric withstand: 2kV in common, 1kV in differential mode 3. Impulse Voltage: 5kV in common, 1kV in differential mode 4. Insulation resistance > 100M ohm 5. Vibration: Shock and bump and Seismic 6. Storing and transportation 7. Radio Interference: IEC 61000 for high frequency disturbance, Transient disturbance, Electrostatic discharge 8. KEMA/CPRI Certification for the particular model offered with respect to IEC 61850 Protocol

24.	Communication Port	<p>1. Two nos. IEC 61850 protocol compliant Ethernet RJ45/F.O port for communication with SCADA system through two managed Ethernet Switches operating in redundant mode. The communication shall be made in 1+1 mode between individual IED to Switch, such that failure of one set of LAN shall not affect the normal operation of SCADA. However, it shall be alarmed in SCADA.</p> <p>2. Functioning of Relay shall not hamper to fault occurring any interconnected relay.</p> <p>3. One Front port Ethernet RJ45/USB 2.0 for relay parameterization and configuration etc. with the help of PC. In case RS-232 port offered, suitable interfacing cable with one end having RS 232 port and other end USB 2.0 to be provided to connect with PC free of cost.</p> <p>4. Relay should generate GOOSE message as per IEC 61850 standard for interlocking and also ensure interoperability with third party relays.</p>
25.	Name Plate and marking	<p>Each IED shall be clearly marked with manufacturer's Name, type, serial no. and electrical rating data. Name plate shall be made of anodized aluminium with white engraving on black surface.</p>
26.	Performance Guarantee	<p>Relays will be guaranteed for the period of five years from the date of last dispatch.</p> <p>Any problem in the said period should be attended free of charge inclusive of repair/replacement of relays/component (both H/W, S/W).</p>

27.	Type Test	<ul style="list-style-type: none"> • Dielectric Withstand Test—IEC 60255-5 • High Voltage Impulse Test, class III---IEC60255-5(5kV peak, 1.2/50 microSec; 3 Positive and 3 negative shots at interval of 5Sec.) • DC Supply Interruption ----IEC 60255-11 • AC Ripple on DC supply----IEC 60255-11 • Voltage Dips and Short Interruptions--- IEC61000-4-11 • High frequency Disturbance---- IEC60255-22-1, Class III • Fast Transient Disturbance ---- IEC 60255-22-4, Class-IV • Surge withstand capability ---- IEEE/ANSI C37.90.1(1989) • Degree of Protection • Electromagnetic compatibility • Mechanical stress/vibration test • Temperature withstand <p>Types test reports for the above tests shall be submitted for the approval of EMPLOYER along with Tender. Wherever the above mentioned standards and IEC 61850 overlap, the latter will prevail.</p>
28.	Training	<p>Suitable training to be imparted to employer's persons on the following items:-</p> <ol style="list-style-type: none"> 1. Relay setting and parameterization 2. Relay configuration with respect to I/P, O/P and functional block for protection. 3. GOOSE configuration. 4. Configuration and Interfacing required for third party SCADA System Integration. 5. Diagnostic features
29.	Service Charge for Commissioning Engineer	<p>Firm rates shall be quoted separately for commissioning and integration of Relay with SCADA as per format. This rate shall be valid for three years from the date of submission of tender. However, the above cost will not be considered for evaluation.</p>

30.	Credential as pre-requisite of Tender	<p>1. Copies of performance certificate for two years successful operation as on the due date of bid opening for the offered relay in respect to implementation of IEC 61850 protocol to any SCADA/substation automation system from reputed Power Sector Utility in India shall have to be furnished along with the Bid. Copies of Purchase Orders and corresponding Delivery Challans/Stores Receipt vouchers/Excise Duty Invoice, etc., i.e. Proof of Execution of the Purchase Orders.</p> <p>OR</p> <p>Successful testing and operation of minimum one year in EMPLOYER network..</p> <p>2. Documentary evidence for being manufacturers like registration Certificate issued by SSI/NSIC/Directorate of Industries/DGS&D, etc. for Qualifying requirement.</p> <p>3. The manufacturers should have testing facilities of all functional tests or should have arrangement of all functional tests at government approved testing laboratories.</p> <p><u>Inter-operability test:-</u></p> <p>After fulfilment of the above Q.R. inter-operability test of the offered relay (other than Make & Model used in EMPLOYER) with the existing relay in EMPLOYER Network will be tested in EMPLOYER Distribution Testing Department, EMPLOYER for which due intimation for supply of sampled of offered relay will be given to the Manufacturer. The Manufacturer needs to submit the said relay to Distribution Testing Department, EMPLOYER within one week from the said intimation.</p>
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ChecklistforBillof Materialfor supply

Sl.No.	Material	
1.	Relay(Model No.)	Qtyas perTender
2.	Lugs suitableforcurrent andcontrol,wiring	QtyasperTenderXNumber of TBs in relay+20%extra.
3.	CableforconnectionofRelaytolaptop(USBport). Along with converter and power supply if required forrelaylocal setting	10set
4.	Manual,Hardcopyingoodqualitypaperproperly bounded	10set
5.	CopyofTypeTestcertificatealongwithmanual	With offer
6.	Basic applicationsoftware for settingchange,	10nos.
7.	CD with software(licensed) to download disturbancerecorder,eventlogandevaluationof thoserecords	10nos.
8.	Graphical configuration tool for I/P, O/P and functional buildingblockfor protection	10nos.
9.	Anyothersoftwarerequiredforintegrationwith SCADA.	10nos.

N.B All the above tools/ Software should be compatible to WINDOWS XP/WINDOWS NT/WINDOWS7OperatingSystem.

QUALITY ASSURANCE PLAN (Annexure-III)

The manufacturer shall invariably furnish following information along with this offer.

(1) Statement giving list of important raw materials including but not limited to

- (a) Contact material
- (b) Insulation
- (c) Sealing material
- (d) Contactor, limit switches, etc. in control cabinet.

Name of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw materials in presence of Manufacturer's representative, copies of test certificates.

2) Information and copies of test certificates as in (i) above in respect of bought out accessories.

3) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

4) Special features provided in the equipment to make it maintenance free.

5) List of testing equipment available with the Manufacturer for final testing and associated combinations vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in the relevant schedule i.e. schedule of deviations from specified test requirements. The supplier shall, within 15 days from the date of receipt of Purchase Order submit following information to the EMPLOYER:-

i) List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

ii) Necessary test certificates of the raw material and bought out accessories.

iii) Quality Assurance Plan (QAP) with hold points for EMPLOYER's inspection. The quality assurance plan and hold points shall be discussed between the EMPLOYER and supplier before the QAP is finalized.

iv) The supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled Panel.

10. Batteries and Charger

Lead Acid or Ni-Cd, any one of these two can be used by contractor. Both the specification along with specification for their charger are given below:

I. Ni-Cd ALKALINE BATTERIES (PARTIAL RECOMBINATION TYPE) WITH CHARGERS FOR 33/11 kV AND 66/11 kV SUB-STATIONS

Part-A :Ni-Cd ALKALINE BATTERIES (PARTIAL RECOMBINATION TYPE) FOR 33/11 kV AND 66/11 kV SUB-STATIONS

1) SCOPE

This specification covers the requirements and tests for 24 V, 30 V 110 V, 220V partial recombination type Nickel-Cadmium alkaline batteries with chargers, for use in 33/11 kV and 66/11 kV sub-stations.

The batteries covered in this specification are for indoor use. For out-door application a suitable enclosure shall be provided, preferably made of an insulating material like FRP/SMC/DMC/Poly carbonate plastic material, heat/alkali/humidity/UV resistant, confirming to S1 or D1 grade of IS: 13410/IS: 13411 or other relevant international standard, in order to have rust free enclosure. The enclosure shall have rainproof ventilating louvers backed with fine brass wire mesh & suitable canopy. The enclosures shall confirm to IP: 52 degree of protection.

2. APPLICABLE STANDARDS

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. Unless otherwise modified in this specification, the Ni-Cd batteries shall comply with latest version of IEC 62259.

All work shall be carried out as per the following standards and codes.

Sl.No.	International Standards	Indian Standards	Description
1	IEC: 62259	-	Secondary cells and batteries containing alkaline or other non-acid electrolytes-Nickel-cadmium prismatic secondary single cells with partial gas recombination
2	IEC: 60623	IS: 10918	Secondary cells and batteries containing alkaline or other non-acid electrolytes-vented Nickel_Cadmium prismatic rechargeable single cells
3		IS: 1146	Rubber & Plastic container for lead acid storage

Sl.No.	International Standards	Indian Standards	Description
			batteries
4	IEEE: 1106		Recommended practice for maintenance, testing & replacement of Ni-Cd storage batteries for generating stations & substations
5	IEEE: 1115		Recommended practice for sizing of Ni-Cd batteries for stationary applications
6		IS 13410	Glass reinforced Polyester sheet moulding compounds.
7		IS: 1248	Voltmeter

3. STANDARD RATING

The recommended voltage ratings of batteries, for use at 33/11 KV and 66/11 KV sub-stations, shall be 24 volts or 30 volts. The batteries for the above application shall have a rating of 45 Ah (Minimum) in case of 24 V battery system or as per the load requirement of the substation.

Note: Utilities may specify 110 or 220 V DC system if so required. For batteries intended for use with individual or groups of breakers or with higher DC System voltage, lower Ah ratings can be used depending upon the requirements.

4. CELL VOLTAGE

The nominal voltage of a single cell shall be 1.2 V

Nominal Voltage Rating of battery	Nominal single cell voltage	Float cell voltage	Number of cells (to be finalized)	Permissible D.C. System voltage variation	End of discharge cell voltage (Min.)
(V)	(V)	(V)	(V)	(V)	(V)
24	1.2	1.4 to 1.42	19	21.7 to 27	1.14
30	1.2	1.4 to 1.42	23	26.2 to 32.7	1.14
110	1.2	1.4 to 1.42	87	99.2 to 123.5	1.14

220	1.2	1.4 to1.42	170	193.8 to 241.4	1.14
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Note: As the nominal cell voltage is 1.2 V, nominal battery bank voltage may not exactly match nominal DC system voltage.

5. CAPACITY AT 20°C TEMPERATURE

Battery capacity shall be decided based on the following load cycle:-

- (a) 800W for 1/2 minuteto end cell voltage of not less than 1.14 V per cell considering loads (i) to (iv) below.
- (b) 300 W for 1 hour to end cell voltage of not less than 1.14 V per cell considering loads (iii) & (iv) below.
- (c) 100W for 05 hrs to end cell voltage of not less than 1.14 V per cell considering loads (iv) below.

The load cycle has been decided based on the following considerations:-

- (i) Tripping of 03 Nos. circuit breakers simultaneously with battery for which a total load of 500 W has been considered.
- (ii) Closing of 3 circuit breakers one after the other for which a load of 500 W per circuit breaker has been considered.
- (iii) Emergency lighting load of 200 W for 01 hour.
- (iv) 100 W load for panel indication lamps, relays, PLCC/ VHF communication systems, computer etc. for a period of 06 hours.

6. BATTERY SIZING

The supplier shall carry out battery sizing calculations based on the load cycle specified in line with IEEE 1115 and submit the same to the owner justifying the type/number of cells considered against the requirement.

Following factors shall be considered while carrying-out battery sizing calculations:-

- a) Ageing factor – 1.25
- b) Design margin –1.0
- c) State of charge –0.9

The number of cells shall be determined as per load cycle and the battery system voltage level. The owner, if required for the battery system, may specify provision for the number of spare cells.

7. CONSTRUCTION

The cells shall have prismatic, spill-proof type of construction with partial recombination feature. The cells shall be flooded type containing sufficient reserve electrolyte. Battery shall be equipped with nickel-plated inter-cell connectors and terminals. The cells shall be housed in high-strength impact resistant & alkali-resistant containers and should be transparent / translucent to facilitate checking of electrolyte level. Container and Lid should bewelded and should not cause leakage of electrolyte/gases during operation even in case of normal mechanical/electrical abuses. O-rings of

nitrile rubber with Epoxy sealing shall be used to ensure proper sealing of bushings etc. Flip-top vent plugs/ valves with flame arrester feature shall be provided. The regulating valve type design shall be of self-resealing type. Construction of cells shall be so as to ensure proper air circulation between the cells for heat dissipation/ ventilation (by providing either insulated button separators integral with the outer surface of the cell container or by suitably designing the inter cell connectors). The containers shall be strong enough, so that excessive bulging of container does not occur during service. Cells shall be supplied in filled & charged state or otherwise electrolyte in dry form & battery water separately or electrolyte in liquid form shall be shipped as desired by the owner.

Battery shall have provision for water top up to ensure electrolyte level does not fall below recommended level.

8. ELECTRODES

Electrodes shall be deigned for maximum durability under all service conditions. + ve and -ve electrodes shall be made by encapsulating/impregnating active material in order to ensure that the battery is able to perform reliably over its life. +ve and -ve electrodes shall be separated by micro porous separators. The structure of electrodes shall be elastic enough to absorb mechanical stresses & volume changes during charge/discharge cycles.

9. ELECTROLYTE

The electrolyte shall be prepared from battery grade potassium hydroxide (KOH) confirming to IEC 60993. The cells shall contain sufficient reserve electrolyte for efficient heat dissipation & to reduce water topping up interval. Reserve electrolyte shall not be less than 06 ml/Ah.

10. CONNECTORS

Nickel-plated copper inter-cell connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be nickel-plated steel/stainless steel. All terminals and cell inter-connectors shall be fully insulated or have insulation shrouds.

11. TERMINALS

Separate terminals shall be provided on the end cell for connecting load through DCDB and for connecting charger leads. All terminals shall be of suitably sized nickel-plated steel. Suitable nickel-plated copper lugs shall be provided by the supplier for use of the purchaser for connecting up the load wiring. All connectors and lead shall be suitable for carrying 30-minute discharge current continuously and rated for short circuit duty of 4kA for 01 second.

12. MANUAL OF INSTRUCTIONS

The manufacturer shall supply a copy of the instruction manual for commissioning & initial treatment of the battery and maintenance during service with every battery bank ordered.

13. RECOMBINATION EFFICIENCY

In order to reduce topping-up frequency, recombination of Hydrogen & Oxygen gases evolved during charging/discharging shall be achieved by using safe and reliable technology such as catalytic conversion/valve regulation technique or both. Minimum recombination efficiency shall be 80%. Recombination efficiency test shall be done in accordance with IEC 62259. In case the batteries are

operated at high temperatures & are frequently boost charged the water consumption may be higher & topping-up frequency may increase.

14. BATTERY RACKS

Suitable corrosion resistant battery racks and cable supports shall be provided. Metallic racks shall be properly earthed. The bottom tier of stand shall have a ground clearance of 150mm minimum above the floor. Racks shall be made of alkali resistant powder coated steel or stainless steel or FRP to ensure corrosion resistance.

15. TEMPERATURE RANGE

Battery must be capable of continuous operation in temperatures range of -15°C to +50°C for prolonged periods. No Air-conditioning shall be provided where batteries are to be installed.

16. ACCESSORIES

The following accessories (BIS certified) shall be supplied with each set of battery:-

- i) Clamp-on type digital multi-meter of AC/DC current range having ISI mark.
- ii) Pair of gloves
- iii) 10" Slide insulated wrench for opening terminal nuts
- iv) Plastic/glass syringe
- v) Alcohol thermometer
- vi) Hydrometer for use while filling electrolyte.

17. CHARGE RATE

Fully discharged batteries should be able to get recharged in 7 hours maximum to 90% of capacity with charging current in the range of 0.1 to 0.4CmA rate at 20°C. At higher temperatures, the charging time may be more. The trickle charge rate shall be 1-2 mA/Ah.

18. CELL DESIGNATION

The practice as per IS: 10918 (latest version) shall be followed.

19. POLARITY MARKING

The polarity of the terminals shall be marked for identification. Positive terminal may be identified by 'P' or a (+) sign or red colour mark and negative terminal may be identified by 'N' or (-) sign or blue colour mark. Marking shall be permanent and non-deteriorating.

20. WARNING MARKING

The battery shall be furnished with a warning plate located at conspicuous place specifying the use of 'ALKALINE ELECTROLYTE ONLY' (in block letters) and specifying proper filling level of the electrolyte. Marking shall be permanent and non-deteriorating.

21. PACKING

The batteries shall be securely packed in wooden crates suitable for handling during transit by rail/road and secured to avoid any loss or damage during transit. Carton boxes duly palletized shall also be acceptable.

22. TESTS

The batteries shall be tested for type, acceptance and routine tests in line with IS: 10918 & IEC: 62259 (latest versions). The owner may at their discretion to accept the batteries based on type tests already carried-out. In such cases, Type test reports for tests carried out not earlier than 05 years from bid opening date from NABL accredited labs shall be acceptable.

Note : In case Type tests are repeated, life cycle test may not be insisted upon Ni-Cd battery of the specific ratings to be ordered, as this test takes a long time (2-3 years). However, satisfactory evidence is to be furnished for having made this test on cell of any other Ah capacity of the same design.

23. BUYBACK OF USED/UNSERVICEABLE BATTERIES

Manufacturer shall buyback used/unserviceable batteries from the substations where batteries are replaced. The owner shall confirm the following particulars of used/unserviceable batteries to enable the bidder to quote buyback rates:

- i) Type & number of cells for disposal
- ii) Make
- iii) Year of make/purchase
- iv) Capacity
- v) Condition of cells

The bidder should quote their rates for buyback considering the salvage value of the above cells.

24. SAFE DISPOSAL OF UNSERVICEABLE BATTERIES

The bidder shall have facilities for proper treatment & disposal of used/unserviceable batteries that are bought back from the users, in line with the environmental protection rules & regulations of the country.

25. GUARANTEE

The batteries shall be guaranteed for a period of 36 months from the date of commissioning.

Part B : CHARGER FOR Ni-Cd BATTERY (RECOMBINATION TYPE)

1. SCOPE

This specification covers the requirements and tests for Battery charger for partial recombination type Nickel-Cadmium alkaline batteries for use in 33/11 KV and 66/11 KV sub-stations.

2. CODES AND STANDARDS

- 2.1. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards and codes.

2.2.

Sl.No	International standards	Indian standards	Description
1		IS:5	Colours for ready mix paints.
2		IS : 1248	Direct acting indicating analogue electrical measuring instruments.
3	IEC : 947-1	IS : 13947 Prt-1	Low voltage switchgear and control gear - General.
4	IEC : 947-2	IS : 13947 Prt.-2	Low voltage switchgear and control gear - Circuit Breaker
5	IEC : 947-3	IS : 13947 Prt-3	Specification for low voltage switchgear and control gear – Switches, Disconnectors, Switch disconnectors & Fuse combination units.
6	IEC : 947-4	IS : 13947 Prt-4	Specification for low voltage switchgear and control gear –Contactors
7		IS : 13947 Prt-5	Specification for low voltage switchgear and control gear – Control Circuit Devices & Switching Elements
8	IEC: 439	IS:8623	Low voltage switch-gear and control-gear assemblies
9		IS:8686	Static protective relays
10	IEC:225	IS : 3231	Electrical relays for power system protection.
11		IS : 3842	Application guide for Electrical relays for AC System
12	IEC 146	IS : 3895	Mono-crystalline semi-conductor Rectifier Cells and Stacks.
13	IEC 146	IS : 4540	Mono crystalline semi-conductor Rectifier assemblies and equipment.
14		IS:6619	Safety Code for Semi-conductor Rectifier Equipment.

15		IS : 9000	Basic environmental testing procedures for electronic and electrical items.
16	IEC: 60269	IS:13703 Prt-4	Low voltage fuses for protection of semiconductor devices.
17		IS:1901	Visual indicating lamps
18		IS:6005	Code of practice for phosphating of Iron and Steel.
19	IEC: 227	IS:694 /IS: 1554	PVC Insulated Cable for working voltages upto and including 1100 V.

2.3. Equipment complying with other internationally accepted standards such as IEC, BS, VDE. etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

3. EQUIPMENT DESCRIPTION

3.1. a) The Battery Chargers as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in Float mode, i.e. Float charging the associated Ni-Cd Batteries (partial recombination type) while supplying the D.C. loads. The Batteries shall be Float charged at 1.4 to 1.5 Volts per cell. All chargers shall also be capable of Boost Charging the associated Batteries at 1.42 to 1.7 Volts per cell at the desired rate. The Chargers shall be designed to operate, as mentioned above, up-to an ambient air temperature of 50°C. Tapping arrangement in the battery bank shall be provided to limit the over-voltage for supplying load within allowed voltage range under boost charge conditions. The charger should automatically switchover to float charge & to boost charge when the specified limit of voltage is approached. However, necessary timer circuit shall be used to allow a finishing charge before switching over to float mode, as recommended by battery manufacturer in order to ensure that battery gets fully charged. Recommended values of charger rating, tapping cell and specified voltages for automatic changeover to float/boost mode are given in table below, however, the manufacturer may suggest any changes in the recommended values with justification at the time of supply :

Rating of Charger	Charger Rating during Float Charging at 1.4 to 1.45 V per cell	Charger Rating during Boost Charging at 1.42 to 1.7 V per cell	Tapping to be provided at ---th cell	Switching Voltage to Boost Mode	Switching Voltage to Float Mode

Volt	Ampere	Ampere	n	Volt	Volt
24	10	25	15	22	32
30	10	25	18	26	38
110	5	5	69	94	146
220	5	5	136	194	285

Note : Charger rating shall be arrived at with charger in boost mode and also supplying 100% float load i.e. charger current shall be sum of float & boost rating.

- b) Battery Chargers shall automatically select the appropriate mode of operation i.e. Float or Boost. Means shall be provided to avoid current/voltage surges of harmful magnitude/nature, which may arise during changeover.
- c) Soft start feature shall be provided to build up the voltage to the set value slowly within fifteen seconds. The chargers shall have load limiters, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the Charger. The load limiter characteristic shall be such that any sustained overload or short circuit in DC system shall neither damage the Charger nor shall it cause blowing of any of the charger fuses. The Charger shall not trip on overload or external short circuit. After clearance of fault, the Charger voltage shall build up automatically when working in automatic mode.

During external short circuit, output of the charger shall be automatically reduced to near zero volt till it is not isolated/disconnected & normal output voltage shall be restored by charger circuit on isolation with out any harm to source transformer/protection/ regulator circuit

- d) During Float charging, the Charger output voltage shall remain within $\pm 1\%$ of the set value for AC input voltage variation of 230 +10% -15%, frequency variation of $\pm 5\%$, a combined voltage and frequency (absolute sum) variation of 10% and a continuous DC load variation from 5% to full load. Uniform and stepless adjustments of voltage setting shall be provided on the front of the Charger panel covering the entire Float charging output range specified. Stepless adjustment of the load limiter setting shall also be possible from 80% to 100% of the rated output current for Float charging mode.
- e) During Boost charging, the Battery Chargers shall operate on constant current mode with maximum current limiter setting (When automatic regulator is in service).
- f) Energising the Charger with fully charged battery connected plus 10% load shall not result in output voltage greater than 110% of the voltage setting. Time taken to stabilise, to within the specified limits in clause 3.1 (d), shall be less than five seconds.
- g) Momentary output voltage of the Charger, with the Battery connected shall be within 90% to 110% of the voltage setting during sudden load Change from 80% to 20% of full load or vice-versa.

Output voltage shall return to, and remain, within the limits specified in clause 3.1 (d) in less than 1 second after the above-mentioned change.

- h) The Charger manufacturer may offer an arrangement in which the voltage setting device for Float charging mode is also used as output voltage limit setting device for Boost charging mode, and the load limiter of the float charging mode is also used as Boost charging current setting device.
- i) Suitable filter circuits shall be provided in all the Chargers to limit the ripple content (peak to peak) in the output voltage to 3% irrespective of the DC load, even when they are not connected to a battery.
- j) The DC System shall be ungrounded and float with respect to the ground potential when healthy.
- k) Battery shall be isolated in case of short circuit on the load side.
- l) Battery test circuit shall be provided with suitable resistance for discharging the battery for 30Sec at 5 hr rate.
- m) All potentiometers shall be electronically locked to contain the various parameters within allowable limits even if the setting position of potentiometers is changed to extreme positions.
- n) Insulation resistance shall be 5 M Ohm min.

3.2. MCB

AC MCCB shall be provided at the incomer. DC MCCB with provision of auxiliary contacts shall be provided at the output of the battery charger.

3.3. Rectifier-Transformers and Chokes

The rectifier transformer and chokes shall be dry and air cooled (AN) type. The rating of the rectifier-transformers and chokes shall correspond to the rating of the associated rectifier assembly. The rectifier-transformers and chokes shall have class-B insulation as per IS : 4540. Rectifier transformer shall confirm to all type tests as specified in IS 4540/IS 2026. Type test & routine test reports shall be submitted to the owner.

3.4. Rectifier Assembly

The rectifier assembly shall be full wave bridge type and designed to meet the duty as required by the respective Charger. The rectifier cells shall be provided with their own heat dissipation arrangement with natural air-cooling. The rectifier shall utilise diodes/thyristors with heat sinks rated to carry 130% of the load current continuously and the temperature of the heat sink shall not be permitted to exceed 85°C absolute duly considering the maximum temperature inside charger panel with ambient temperature of 50°C. The Contractor shall submit calculations to show what maximum junction temperature will be and what the heat sink temperature will be when operating at 130% and 100% load current continuously duly considering the maximum surrounding air temperature for these devices inside the charger panel assuming ambient temperature of 50°C outside the panel. Necessary surge protection devices and rectifier type fast acting fuses shall be provided in each arm of the rectifier connections. Static silicon controlled rectifiers and diodes complete with resistor/capacitor network for surge protection shall be provided

Design having IGBT or superior technology shall also be acceptable for which full justification & experience shall be required for acceptance.

3.5. Instruments

Analog or digital D.C. voltmeter, D.C. ammeter and A.C. voltmeter with 96 mm square display shall be provided for all Chargers. The instruments shall be flush mounted type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustments. The instruments shall be of 1.5 accuracy class.

3.6. Control and Selector Switches

Control and selector switches shall be of rotary stayput type of reputed make, conforming to relevant IS with escutcheon plates showing the functions and positions. The switches shall be of sturdy construction and suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred. The contact ratings shall be at least the following :

- i) Make and carry continuously - 10 Amps.
- ii) Breaking current at 220 V DC - 0.5 Amp. (Inductive)
- iii) Breaking current at 230 V AC - 5 Amp. at 0.3 p.f.

3.7. Fuses

Fuses shall be of HRC cartridge fuse link type. Fuses shall be mounted on fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on fuse carriers, they shall be directly mounted on plug in type bases. In such cases one insulated fuse pulling handle shall be supplied for each charger. Suitable fuse fail detector circuits with alarm contacts shall be provided for all D.C. fuses.

3.8. Indicating Lamps

The indicating lamp shall be of panel mounting, LED type and capable of clear status indication under the normal room illumination. The lamp covers shall be preferably screwed type, unbreakable and moulded from heat resistant material.

3.9. Blocking Diode

Blocking diode, wherever required, with full redundancy shall be provided in the output circuit of each Charger to prevent current flow from the D.C. Battery into the Charger.

3.10. Annunciation System

Visual indications through indicating lamps/LEDs or annunciation facia shall be provided in all Chargers for the following:

- i. A.C. supply failure
- ii. Rectifier fuse failure

- iii. Surge circuit fuse failure
- iv. Filter fuse failure
- v. Load limiter operated
- vi. Input AC MCCB trip
- vii. Output DC MCCB trip
- viii. Battery on Boost
- ix. Load-side DC under-voltage & over-voltage alarm
- x. Battery side DC over-voltage alarm
- xi. AC available – Battery discharge (Mains available battery discharge) alarm
- xii. Potential free NO contacts shall be provided for following remote alarms:
 - a) Battery on boost
 - b) Charger trouble (this being a group alarm initiated by any of the faults other than 'Battery on Boost')

3.11. Name Plates and Marking

The nameplates shall be made of non-rusting metal/3 ply Lamicaid and shall have black background with white engraved letters and secured by screws. These shall be provided near top edge on the front as well as on rear side of Charger. Nameplates with full and clear inscriptions shall also be provided on and inside the panels for identification of various equipment.

- 3.12. Detailed dimensional drawings, commissioning and operating instructions and Test Certificates of the manufacturer shall be supplied with the equipment.

3.12.1. CONSTRUCTION

- 3.13. The Chargers shall be indoor, floor mounted, self-supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Charger shall be fabricated using cold rolled sheet steel not less than 1.6 mm thick. The panel frame shall be fabricated using cold rolled sheet steel of thickness not less than 2.0 mm. Removable un-drilled gland plates of at least 3.0 mm sheet steel and lugs for all cables shall be supplied by the Contractor. The lugs for cables shall be made of electrolytic copper with tin plating. Cable sizes shall be advised to the Contractor at a later date for provision of suitable lugs and gland plates. Ventilating louvers shall be backed with fine brass wire mesh. All doors and covers shall be fitted with nitrile/neoprene/PU rubber gaskets. The Chargers shall have hinged double leaf doors provided on front and/or backside for adequate access to the Charger internals. All the Charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-42. The construction shall meet the requirements of IS 6619. All equipment mounted in the cabinet shall be provided with individual labels with equipment designation engraved.
- 3.14. In case of outdoor mounting, the charger shall be provided with double doors on both front & back and shall pass IP-42 requirement with one door open on both sides. The enclosure shall be provided with a canopy.
- 3.15. The layout of Charger components shall be such that their heat losses do not give rise to excessive temperature within the Charger panel. Location of the electronic modules will be such that temperature rise, in no case, will exceed 10°C over ambient air temperature outside the Charger.
- 3.16. Each Charger panel shall be provided with an illuminating lamp (CFL or tube-light) and one 5 Amp. socket. Switches and fuses shall be provided separately for each of the above.

3.17. Locking facilities shall be provided as following:

- a) For locking Float/Boost selector switch in the float position only.
- b) The Charger enclosure door shall have provision for padlocks. Padlocking arrangement shall allow ready insertion of the padlock shackle but shall not permit excessive movement of the locked parts with the padlock in position.

4.6 WIRING

3.17.1. Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks, ready for external connection. The power wiring shall be carried out with 1.1 kV grade PVC insulated cables conforming to IS:1554 (Part-I). The control wiring shall be of 1.1kV grade PVC insulated stranded copper conductors of 1.5 sq.mm. minimum, conforming to IS:694. Control wiring terminating at electronic cards shall not be less than 0.75 sq. mm. Control terminal shall be suitable for connecting two wires of 1.5 sq.mm. stranded copper conductors. All terminals shall be numbered for ease of connections and identification. At least 20% spare terminals shall be provided for circuits.

3.17.2. Power and control wiring within panels shall be bundled separately. Any terminal or metal work which remains alive at greater than 415 V, when panel door is opened, shall be fully protected by shrouding.

An air clearance of at least ten (10) mm shall be maintained throughout all circuits, except low voltage electronic circuits, right upto the terminal lugs. Whenever this clearance is not available, the live parts should be insulated or shrouded.

3.18. Painting

Pre-treatment & phosphating with 7 tank process shall be provided as per IS: 6005. The phosphate coating shall be 'class-C' as specified in IS: 6005. Electrostatic powder painting with final shade – 692 (smoke grey) of IS: 5 shall be provided. The thickness shall not be less than 50 microns.

3.19. PACKING & DISPATCH

The equipment shall be dispatched securely packed in wooden crates suitable for handling during transit by rail/road so as to avoid any loss or damage during transit.

4. QUALITY ASSURANCE PLAN

4.1. The vendor shall furnish the following information along with his bid; failing which the bid shall be liable for rejection. Information shall be separately given for individual type of material offered.

- i) The structure of Organization
- ii) The duties and representatives assigned to staff ensuring Quality of work
- iii) The system of purchasing, taking delivery and verification of materials
- iv) The system for ensuring quality of workmanship
- v) The quality assurance arrangements shall conform to the relevant requirement of ISO 9001 or ISO 9002 as applicable

- vi) Statement giving list of important raw materials/components, list of sub-suppliers, list of standards according to which the raw materials are tested.
- viii) List of manufacturing facilities available.
- ix) Level of automation achieved and list of areas where manual process exists.
- x) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- xi) Lists of testing equipment available with the bidder for final testing of equipment specified and test plant limitation if any, vis-à-vis the type, special acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

4.2. The contractor shall also submit following information after award of contract:

- i) Sub-suppliers of raw materials as well as bought out accessories & components. The equipment supplied shall adhere to the list of components submitted & as per type-tested equipment.
- ii) Type test certificates of the raw materials and bought out accessories as required by the owner.
- iii) Manufacturing Quality Plan (MQP) shall be submitted. The owner hold points for stage inspection shall be discussed between the owner and contractor at the time of award of contract before the MQP is finalized.

4.3. Makes of the following components (not restricted to) shall be subject to owner's approval.

- i) Relays
- ii) Instruments
- iii) SCR/IGBT
- iv) Diodes
- v) Annunciator

5. TESTS

Battery chargers including the components shall confirm to all type tests including heat run test as per relevant Indian standards. Performance test on the chargers as per specification shall also be carried out on each charger.

5.1. TYPE TESTS

5.1.1. Following type tests, in addition to the requirement of IS : 4540, should have been carried out on each rating and type of Battery Charger for which reports are to be submitted.

- i. Complete physical examination.
- ii. Temperature rise test at full load (at highest voltage & highest current).
- iii. Insulation resistance test.

- iv. High voltage (power frequency) test on power and control circuits except low voltage electronic circuits.
- v. Ripple content test at
 - vi. No load
 - vii. Half load
 - viii. Full load
- ix. Automatic voltage regulator operation test at specified A.C. supply variations at
 - a) No load
 - b) Half load
 - c) Full load
- x. Load limiter operation test
- xi. Short circuit test at full load and at no load for sustained short circuit of 1-minute minimum shall be carried out. The charger shall not trip, no fuse shall blow and charger current shall be limited to 150% of the rated current.
- xii. Efficiency and power factor measurement.
- xiii. Environmental Tests
Steady state performance tests (clause 7.2.2 (f) and (g)) shall be carried out before and after the following tests.
 - i) Dry heat, Damp Heat, Vibration, Low temperature, Transportation, shock as per IS : 9000.
 - ii) Degree of protection test (IP-42).
- xiv. Rectifier transformer – As per IS 4540.

5.1.2. If type tests are carried out against the contract, minimum 15 days notice shall be given by the contractor. The contractor shall obtain the owner's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type tests to be carried out.

5.1.3. In case the contractor has carried out the type tests within last five years as on the date of bid opening, he may submit the type test reports from NABL accredited laboratory to the owner for waiver of conductance of such type tests. These reports should be for the tests conducted on the equipment with identical design to that proposed to be supplied under this contract. The owner reserves the right for conducting any or all of the specified type tests under this contract.

5.2. ROUTINE TESTS :

5.2.1. Following routine tests shall be carried out on all Rectifier transformers in addition to tests required as per IS-4540.

- a) Insulation resistance test.
- b) High voltage (power frequency) test.

5.2.2. Following routine tests shall be carried out on all Battery Chargers in addition to tests required as per IS-4540 :

- a) Complete physical examination.

- b) Short circuit test at full load and at no load for sustained short circuit of 1-minute minimum shall be carried out. The charger shall not trip, no fuse shall blow and charger current shall be limited to 150% of the rated current.
- c) Insulation resistance test.
- d) High voltage (power frequency) test.
- e) Ripple content test at
 - i) No load
 - ii) Half load
 - iii) Full load
- f) Automatic voltage regulator operation test at specified A.C. supply variations at
 - i) No load
 - ii) Half load
 - iii) Full load
- g) Load limiter operation test
- h) Checking of proper operation of annunciation system.
- i) Dynamic response test Overshoot/Undershoot in output voltage of the charger as a result of sudden change in load from 100% to 20 % and 20% to 100% shall be measured.
- j) Soak Test - All electronic modules shall be subjected to continuous operation for a minimum period of 72 hours. During last 48 hours, the ambient temperature shall be maintained at 50 deg. C. The manufacturer shall submit the record of carrying out this test to the owner's engineer at the time of inspection.
- k) The charger shall be checked for gasketing arrangement as per drawing.

5.2.3. Following routine tests shall be carried out on annunciation system.

- a) Soak test shall be carried out as per Cl. 7.2.2 (j).

5.3. ACCEPTANCE TESTS:

5.3.1. Following acceptance tests and checks shall be carried out by the owner at the manufacturer's works:

- a) Complete physical examination.
- b) Checking of proper operation of annunciation system.
- c) Temperature rise test at full load.
- d) Insulation resistance test.
- e) Automatic voltage regulator operation.
- f) Load limiter operation.
- g) Dynamic response test.

h) Ripple content test

5.3.2. Overshoot/Undershoot in output voltage of the Charger as a result of sudden change in load from 100% to 20% and 20% to 100% shall be measured with the Batteries connected/disconnected. Output voltage of the Charger connected with Battery shall be within 90 % to 110 % of the voltage setting in above conditions and shall return to, and remain, within the limits specified in clause 3.1 (d) in less than 2 seconds.

5.3.3. The Contractor shall furnish for inspection, the type and routine tests certificates for Chokes and transformer whenever required by the Employer.

6. GUARANTEE

The battery charger shall be guaranteed for a period of 24 months from the date of commissioning.

II. 30 VOLT 100 AH LEAD ACID BATTERY

Part A : 30 Volt 100 Ampere-Hour Lead Acid stationary Battery

1. SCOPE

This specification covers 30 Volt 100 Ampere-Hour Lead Acid stationary Battery, for use at 33/11KV substations for feeding auxiliary supply to Switchgear equipment at the time of interruption in mains supply. The battery is to be supplied along with wooden stand/rack as per description given below. Specifications of battery rack are indicated separately.

2. APPLICABLE STANDARDS

The cells of Lead Acid Battery shall conform to the requirements of IS 1651: 1991 with latest amendment thereof.

3. STANDARD RATINGS

The standards rating for 30 Volt Lead Acid Battery shall be 100 AH.

4. CELL VOLTAGE

The nominal voltage of a single cell shall be 2.1 to 2.2 Volts.

5. CAPACITY AT ROOM TEMPERATURE

The battery shall comprise of 15 cells with capacity not less than 100 AH at 10-hour rate of discharge to end voltage of 1.85 Volts per cell at room temperature not exceeding 32 degree C.

6. GENERAL DESCRIPTION

Cells shall be supplied in glass containers having ample space provided below the plate for accumulation of deposit. The glass containers shall be sufficiently robust, transparent and free from flaws. The bidder may also quote for battery with hard rubber containers, which shall conform to IS 1146: 1981.

Lead acid battery, comprising of closed type cells shall be complete with plate / tubular type positive plate assemblies, glass boxes, lids, micro porous plastic separators, polystyrene dowels and buffers, inter cell connectors and bolts & nuts. The battery shall be complete with (i) inter row connectors and bolts & nuts, acid jars and packing case, (ii) stands (iii) stand insulators (iv) cable sockets for end and tapping connections.

The sulphuric acid and water used for the preparation and maintenance of electrolyte shall conform to IS 266: 1977 and IS 1069: 1964 respectively.

The separators used shall be either wooden or synthetic. The wooden separators when used shall conform to IS 652:1960 and the synthetic separators to IS 6071: 1986.

The venting device shall be of anti-splash type with more than one exit hole and shall allow the gases to escape freely but shall effectively prevent acid particles or spray from coming out.

A suitable electrolyte level indicator indicating lower and upper limits shall be fitted to facilitate checking of electrolyte level in opaque containers. The materials used shall be acid proof and shall not deteriorate during service.

The manufacturer's identification shall be embossed/impressed on the connectors. Where it is not possible to bolt the cell terminals directly to assemble a battery, separate lead, copper or aluminium connectors of suitable size shall be provided to enable connection of the cells.

The material for bolts and nuts shall be brass. Bolts and nuts for connecting the cells shall be effectively lead-coated to prevent corrosion.

Open cells shall be provided with spray arrestors of adequate area over the plates. These may be of glass sheet at least 3 mm thick and shall be adequately supported.

7. MOUNTING STAND

The cells shall be accommodated in double tier stand constructed of "SAL" wood and painted with 3 coats of acid proof paint. Necessary paint for this purpose shall be supplied. No metal fastenings shall be used. Stand should be self-supported and free from warp & twist. The assembled stand / rack should be suitable for bolting end to end to form continuous row. The stands shall be supported on insulators to obtain necessary insulation from earth and there shall be insulators between each cell and stand. The price of stand shall be included in the cost of the battery.

8. TERMINALS

Separate terminals shall be provided for connecting load and charger leads to the battery terminals. All terminals shall be of M 12 size. The agency shall provide suitable copper lugs for use of the owner for connecting the load wiring.

9. ACCESSORIES

The following accessories shall be supplied along with each battery and price for the same shall be included in the cost of the battery:-

1. One battery logbook
2. Two copies of printed instruction sheet
3. One no. cell testing voltmeter (3-0-3 volts) complete with leads

4. One no. floating hydrometer
5. One no. syringe hydrometer
6. One no. thermometer (0 to 100 degree C) with specific gravity correction scale
7. One set of suitable insulated spanners
8. One no. acid resisting funnel
9. One no. acid resisting jar
10. One pair of rubber gloves
11. Lead plated 2 nut – bolts and 2 washers set = 30 + 4 extra = 34 Nos.
12. Cell insulators for mounting of cells = 15X4+6 extra = 66 Nos.
13. Rack insulator for mounting of battery rack = 8 Nos. minimum

10. CHARGE RATE

Fully discharged batteries should normally be recharged at 10 Amps. for 10 hours at room temperature. New batteries and old batteries at high temperatures may need more time. Trickle charge rate shall be about 50 to 100 mA,

11. CELL DESIGNATION AND MARKING

The practices indicated in relevant IS shall be followed for cell designation purpose.

The following information shall be indelibly and durably marked on the outside of the cell:-

1. Indicating the source of manufacture
2. Ah capacity at 10-hour rate
3. Upper and lower electrolyte level in case of transparent containers
4. Year of manufacture and
5. Country of origin
6. Each cell and battery may also be marked with the Standard Mark.

The polarity of the terminals shall be marked for identification. The positive terminal may be identified by "P" or (+) sign or Red colour mark and the negative terminal may be identified by "N" or (-) sign or a Blue colour mark. Terminal marking shall be permanent and non-deteriorating.

The battery shall be supplied with a warning plate located at conspicuous place specifying the use of "PARTICULAR ELECTROLYTE ONLY" (in block letters) & specifying the proper filling level of the electrolyte. Marking shall be permanent and non-deteriorating.

12. TESTS

The following tests shall be carried out in accordance with IS 1651:1991 with latest version thereof.

13. TYPE TESTS

1. Verification of constructional requirements
2. Verification of marking
3. Verification of dimensions
4. Test for capacity
5. Test for voltage during discharge
6. Ampere-hour and watt-hour efficiency tests

7. Test for loss of capacity on storage
8. Endurance test

14. ACCEPTANCE TESTS

The following shall constitute acceptance tests: -

1. Marking and packing
2. Verification of dimensions
3. Test for capacity, and
4. Test for voltage during discharge

15. ROUTINE TESTS

The battery shall be tested after manufacture as per the requirement of IS: 1651-1991 (with latest amendment, if any). Two copies of test certificates indicating the results obtained during the tests shall be submitted.

16. MANUAL INSTRUCTIONS

The manufacturer shall supply one copy of instruction manual for initial treatment and routine maintenance during service with each battery.

The following information shall be provided on the instruction cards:-

1. Designation of cell or battery
2. Ampere – Hour capacity
3. Nominal voltage
4. Manufacturer's instructions for filling, initial charging
5. Normal and finishing charging rates and
6. Maintenance instructions

17. GUARANTEE PARTICULARS

Expected life span of battery shall be minimum 10 years. Loss of capacity on storage of a fully charged battery stored for 28 days should not be more than 3%. Battery should be capable to bear under floating & over floating conditions.

The bidders shall essentially fill up the enclosed Schedule of Guaranteed Technical Particulars of Battery offered by him.

18. PACKING

The battery shall be suitably packed in wooden crates suitable for handling during transit by rail/road, and secured to avoid any loss or damage during transit.

Part B: Battery Charger

1. SCOPE

This specification covers design, manufacturing, testing at manufacturer's works before dispatch and supply of 30 Volt 10 Ampere Single Phase Battery Charger required for charging of 30 Volt 100

Ampere-Hour Lead Acid Battery and for feeding auxiliary supply to Switchgear equipments at 33/11 kV substations.

2. STANDARDS

Unless otherwise specified, the equipment shall conform to the latest applicable Indian standards and in particular to the following standards:-

1	IS: 3895	Specification for Rectifier equipment's in general
2	IS: 13947(Part II)	Specification for MCB
3	IS: 1248	Indication instruments
4	IS: 2147	Degree of protection for cubicles
5	IS: 375	Specification for wiring
6	IS: 4540	Mono crystalline semiconductor rectifiers assemblies & equipment
7	IS: 6619	Safety code for semiconductor rectifier equipment
8	IS: 2026	Transformers
9	IS: 4237	General requirement for switchgear and control gear for voltage not exceeding 1000 Volts
10	IS: 4064	Air Break switches and fuse combination units
11	IS: 6005	Code of practice for phosphating of Iron & Steel
12	IS: 5	Colour for ready mix paints
13	IS: 5921	Printed circuit Board
14	IS: 249	Printed circuit Board
15	IS: 5578	Guide for making insulated conductor

The agency shall clearly state the standards to which the equipment offered by him conforms.

3. DRAWING AND LITERATURE

The bidder shall furnish all such drawings, instruction manuals, descriptive literature etc., as may be necessary for the proper understanding of the functioning of the charger.

The write-up should include the following:-

1. Technical specification of the charger.
2. Detailed circuit description of the charger. It should also include the functions of various components, protection circuits/cards, and relays along with their individual brief write-ups/leaflets.
3. List of the main components of the charger.
4. Following details are to be clearly indicated in the circuit diagram:-
 - a. Make and Rating of components used
 - b. All the fuses should be numbered and individual rating should be indicated.

4. GENERAL DESCRIPTION

The Charger shall be of simple design so as to ensure its reliable functioning and ease in maintenance/repairing. Complicated circuitry shall be avoided, as far as possible. The bidder shall indicate, as to how reliable functioning of the charger is achieved. He shall also indicate the quality control adopted for the reliable product.

The battery charging equipment shall comprise of a selenium/solid state silicon rectifier suitable for operation on 230/250 Volt Single Phase AC system. Associated transformer, regulatory resistance, switches etc. shall be accommodated in a sheet steel cubicle arranged for continuous load of 3 Amps. Adjustable from 0 to 3 Amps trickle charge of the battery and manual provision to operate at a higher voltage to recharge the battery of 100 AH capacity quickly at 10 Amp rate.

The equipment shall comprise of:-

1. AC mains switch/MCB 230/250 Volt Single Phase with fuses/MCB
2. Pilot lamp/LED type to indicate AC supply ON.
3. Ballast choke
4. Single Phase Double Wound Transformer for rectifiers
5. Main transformer single phase variac with rough and fine control to charge battery in steps of 6-12, 12-18, 18-24, 24-30, 30-36, 36-42 volts.
6. Full wave bridge connected plate/solid state silicon rectifier
7. Fuses for rectifier output
8. Moving Coil Ammeter 96-mm sq. flush mounting type (0-15 Amps.)
9. Moving Coil Voltmeter 96 mm sq flush mounting type (0-50 Volts)
10. Voltmeter fuses
11. DC ON/OFF switches with fuses.

The sheet steel cubicle of the rectifier unit shall also accommodate the switches for charge rate selection, incoming from battery and various apparatus for battery control.

The chargers should have in-built automatic input voltage stabilizer in the range of 180 volt to 275 volt to facilitate steady output voltage and current from the charger.

5. CABINET

The charger shall be enclosed in a cabinet made of sheet steel of not less than 1.5 mm thickness and should be suitable for mounting on a plane surface/floor with ventilation louvers on two sides and finish painted with synthetic enamel paint of white on inside and opeline green on outside. Two coat of zinc primer shall be applied before finishing synthetic enamel paint. The cabinet shall have vermin proof construction. The cabinet legs shall be of adequate height and strength and should provide minimum clearance of 100 mm from ground.

6. FRONT PANEL MOUNTINGS

The following provisions conforming to relevant ISS shall be made on the front panel:

1. Voltmeter to indicate battery/charger DC voltage
2. Voltmeter to indicate incoming AC voltage
3. Ammeter to indicate charging/load current
4. Indicating LEDs to indicate:-
 - a. Supply of power;
 - b. Charger on;
 - c. Input voltage less than 180 Volt
5. Audio/Visual alarm to indicate:-
 - a. Power failure;
 - b. Charger failure;
 - c. Battery disconnection/failure;
 - d. Battery reverse; and
 - e. DC under/Over voltage.

In case of failure of charger on fault, it should give buzzer as well as LED indication. However, the buzzer alarm should be provided with a reset switch. The indicating instruments shall be of class 1.0 accuracy

7. TRANSFORMER

The power transformer rectifier unit of the battery charger shall be designed for adequate VA rating but in any case it should not be less than 700 VA and should be rated for 300 V at factor of safety of 3. The heat dissipation and power control system should be designed with a factor of safety of 8. Rating of silicon diode should not be less than 15 A.

Please note, necessary documentary evidence, showing transformer rating of 700 VA along with test certificate from manufacturer, if bought-out, shall be enclosed, for approval of the owner.

8. PROTECTION

The charger should have built-in reverse polarity protection with indication lamp so as to protect the battery from high drains. The charger should also have MCB in the output circuit for protection from short circuits.

9. LIGHT EMITTING DIODES

For the purpose of indication LED indicators shall be provided.

10. SWITCHES AND FUSES

Control and instruments switches shall be of toggle type. All fuses shall be of HRC type and of English Electric/L&T make only.

11. LABELS

All front panel mounted equipment as well as the equipment mounted inside the cabinet shall be provided with individual labels with equipment designation engraved on aluminium plate (stickers are not acceptable).

12. WIRING

The charger shall be supplied completely wired ready for external connections at the terminal blocks. All the wiring shall be carried out with 1100 V Grade PVC insulated standard copper conductor of 2.5 Sq.mm. Colour coded wires should be used to facilitate easy tracing, as under :-

A. Single Phase AC Circuit:-

1. Red for Phase
2. Green for Earthling
3. Black for Neutral

B. D.C. Circuit:-

1. Red for Positive
2. Black for Negative

C. Control Wiring:- Gray for annunciation and other control circuits.

13. FERRULES

Engraved core identification ferrules, marked to correspond with the wiring diagram shall be fitted at both ends of each wire.

14. EARTHING TERMINALS

The battery charger cabinet shall be provided with two separate suitable earthing terminals of good quality and adequate size.

15. TESTING

The manufacturers on each battery charger shall carry out the following tests and copy of the tests certificate for each charger shall be submitted:-

1. Checking of wiring and continuity of circuits and visual inspection
2. High voltage test on the equipment with accessories. (All equipment and wiring should be tested for with-standing the power frequency voltage of 2 KV r.m.s. for 20 seconds.)

3. Checking of charging current and load currents.
4. Checking of relays operation, alarm circuit operation, lamp indication, charger failure, mains failure, load fuse failure and annunciation (manufacturer's test certificate for the instruments shall also be furnished).
5. Regulation and Ripple tests.
6. Efficiency test.
7. Burn-out/Heat-run test (for 10 Hrs.)

16. CIRCUIT DIAGRAM AND WRITE-UP

It is desired that the complete schematic of the charger is provided on a permanently laminated/engraved plate of suitable thickness, which has to be bolted/riveted at the four corners on the inside face of rear door. In addition, one more plate of similar type and dimension shall be provided on the outside of the rear door providing guidelines and instructions for operation of the charger. The guidelines and schematic to be provided on the plates shall be as per our approval for which separate drawings shall furnish, after award of contract.

17. TERMINALS

Separate terminals shall be provided for connecting load and battery leads to the charger. All terminals shall be of M12 size. Suitable copper lugs for connecting the load wiring are to be provided.

It would be the bidder responsibility to prove the adequacy of its design by submitting all technical particulars and relevant graphs to show suitability of charger for supplying load on continuous basis.

18. PRINTED CIRCUIT BOARD

The printed circuit boards should be made out of glass fiber re-in forced epoxy boards and should be coated with suitable protective coating for protection against humidity and corrosion.

19. POLARITY MARKING

The polarity marking of the terminals shall be marked for identification. The positive terminal may be identified by "P" or (+) sign or red colour mark and the negative terminal may be identified by "N" or (-) or blue colour. Terminal marking shall be permanent and non-deteriorating.

20. MANUAL OF INSTRUCTIONS

The manufacturer shall supply a copy of the Instruction Manual for commissioning and initial testing of the charger and maintenance during service with every charger supplied.

21. PACKINGThe charger shall be securely packed in wooden crates suitable for handling during transit by rail/road so as to avoid any loss or damage during transit.

11. LT upto (1100 V) XLPE Insulated

1.0 SCOPE:

1.1 The scope of this specification covers the design, manufacture inspection and testing the finished ISI marked LT (1100 volts, 31/2 x25 Sq.mm to 400 Sq.mm stranded, compact aluminum conductor, with XLPE insulated, PVC inner sheathed, galvanized steel strip armored/unarmoured and overall PVC sheathed Black colour cable conforming to IS:7098 /88 with latest amendments and as per specification detailed.

2.0 RATED VOLTAGE:

2.1 The rated voltage of the cable shall be 1100 Volts AC with the highest system voltage of 1100 Volts between phases of the effectively earthed three-phase transmission system.

2.2 The cables shall be capable of operating continuously under the system frequency variation of ± 3 Hz, voltage variation of $\pm 10\%$ and a combined frequency – voltage variation of $\pm 10\%$.

3.0 APPLICABLE STANDARDS:

i) Unless otherwise stipulated in the specifications, the latest version of the following Standards shall be applicable:

IS 7098 (Part 2)-Cross-linked Polyethylene insulation for Cables.

IS 8130-Conductors for insulated electrical cables and flexible cords.

IS 10810(series)-Methods of tests for cables.

IS 10418-Drums for electric cables.

IS 3975-Specification for mild steel wires, strips and tapes for armouring of cables.

IS 5831-Specification for PVC insulation sheath for electric cables.

IS 10462-Fictitious calculation method for determination of dimensions of protective coverings of cables Part 1 - Elastomeric and thermoplastic insulated cables.

ii) The cables manufactured to any other International Standards like BSS, IEC or equivalent standards not less stringent than Indian Standards are also acceptable. In such cases the Manufacturer shall enclose a copy of the equivalent international standard, in English language.

4.0 CONSTRUCTION:

4.1 Conductor: - The cable conductor shall be made from stranded aluminum to form compact sector shaped conductor having resistance within the limits specified in IS:8130/1984 and any amendment thereof. The wires shall be laid up together with a suitable right hand lay. Stranded Class 2 – as per the IS:8 130 / IEC 60228/ BS 6360 standards.

4.2 Insulation: - The insulation shall be cross linked polyethylene applied by extrusion and shall be steam (wet) cured as per IS:7098(1)1988 and curing in hot water tank/bath is not accepted.:

Sl.No.	Properties	Requirements
1.	Tensile Strength	12.5N/mm ² , Min.
2.	Elongation to break	200 percent, Min
3.	Aging in air oven:	

	a) Treatment: Temperature: Duration:	135±3°C 7 days
	b) Tensile Strength variation:	±25 percent, Max
	c) Elongation variation:	±25 percent, Max
4.	Hot set: a) Treatment: Temperature: Time under load Mechanical stress	200±3°C 15 min 20N/cm ²
	b) Elongation under load	175 percent, Max
	c) Permanent elongation (set) after cooling	15 percent, Max
5.	Shrinkage: a) Treatment: Temperature Duration	130±3°C 1 hour
	b) Shrinkage	4 percent, Max
6.	Water absorption (Gravimetric): a) Treatment: Temperature: Duration	85±2°C 14 days
	b) Water absorbed	1 mg/cm ² , Max
7.	Volume Resistivity a) at 27°C b) at 70°C	1x10 ¹⁴ ohm-cm, Min 1x10 ¹³ ohm-cm, Min
8	Thermal Resistivity	350 degrees C cm/W
9	Powerfactoratmaximumconductor temperature	0.008
10	Dielectric strength	22 kV/mm

- 4.3.1 The XLPE insulation should be suitable for specified 1.1 KV system voltage.
- 4.3.2 The manufacturing process shall ensure that insulations shall be free from voids.
- 4.3.3 The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions.
- 4.3.4 The insulation of the cable shall be high stranded quality, specified in IS:7098 (Part-II/1985). Withstand continuous conductor temperature of 90 deg C, which means higher continuous rated current carrying capacity.
- 4.3.5 The cables can operate even at conductor temperature of 130 deg C continuously and 250 deg C during a Short Circuit condition
- 4.4 **SHEATH :**
The sheath shall be suitable to withstand the site conditions and the desired temperature. It should be of adequate thickness, consistent quality and free from all defects. The PVC sheath shall be extruded as per IS:7098 (Part – I/1988). IEC:60502 Part– I, BS:6622, LSOH to BS:7835.
- 4.5 **ARMOUR :**
Armoring shall be applied over the inner sheath with single galvanized steel complying with the requirements of IS:3975/1979. The dimensions of the galvanized strip shall be as specified in table 4 of the IS:7098/Part-I/1988. The armour wire shall be applied as closely as practicable. The direction of the lay of the armour shall be left hand. The joints in armour wire shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any wire shall be atleast 300mm from the nearest joint in any other armour wire in the complete cable and shall be as per IS:7098 Part 1, IS: 3975.

The cable without armouring shall also be accepted of type detailed in price schedule.

4.6 OUTER SHEATH : Extruded PVC ST2, outer sheath as per IS:5831/1984, IS:7098

Part 1, IEC:60502 Part – 1, BS:6622, LSOH to BS:78 35. shall be applied over armoring with suitable additives to prevent attack by rodents and termites. Outer sheathing shall be designed to offer high degree of mechanical protection and shall also be heat, oils, chemicals, abrasion and weather resistant. Common acids, alkalis, saline solutions etc., shall not have adverse effects on the PVC sheathing material used.

4.7 The cables should be suitable for use in solidly earthed system.

4.8 The power cables shall be manufactured to the highest quality, best workmanship with scientific material management and quality control. The Manufacturer shall furnish the quality plan, giving in detail the quality control procedure / management system.

4.9 The cable shall be suitable for laying in covered trenches and/or buried underground to meet the outdoor application purposes.

4.10 The parameters of the LT power cables to be supplied shall be as specified below

Nom. cross sectional area (Sq.mm)	Nom. Thickness of XLPE Insulation mm main core	Armoured			Max.DC Conductor Resistance at 20°C (ohm/km)	AC current rating	
		Nom. Steel Armour size (mm)	Approx. Overall dia. (mm)	Approx. Weight (kg/km)		In air (amps)	In Grpund (amps)
25	0.90	4 X 0.8	22.8	821.0	1.200	95	97
35	0.90	4 X 0.8	24.9	961.0	0.868	117	116
50	1.00	4 X 0.8	28.1	1195.0	0.641	140	134
70	1.10	4 X 0.8	33.0	1569.0	0.443	176	167
95	1.10	4 X 0.8	35.8	1903.0	0.320	221	199
120	1.20	4 X 0.8	39.0	2303.0	0.253	258	227
150	1.40	4 X 0.8	42.9	2720.0	0.206	294	255
185	1.60	4 X 0.8	47.5	3276.0	0.164	339	287
240	1.70	4 X 0.8	52.7	4048.0	0.125	402	333
300	1.80	4 X 0.8	58.4	4872.0	0.100	461	375
400	2.00	4 X 0.8	65.6	6101.0	0.0778	542	426

4.11 The short circuit current of the LT cable to be as specified below

Sq.mm of LT Cable	Short Circuit Current (KA)
25	2.420
35	3.370
50	4.790
70	6.680

95	9.030
120	11.400
150	14.200
185	17.500
240	22.600
300	28.200
400	37.600

5.0 SYSTEM DETAILS:

General Technical particulars

Nominal system voltage (rms) (U)	0.44KV
Highest system voltage (rms) (U _m)	1.1 KV
Number of Phase	3
Frequency	50Hz
Variation in Frequency	+/- 3%
Type of Earthing	Solidly Earthed
Total relay & circuit breaker Operating time	15 – 20 cycles

6.0 CLIMATIC CONDITIONS:

(a) Maximum ambient air temperature (in shade)	45 ⁰	C
(b) Maximum ambient air temperature (under sun)	50 ⁰	C
(c) Maximum daily average ambient air temperature	35 ⁰	C
(d) Maximum yearly average ambient air temperature	30 ⁰	C
(e) Maximum humidity	100%	
(f) Altitude above M.S.L.	Up to 1000M	
(g) Average No. of thunder storm days per annum	50	
(h) Average No. of dust storm days per annum	Occasional	
(i) Average No. of rainy days / annum	90	
(j) Average Annual Rain fall	925mm	
(k) Normal tropical monsoon period	4 months	
(l) Maximum wind pressure	150 kg/Sq.M	

7.0 DESIGN CRITERIA:

- i. The cables that are covered in these specifications are intended for use outdoor , under the climatic conditions and installation conditions described in the technical specification.
- ii. For continuous operation of the cables, at specified rating, the maximum conductor temperature shall be limited to the permissible value as per the relevant standard, generally not exceeding 90°C under normal operation and 250°C under short – circuit conditions.
- iii. The cables in service will be subject to daily load cycles, of two peaks during a day; morning peak and evening peak, with around 25% to 50% loading during the nights.
- iv. The materials used for outer sheaths shall be resistant to oils, acids and alkalis.
- v. The cables shall have the mechanical strength required, during handling and laying.

- vi. The cables shall be designed to withstand the thermo-mechanical forces and electrical stresses during normal operation and transient conditions.
- vii. The cables shall be designed to have a minimum useful life span of Thirty-five years.
- viii. The detailed design drawings shall be submitted along with Purchase order.

8.0 MANUFACTURE PROCESS:

Cross-linking of the insulation materials (pre compounded polyethylene) shall be conforming to IS: 7098 (Part – II) and the proof of purchase of the above insulating material shall be submitted and is to be offered for stage inspection..

9.0 MATERIALS:

- 9.1 Conductor: -The conductor shall be of stranded construction. The material for conductor shall consist of the plain aluminum of H2 or H4 grade as per clause – 3 of IS 8130/ 1984.
- 9.2 The minimum number of wires shall be 53 for circular compacted 400 sq. mm aluminum conductor as per table – 2 of IS 8130/ 1984.

10.0 CORE IDENTIFICATION:

- 10.1. The core identification for 31/2 core cables shall be provided, by suitable means, like, by application of individual colour or colored stripes, or by numerals or by printing on the cores as per clause 13 of IS: 7098 - Part 2
- 10.2. For identification of different coloring of XLPE Insulation, or by using colored strips, red, yellow and blue colors respectively shall be used to identify the phase conductors.

11.0 LAYING UP OF CORES:

The cores shall be laid together with a suitable right hand lay. The interstices at the center shall be filled with a non- hygroscopic material.

12.0 INNER SHEATH (COMMON COVERING):

- 12.1 The laid up cores shall be provided with inner sheath applied either by extrusion. It shall be ensured that the shape is as circular as possible. The inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it without damage to the insulation.
- 12.2 The thickness of the inner sheath (common covering) shall be given as follows:

CALCULATED DIAMETER IN MM OVER LAID UP CORES [REF IS 10462 (PART 1)]		THICKNESS OF INNER SHEATH (Min) mm
Over	Up to and including	
–	25	0.3
25	35	0.4
35	45	0.5
45	55	0.6
55	–	0.7

- 12.3 When one or more layers of binder tapes are applied over the laid up cores, the thickness of such tapes shall not be construed as a part of inner sheath.

13.0 **ARMOURING:**

- 13.1 Armouring shall be single strip steel wire applied over the inner sheath as closely as practicable. The direction of the lay of the armour shall be left hand.
- 13.2 The armour shall consist of galvanized strip steel. The dimensions of the galvanized steelwires shall be 4 X 0.8 mm (Nominal)
- 13.3 The joints in the armour strip shall be made by brazing or welding and the surface irregularities shall be removed. A joint in the wire shall be at least 300-mm from the nearest joint in any other wire in the complete cable.
- 13.4 Manufacturers shall furnish the calculation / data sheet for the short circuit carrying capability of the Armour.

14.0 **OUTER SHEATH:**

- 14.4 The outer sheath shall be applied by extrusion. It shall be applied over the armouring shall consist of poly-vinyl chloride (PVC) compound, conforming to the requirements of type ST-2 of IS 5831. Suitable additives shall be added to give anti termite protection.
- 14.5 The minimum thickness of the PVC outer sheath shall be as per IS:10462 and as detailed.

Calculated diameter under the outer sheath [IS 10462 Part 1] – mm		Nominal thickness of the outer sheath (ts) - mm
Over	Up to and including	
–	15	1.24
15	25	1.40
25	35	1.56
35	40	1.72
40	45	1.88
45	50	2.04
50	55	2.20
55	60	2.36
60	65	2.52
65	70	2.68
70	75	2.84
75	–	3.0

14.6 **IDENTIFICATION:**

The outer sheath shall have the following information embossed or indented on it; ISI marking, the manufacturer's name or trade mark, the voltage grade, the year of manufacture and the letters "DDUGJY, Name of Employer" The identification shall repeat every 300/350mm along the length of the cable. Outer sheath of cable shall be black in permanent colour.

15.0 **INSPECTION AND QUALITY CONTROL:**

The Manufacturer shall furnish a complete and detailed quality plan for the manufacturing process of the cable. All raw materials shall conform to relevant applicable standards and tested for compliance to quality and requirement. During the manufacturing process, at all stages, inspections shall be made to check the physical and dimensional parameters, for verification to compliance to the standards. The Manufacturer shall arrange, for inspection by the purchaser, during manufacture with one month

advance notice for verifying the various stage inspections as specified in the quality assurance plan enclosed to verify the quality control process of the Manufacturer.

16.0 TYPE TESTS:

Type test certificates from Accredited NABL Testing Laboratories for 1.1 kV XLPE, shall be submitted along with Purchase order. The Type Tests should have been conducted not later than 5 years as on the date of supply.

16.1 Stage wise Inspection: The Manufacturer shall offer the stage wise inspection as detailed in the in the quality assurance plan

16.2 All acceptance tests shall be conducted in the presence of the Employer's representative.

16.3 The supplier shall give 10 days advance notice for inspections, and witnessing of tests by the Employer representative.

16.4 The following type tests shall be conducted on the cable.

Sl. No.	Test	Requirement	Test method Ref Part no of IS: 10810
a)	Tests on conductor		
	i) Tensile test	IS:8130	2
	ii) Wrapping test	IS:8130	3
	iii) Resistance test	IS:8130	4
b)	Tests for armoured wires and strips	Clause 15.2 & IS:3975	36 to 42
c)	Test for thickness of insulation and sheath	Clause 4.3, 14.2 & 16.2	6
d)	Physical tests for insulation:	Clause 4.2	
	i) Tensile strength and elongation at break		7
	ii) Aging in air oven		11
	iii) Hot test		30
	iv) Shrinkage test		12
	v) Water absorption (gravimetric)		33
e)	Physical tests for outer sheath	IS: 5831	
	i) Tensile strength and elongation at break		7
	ii) Aging in air oven		11
	iii) Shrinkage test		12
	iv) Hot deformation		15
f)	High voltage test	Clause 22.7	45
g)	Flammability test	Clause 22.8	53

17.0 ACCEPTANCE TEST:

17.1 The sampling plan for acceptance test shall be as per IS 7098 part -II, Appendix 'A'.

17.2 The following shall constitute the acceptance test.

- a. Tensile test for aluminum.
- b. Wrapping test for aluminum.

- c. Conductor resistance test.
- d. Test for thickness of insulation.
- (i) Test for thickness of inner and outer sheath.
- (ii) Hot-set test for insulation.
- (iii) Tensile strength and elongation at break test for insulation and outer sheath.
- (iv) High voltage test.
- (v) Insulation resistance (volume resistivity) test.

18.0 ROUTINE TEST:

The following shall constitute routine tests:

- o Conductor resistance test.
- o High voltage test.

19.0 DETAILS OF TESTS:

19.1 Unless otherwise mentioned in this specification, the tests shall be carried out in accordance with appropriate part of IS: 10810.

19.2 High Voltage Test at room temperature:

The cables shall withstand a voltage of 3KV AC (rms) at a frequency of 40 to 60 Hz or an AC voltage of 7.2kV , between conductors and between conductors and ECC (if any) for a period of 5 minutes each test connection.

19.3 Flammability test: Period of burning after removal of the flame shall not exceed 60 seconds and the unaffected (uncharred) portion from the lower edge of the top clamp shall be at least 50-mm.

Employer reserves the right to select a random sample of 1.1 kV UG cable from the Manufacturer's end which are ready to dispatch and also ongoing cable laying works and the same samples will be sent to any testing laboratory as desired by Employer. If the testing results are found to be not satisfactory Employer reserves the right to reject the entire batch of cable received and insists for replacement of material free of cost. The decision of Employer in this regard is final.

20.0 PACKING:

20.1 The cables, as per specified delivery lengths, shall be securely wound /packed in non-returnable wooden drums, capable of withstanding rough handling during transport by Rail, Road, etc. The packing should withstand storage conditions in open yards. The cable drums shall conform to IS 10418-1982 or equivalent standard. The dimensional drawings of wooden drums shall be furnished with the Purchase order. The drum shall be provided with circumferential lagging of strong wooden planks. The end of the cable shall be sealed with good quality heat shrink sealing caps. The sufficiently required additional sealing caps shall be supplied for use of testing during laying and jointing at site and to seal spare lengths of cable. The packing should be able to withstand the rigorous of transport. The following information in bold letters in English shall be painted on the flanges.

- a. Name & Address of the manufacturer, Trade name/Trade mark/Brand
- b. ISI Marking
- c. Size of cable (Cross section) rated voltage, standard, insulation, cable code, drum No., and year of manufacture.
- d. Length of cables (Meters)
- e. Direction of rolling
- i) Net weight (in Kg)
- ii) Gross weight (in Kg)
- iii) Owners purchase order reference.

21.0 SEALING OF CABLE ENDS ON DRUMS:

21.1 The cable ends shall be sealed properly so that ingress of moisture is completely prevented. The individual core endings shall be sealed effectively with water resistant compound applied over the core

and provided with a heat shrinkable or push-on or Tapex or cold shrinkable type cap of sufficient length with adequate cushion space so that the conductor does not puncture the cap in case of movement of the core during unwinding or laying. Before sealing, the semi conducting layer on the cores may be removed for about 2 mm at each end, to facilitate checking the insulation resistance from one end, without removing the sealing cap at the other end.

- 21.2 The three cores should have an overall heat shrinkable or push-on or Tapex or cold shrinkable type cap with adequate end clearance, and sufficient cushioning to prevent puncturing of the overall sealing cap due to stretching of the cores. The sealing cap shall have sufficient mechanical strength and shall prevent ingress of moisture into the cable. The ends of single core cables shall also be sealed on the same lines to prevent entry of moisture.

22.0 CABLE LENGTHS:

The cables shall be supplied in continuous lengths of 500 m or more with 5% tolerance and cable shall on the wooden drums only.

23.0 QUANTITY TOLERANCE:

A +3% tolerance shall be allowed on the ordered quantity including 300-m cable as spare.

24.0 MARKING:

- 24.1 The packed cable drum shall carry the following information, clearly painted or stenciled.

- a. The letters 'DDUGJY, Name of Employer'
- b. Reference to Standard and ISI mark.
- c. Manufacturer's Name or trade mark.
- d. Type of cable & voltage grade.
- e. Number of cores.
- f. Nominal cross-sectional area of conductor.
- g. Cable code.
- h. Length of cable on the drum.
- i. Direction of rotation.
- j. Gross weight.
- k. Country of Manufacture.
- l. Year of Manufacture.
- m. Purchase order and date.
- n. Address of consignee.

25.0 GUARANTEED TECHNICAL PARTICULARS:

The manufacturer, shall furnish the guaranteed technical particulars of the cable offered in the GTP format provided.

26.0 DRAWING & LITERATURE:

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

- 27.0 **GUARANTEE:** The cable manufactured shall be guaranteed for the period of 18 months from the date of receipt at stores.

- 28.0 The Manufacturer shall furnish a copy of valid BIS licence for ISI marking without which the cable shall not be accepted.

GUARANTEED TECHNICAL PARTICULARS FOR 1.1 KV

	Manufacturer's Name		
	Class of Power Cable		
1	Name of the Manufacturer and country of origin		
2	Country of Manufacture		
3	Type of cable / cable code		
4	Applicable standard		
5	Voltage		
	a. Rated Nominal voltage		
	b) Rated Maximum voltage		
6	Suitability for :		
	a. Earthed system		
7	Conductor		
	a) Nominal cross section (sq.mm)		
	b) Material		
	c) Shape		
	d) Diameter of conductor (mm)		
	e) Number of wires per conductor (Nos.)		
	f) Nominal diameter of wire in conductor (mm)		
8	Insulation XLPE		
	a) Curing process (furnish details separately)		
	b) Material/Composition		
	c) Dia over insulation		
	i. Nominal (mm)		
	ii. Average (mm)		
	iii. Minimum (mm)		
9	Inner sheath		
	a) Type / composition		
	b) Material		
	d) Tolerance on thickness		
	e) Diameter of cable over sheath (mm)		
10	Armouring		
	a) Material		
	b) Dia of wire		
	Nom. (mm)		
	Min. (mm)		

11	Outer sheath		
	a) Type / composition		
	b) Material		
	c) Nominal thickness		
	d) Tolerance on thickness		
	e) Diameter of cable over sheath (mm)		
12	Anti-thermite treatment to outer sheath		
	a) Material		
	External overall dia of cable		
	Short circuit rating of conductor 90 deg. C operating temperature for 1 Sec.		
13	Minimum cable bending radius (in terms of cable diameter)		
14	Permissible maximum tension		
15	Continuous current rating under specified insulation conditions at conductor temperature of 65 deg. C and 90 deg. C.		
16	Ground Temperature 30 deg. C		
17	Thermal resistivity of soil 150 deg. C CM/W		
18	Depth of laying 200 mm		
19	Ambient Air temperature 40 deg. C		
20	No. of circuits 1 OR 2		
21	Spacing between two circuits		
22	Formation		
23	Maximum permissible conductor temperature for continuous operation under specified installation conditions (deg. C)		
24	Conductor temperature at rated current (deg. C)		
25	Basic impulse level at conductor temperature of 90 deg. C (KV)		
26	Impulse wave shape		
27	Power frequency with stand voltage (KV)		
28	Tan Delta at 50 Hz (at U.KV and 90 (-5/+10) deg. C		
29	Sheath voltage at max. load		
30	Withstand voltage of sheath on spark test		
31	Permissible short circuit current ratings of conductor		
	i) 0.1 Sec KA		
	ii) 0.2 Sec KA		
	iii) 0.5 Sec KA		

	iv) 1.0 Sec KA		
32	Conductor resistance DC & AC		
	a) at 20 deg. C (d.c)/A.C. ohm/KM		
	b) at 90 deg. C (d.c)/A.C. ohm/KM		
	c) at 105 deg. C (d.c)/A.C. ohm/KM over load temp) a.c. (ohm)		
33	Equivalent star resistance at 50 Hz of 3 phase current		
	a) at 20 deg. C (d.c)/A.C. ohm/KM		
	b) at 90 deg. C (d.c)/A.C. ohm/KM		
	c) at 10% continuous overload temperature (ohm/KM)		
34	Star reactance at 50 hz (ohm/KM)		
	Approximate impedance at 50 hz per KM		
	a. at 20 deg. C ohm/KM		
	b. at 90 deg. C ohm/KM		
	c. at 10% continuous overload temperature (ohm/KM)		
35	Self-electrostatic capacitance per phase (Micro farad/KM)		
36	Maximum power factor at charging KVA of cables when laid direct in ground at normal voltage & frequency		
	a) at ambient Temperature		
	b) at Maximum conductor Temperature		
37	Impedance		
	a) Positive and negative sequence impedance 37 (ohm/KM)		
	b) Zero sequence impedance (ohm/KM)		
	c) Zero sequence data		
38	Series reactance / Resistance		
	a) Series resistance (ohm/KM)		
	Series reactance (ohm/KM)		
	Shunt capacitive reactance (ohm/KM)		
39	Sheath resistance at 20 deg. C ohm/KM		
40	Surge impedance of cable (ohm/KM)		
41	IR value at amient temperature per KM		
	Maximum magnitude of partial discharge at 1.5 U.o		

	At Ambient Temperature (Po)		
	At High Temperature (Po)		
	Losses per Km.		
	NOTE : (i) Cable Conductor size 400 sq. mm		
	a) Total 3 phase dielectric loss		
	i. One circuit alive Kw/KM		
	ii. Both circuits alive KW/KM on each circuit		
	b) Total 3 phase resistive loss		
	i. One circuit alive Kw/KM		
	ii. Both circuits alive KW/KM on each circuit		
	c) Total 3 phase sheath / screen loss		
	i. One circuit alive Kw/KM		
	ii. Both circuits alive load KW/KM on each circuit		
42	d) Other losses due to reinforcement		
43	One circuit alive KW/KM		
	Both circuits alive KW/KM on each circuit		
	Total losses		
44	i. One circuit alive KW/KM		
	ii. Both circuits alive KW/KM		
	Charging current at rated voltage per Km (Amps)		
45	Short circuit capacity of conductor for one second at 90 deg. C prior to short circuit and 250 deg. C during short circuit (KA)		
	Screening factor of cable for calculating interference on control and communication cables :		
	Approximate value of attenuation of carrier current signals operating over a frequency range		
46	i. 50 KC/s- dB/KM		
	ii. 100 KC/s- dB/KM		
	iii. 150 KC/s- dB/KM		
	iv. 200 KC/s- dB/KM		
	Shipping weight and size of cable drum		
	a) Size of Drum		
47	i. Dia of Drum (M)		
	ii. Width of Drum (M)		
	iii. Gross Weight (Kgs)		
	iv. Length of cable per Drum(M)		
	v. Weight of Cable (Kg/M)		

Current Rating Factor

Particulars	Single Point Bonded		Both End Bonded	
	65 deg. C Amps	90 deg C Amps.	65 deg. C Amps	90 deg. C Amps
Current Rating conductor size 400 Sq. mm				
a) In Ground				
i. Of each circuits (when both the circuits alive)				
b) In Duct				
i. Of each circuits (when both the circuits alive)				
ii. Of one circuits (when other circuit is isolated)				
c) In pipe, one cable per pipe.				
i. Of each circuits (when both the circuits alive)				
ii. Of one circuits (when other circuit is isolated)				
d) In Air				
i. Of each circuits (when both the circuits alive)				
ii. Of one circuits (when other circuit is isolated)				

Derating Factors

1. VARIATION IN GROUND TEMPERATURE :							
Ground Temperature (deg. C) :	15	20	25	30	35	40	45
Rating Factor							
2. VARIATION IN DEPTH OF LAYING :							
Depth of Laying (Meters):	0.7	0.9	1.0	1.2	1.3	1.5	
Rating Factor							
3. VARIATION IN THERMAL RESISTIVITY OF SOIL							
Thermal Resistivity of Soil : (deg. C cm/watt)	100	120	150.0	200	250		
Rating Factor							
4. VARIATION IN AIR TEMPERATURE :							
Air Temperature (deg. C) :	25	30	35	40	45	50	55

Rating Factor							
5. VARIATION DISTANCE (MM) :							
Axial Distance (mm) Between circuits :	100	200	300.0	400	600	800	
Rating Factor							

AB CABLE

A. AERIAL BUNCHED CABLES FOR 33KV LINES

SCOPE:

This specification covers requirements of XLPE insulated, 33 kV Aerial Bunched Cables for overhead lines.

1. Qualifying Requirement of AB Cable Manufacturer/Supplier

The manufacturer should have manufactured, successfully type tested and supplied at least one hundred (100) kms of 33 kV or above voltage grade XLPE armoured and/or AB Cable in the last five (5) years as on the date of bid opening.

2. COMPOSITION OF THE CABLE

The Composite cable shall comprise three single-core cables twisted around a bare aluminium alloy messenger wire, which will carry the weight of the cable.

3. RATED VOLTAGE

The rated voltage of the cables shall be 33 kV and the maximum operating voltage shall be 36 kV.

4. APPLICABLE STANDARDS

Unless otherwise stipulated in this Specification, the following standards shall be applicable:

- i) IS: 7098 (part-II) – 1985 – Cross linked Polyethylene Insulated PVC Sheathed Cables.
- ii) IS:9130-1984-Conductors for Insulated Cables
- iii) IS: 398 (Part-IV) – 1979 – Aluminium Alloy Conductors.

5. DETAILS OF SINGLE CORE CABLE

5.1 The cable conductors shall be or round standard and compacted aluminium, of nominal cross sectional area 95 mm².

5.2 Conductor Screen

The conductor screen shall be of extruded semi-conducting cross linked polyethylene compound of thickness as per relevant IS.

5.3 Insulation

The Insulation shall be of extruded cross linked polyethylene (XLPE) of nominal insulation thickness as per relevant IS and its properties shall conform to IS:7098 (Part-II).

5.4 Insulation Screen

The insulation screen shall be as per IS:7098 (Part-II).

5.5 Outer Sheath

The outer sheath shall be black polyethylene.

6. MESSENGER (NEUTRAL CONDUCTOR)

6.1 The bare messenger wire shall be of 120 mm² (nominal area) aluminium alloy, generally conforming to IS:398 (Part IV) – 1979, comprising multi strands and shall be suitably compacted to have smooth round surface to avoid damage to the outer insulating sheath of single-core phase cables twisted around the messenger.

6.2 There shall be no joints in any wire of the stranded messenger conductor except those made in the base rod or wire before finally drawing.

7. TESTS

7.1 The following tests shall be carried out on the single-core cables as per IS-7098 (Part-II).

7.1.1 Type Tests

a) Tests on conductor:

- i) Tensile test
- ii) Wrapping test
- iii) Resistance test

b) Tests for thickness of insulation and sheath

c) Physical tests for insulation:

- i) Tensile strength and elongation at break
- ii) Ageing in air oven
- iii) Hot test
- iv) Shrinkage test
- v) Water absorption

d) Tests for outer sheath:

- i) Tensile strength and elongation at break
- ii) Ageing in air oven
- iii) Shrinkage test
- iv) Hot deformation
- v) Bleeding and blooming test.

e) Partial discharge test

f) Bending test

g) Dielectric Power factor test:

- i) As a function of voltage
- ii) As a function of temperature

h) Insulation resistance test

g) Heating cycle test

k) High voltage test

l) Flammability test

7.1.2 Acceptance Test

- a) Tensile Test
- b) Wrapping Test
- c) Conductor resistance test
- d) Test for thickness of insulation and sheath
- e) Hot set test for insulation
- f) Tensile strength and elongation at break test for insulation and sheath
- g) Partial discharge test
- h) High voltage test
- i) Insulation resistance (volume resistivity) test

7.1.3 Routine Tests

- a) Conductor resistance test
- b) Partial Discharge Test
- c) High voltage test

7.2 The following tests shall be carried out on the bare messenger wire in accordance with IS:398 (Part-IV).

Type Tests/Acceptance Test

- a) Breaking Load Test (on finished wire)
- b) Elongation Test
- c) Resistance Test

8. PACKING AND MARKING

8.1 Packing

Cables shall be supplied in returnable wooden drums conforming to IS: 10418. The standard length of the bunched cable in each drum shall be 250 meters (+/-) 10%. Other lengths may be acceptable subject to the approval of employer/purchaser.

8.2 Marking

The Cable drum shall carry the information as per the requirements of IS: 7098 (Part-II). However, exact details of marking/embossing, color of outer sheath etc. will be as per the detailed purchase order.

8.3 Suitable identification marks shall be given on the outer sheath to clearly distinguish three phases of the bunched cable.

B. AERIAL BUNCHED CABLES FOR 11KV LINES

SCOPE: This specification covers requirements of XLPE insulated, 11kV Aerial Bunched Cables for overhead lines.

1.0 Qualifying Requirement of ABCable Manufacturer/Supplier

The manufacturers should have manufactured, successfully type tested and supplied at least one hundred (100) km of 11kV or above voltage grade XLPE armoured and/or ABCable in the last five (5) years as on the date of bid opening.

2. COMPOSITION OF THE CABLE

The composite cables shall consist of three single-core cables twisted around a bare aluminium alloy messenger wire, which will carry the weight of the cable.

3. RATED VOLTAGE

The rated voltage of the cables shall be 6.35kV/11kV and the maximum operating voltage shall be 12kV

4. APPLICABLE STANDARDS

Unless otherwise stipulated in this specification, the following standards shall be applicable:

- i) IS: 7098 (part-II)–1985 –Cross linked Polyethylene Insulated PVC Sheathed Cables
- ii) IS: 8130-1984-Conductors for Insulated Cables
- iii) IS: 398(Part-IV)–1979 –Aluminium Alloy Conductors

5. DETAILS OF SINGLE CORE CABLE

5.1 The cable conductors shall be of round, stranded and compacted aluminium of nominal cross sectional area 35mm² and 70mm². Corresponding nominal conductor diameter and number of wires in the conductor shall be as given in clause 5.7.

5.2 Conductor Screen

The conductor screens shall be of extruded semi-conducting crosslinked polyethylene compound of thickness not less than 0.5 mm.

5.3 Insulation

The insulation screen shall be as per IS: 7098 (Part II).

5.4 Insulation Screen

The insulation screen shall comprise extruded semi-conducting compound and/or semi-conducting tape. Thickness of the screen shall be not less than 0.6 mm.

5.5 Outer Sheath

The outer sheath shall be black polyethylene.
The nominal thickness of sheath shall be 1.8mm and it shall conform to the technical requirements of ST-3 of EIC-502

5.6 Dimensional and Electrical Data

The Dimensional and Electrical Data for single-core cable is given below:

S.No.	Description	Nominal area of conductors	
		35 mm ²	70mm ²
I.	Nominal conductor diameter(mm)/No. of wires in conductor	6.8/6	10/12
II.	Approx over dia of cable (mm)	22	25
III.	Max D.C. resistance at 20°C Ohm/Km	0.868	.443
IV.	Max SC current for 1 Sec. KA	3.4	6.7
V.	Max continuous load (amps)	106	156

Note: Due to limitation of short circuit current rating, it is recommended that 70mm² cable is used the base line for the first 4-

5kms from the 33/11kV substation and thereafter the lower size of cable i.e. 35mm² can be used depending upon the line loading. Normally the current loading of 70mm² cable should not exceed 145amps and that of 35mm² cable as 95amps. For a maximum ambient temperature of 50°C.

6. MESSENGER (NEUTRAL CONDUCTOR)

6.1 The bare messenger wire shall be of 70mm² (nominal area) aluminium alloy, generally conforming to IS: 398 (Part IV) –

1979, comprising of seven (7) strands and shall be suitably compacted to have smooth round surface to avoid damage to the outer insulating sheath of single-core phase cables twisted around the messenger.

6.2 There shall be no joints in any wire of the stranded messenger conductor except those made in the base rod or wire before finally drawing.

6.3 The technical characteristics of messenger wire shall be as follows:

i.	Nominal sectional area (mm ²)	70
ii.	Nos. of wire	7
iii.	Nominal dia of wires / compacted conductor (approx.) mm	3.5/10
iv.	Approx. Mass kg/Km	184
v.	D.C. resistance at 20°C Ohm/Km	0.493
vi.	Breaking load (KN)	20
vii.	Modulus of elasticity (approx) KN/mm ²	59
viii.	Coefficient of linear expansion	22 × 10 ⁻⁶ /°C

Note: the value of item vi above is to be guaranteed. A tolerance of (-)5% is permissible on the value in item vi above.

7. DESIGNATION AND PARAMETER OF FINISHED CABLES

The designation and parameter of finished cables are given in the following table:

S.No.	Designation	Complete bunched cables	
		Overall dia approx mm	Total mass (Approx.) Kg/Km
I.	3x35+70	53	1450
II.	3x70+70	59	1900

Note: the first part of the designation refers to the number and size of phase conductor and the second to the size of messenger wire. The sizes shown represent the nominal cross-sectional area in mm.

8. TESTS

8.1 The following tests shall be carried out on the single-core cables as per IS-7098 (Part-II).

8.1.1 Type Tests

- a) Tests on conductor:
 - i) Tensile test
 - ii) Wrapping test
 - iii) Resistance test
- b) Tests for thickness of insulation and sheath
- c) Physical tests for insulation:
 - i) Tensile strength and elongation at break
 - ii) Agency in air oven
 - iii) Hottest
 - iv) Shrinkage test
 - v) Water absorption
- d) Tests for outer sheath:
 - i) Tensile strength and elongation at break
 - ii) Ageing in air oven
 - iii) Shrinkage test
 - vi) Hot deformation

- vii) Bleeding and blooming test.
- e) Partial discharge test
- f) Bending test
- g) Dielectric Power factor test:
 - i) As a function of voltage
 - ii) As a function of temperature
- h) Insulation resistance test
- g) Heating cycle test
- k) High voltage test
- l) Flammability test

8.1.2 Acceptance Test

- a) Tensile Test
- b) Wrapping Test
- c) Conductor resistance test
- d) Test for thickness of insulation and sheath
- e) Hot set test for insulation
- f) Tensile strength and elongation at break test for insulation and sheath
- g) Partial discharge test
- h) High voltage test
- i) Insulation resistance (volume resistivity) test

8.1.3 Routine Tests

- a) Conductor resistance test
- b) Partial Discharge Test
- c) High voltage test

8.2 The following tests shall be carried out on the bare messenger wire in accordance with IS: 398 (Part-IV).

Type Tests/Acceptance Test

- a) Breaking Load Test (on finished wire)
- b) Elongation Test
- c) Resistance Test

9. PACKING AND MARKING

9.1 Packing

Cables shall be supplied in returnable wood end drums conforming to IS: 10418. The standard length of the bunched cable in each drum shall be 1000 meters (+/-) 10%. Other lengths may be acceptable subject to the approval of employer/purchaser.

9.2 Marking

The Cable drum shall carry the information as per the requirements of IS: 7098 (Part-II). However, exact details of marking/embossing, color of outer sheath etc. Will be as per the detailed purchase order.

9.3 Suitable identification marks shall be given on the outer sheath to clearly distinguish three phases of the bunched cable.

12. LT Aerial Bunched Cables
 (APPLICABLE FOR LT AB CABLE WITH XLPE INSULATION ONLY)

1. SCOPE:

This specification covers XLPE insulated Aluminum cable twisted over a central bare Aluminum Alloy messenger wire for use of L.T. Over-Headlines in Rural Electrification System. The Aerial Bunched cable and messenger wire should be conforming to IS.

(Sizes: of the cable)

- 1.01 1X16 (Ph) + 1X25 (bare messenger cum neutral) SQ. MM.
- 1.02 1X16 (Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting)SQ. MM.
- 1.03 3X16(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 1.04 3 X 16(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 1.05 1X25(Ph)+1x25 (bare messenger cum neutral) SQ. MM.
- 1.06 1X25(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 1.07 3X25(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 1.08 3 X 25(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 1.09 1X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 1.10 1x35(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 1.11 3X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 1.12 3X35 (Ph) + 1x25 (bare messenger cum neutral)+ 1x16 (insulated Street lighting) SQ. MM.
- 1.13 3X50(Ph)+1X35 (bare messenger cum neutral) SQ. MM.
- 1.14 3X50 (Ph)+1x35 (bare messenger cum neutral) +1x16 (insulated Street lighting) SQ. MM.
- 1.15 3X95(Ph)+1X70 (bare messenger cum neutral) SQ. MM.
- 1.16 3X95(Ph)+1X70 (bare messenger cum neutral) SQ. MM.+1x16 (insulated Street lighting)SQ. MM.

2. RATED VOLTAGE:

The rated voltage of the AB cables shall be 1100 volts

3. APPLICABLE STANDARDS:

Unless otherwise stipulated in this specification the following Standards shall be applicable.

- i) IS – 14255/1995 : ABC cables 1100 volts.
- ii) IS – 8130/1984 : Conductors for insulated cables.
- iii) IS – 398/Pt.IV/1994: Aluminium alloy conductor.
- iv) IS – 10418/1982 : Drums for electric cables

4. GENERAL:

The AB cable covered under this specification should be suitable for use on three phase, 4 wire earthed system for working voltage up to 1100 V. It should confirm the relevant standards stated above and others if applicable.

The phase conductor shall be 95 mm², 50 mm², 35 mm², 25 mm² and 16 mm² XLPE insulated and the messenger-cum-neutral conductor of sizes 70 mm², 35 mm² and 25 mm² shall be bare heat treated aluminium-magnesium-silicon alloy wires containing 0.5% magnesium and approximately 0.5% silicon confirming to IS: 398 (Part-IV):1979 and its latest amendment, if any.

5. PHASE CONDUCTORS:

5.1 The phase & street lighting conductor shall be provided cross linked poly ethylene insulation applied by extrusion. The thickness of insulation shall not be less than 1.2 mm up to 35mm² and shall not be less than 1.5 mm for above 35mm² at any point and insulation shall be so applied that it fits closely on the conductor and it shall be possible to remove it without damaging the conductor. The insulated conductors shall generally conform to the standards IS-14255:1995.

5.2 The phase conductors shall be provided with one, two & three 'ridges' for easy identification.

5.3 The tensile strength of the aluminum wire used in the conductor shall not be less 90 N/mn².

5.4 The standard size and technical characteristics of the phase conductors shall be as shown in the Table-1.

TABLE-I

Nominal Sectional area in mm ²	No. of Strands	Diameter of Compacted conductor in mm	Approx. Mass Kg/KMs.	Max. DC Résistance at 20°C (Ohm/km)	Insulation Thickness in mm
1	2	3	4	5	6
16	7	4.4	42	1.91	1.2
25	7	5.6	65	1.20	1.2
35	7	6.7	95	0.868	1.2
50	7	8.0	127	0.641	1.5
95	19	11.0	266	0.320	1.5

NOTE: 1) The resistance values given in col.5 are the max. permissible.

Tolerance of + 5% is allowable on dimension.

6. MESSENGER-CUM-NEUTRAL WIRE:

6.1 The bare messenger wire shall be of aluminium alloy generally confirming to IS-398/Pt.IV/94 composed of 7 strands and shall be suitable compacted or stranded to have smooth round surface to avoid damages to the overall insulation of phase & neutral conductor twisted around the messenger.

- 6.2 There shall be no joint in any wire of the stranded messenger Conductor except these made in the base rod or wires before final drawing.
- 6.3 The sizes and other technical characteristics of the messenger wire shall be as given in the Table No.2.

TABLE -2

Nominal Sectional Area in mm ²	No. of strands	Diameter of Compacted conductor in mm	Diameter of Stranded conductor in mm	Approx. Mass Kgs/KMs	Max .DC Resistance
1	2	3	4	5	6
25	7	5.6	6.42	65	1.380
35	7	6.7	7.56	95	0.986
70	7	9.4	10.65	196	0.492

NOTE: while limiting values in col. 3 is to be guaranteed a tolerance of + 5% will be permissible.

7. XLPE INSULATION:

The insulation shall generally conform to IS-14255

Sr.No.	Property	Requirement
1	Tensile Strength	12.5 N / mm ² Min
2	Elongation at break	200 % Min.
3	Ageing in air over	
a	Treatment: Temperature & duration	135 ± 3°C & 7 days
b	Tensile strength variation	± 25% Max.
c	Elongation variation	± 25% Max.
4	Hot Set	
a	Treatment temperature, Time Under load, mechanical stresses	200 ± 3°C, 15 minutes 20 N /cm ² .
b	Elongation under load	175 % max.
c	Permanent elongation (set) after cooling	15 % Max
5	Shrinkage	
a	Treatment temperature duration	130 ± 3°C For 1 hour

Sr.No.	Property	Requirement
b	Shrinkage	4% Max
6	Water absorption (Gravimetric)	
a	Treatment– Temp.	85 ± 2°C
	Duration	14 days
b	Water absorbed	1 mg. / cm ² max.

8. TYPE TEST:

A. Test for Phase/Street Light Conductors

- (iv) Tensile Test (IS-8130)
- (v) Wrapping Test (IS-8130)
- (vi) Conductor Resistance Test (IS-8130)

B. Test for Messenger:

- (i) Breaking load test (to be made on finished conductor) -(IS-398/ Pt.IV/ 1994 with latest revision)
- (ii) Elongation test (IS - 398 / Pt.IV/1994)
- (iii) Resistance test (IS - 398 / Pt. IV /1994)
- (iv) If insulated , the test of insulation as per relevant IS will be applicable

C. Physical test for XLPE insulation

- (v) Tensile strength and Elongation at break
- (vi) Ageing in air oven
- (vii) Hot set test
- (viii) Shrinkage test
- (ix) Water absorption (Gravimetric)
- (x) Carbon black 1. Content & 2. Dispersion

D. Test for thickness of insulation

E. Insulation Resistance (Volume Resistivity) Test

F. High Voltage Test

Note: The Manufacturer should submit the entire above type test of Govt. of India's approved Laboratory along with their offer.

Optional Test:

Bending test on the completed cable:

Bending test shall be performed on a sample of complete cable. The sample shall be bent around a test mandrel at room temperature for at least one complete turn. It shall then be unwound and the process shall be repeated after turning the sample around its axis 180° . The cycle of this operation shall be then repeated twice.

The diameter of mandrel shall be $10(D+d)$.

Where

D = Actual diameter of cable (i.e. the min. circumscribing diameter in mm) d = Actual diameter of the phase conductor in mm

No cracks visible to the naked eye are allowed.

9. ACCEPTANCE TESTS:

Tests for Phase / Street Light Conductors:

- a. Tensile test (for Phase / Street light conductor)
- b. Wrapping test (for Phase / Street light conductor)
- c. Breaking load test for messenger conductor
- d. Elongation test for messenger conductor
- e. Conductor Resistance test
- f. Test for thickness of insulation
- g. Tensile strength and elongation at break test
- h. Hot set test (For XLPE insulation)
- i. Insulation Resistance test
- j. High voltage test

10. PACKING MARKING:

- 10.1 The LT AB cable shall be wound in nonreturnable drums conforming to IS-10418/1982 "Specification for Reels and Drums for bare wire" of the latest version thereof. The drums shall be marked with the following:

- d) Manufacturers name
 - e) Trade mark if any
 - f) Drum number
 - g) Size of Conductor
 - h) Size of Messenger
 - i) Voltage grade
 - j) Number of lengths of pieces of Cable in each drum
 - k) Gross mass of the packing
 - l) Net mass of Cable
 - m) ISI mark
- 10.2 The drums shall be of such a construction as to assure delivery of conductor in field free from displacement and damage and should be able to withstand all stresses due to handling and the stringing operation so that cable surface not dented, scratched or damaged in any way during transport and erection. The cable shall be properly lugged on the drums
- 10.3 The cable drums should be suitable for wheel mounting.
11. STANDARD LENGTH:
- The standard length of drum will be 500 meter with $\pm 5\%$
- Non-standard Length:
- Nonstandard length not less than 50% of the standard length shall be accepted to the extent of 10% of the ordered quantity.
12. INSPECTION:
- All tests and inspections shall be made at the place of manufacturer unless otherwise especially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification.
13. EXPERIENCE:
- The manufacturer must have some experience of manufacturer and supply of this cable to any Electricity Board. Copy of order executed and performance report may be submitted along with the offer.
14. TYPE TEST CERTIFICATES:

The duly attested copy of Type Test Certificate of the offered sizes of AB cable, as per IS: 14255/1995 with latest amendment/revision be submitted from any Govt. laboratory or from a NABL accredited laboratory along with the offer. Type Test Certificate shall not be more than Five Years Old from Date of supply.

However, if the same are not available at the time of bidding, the same may be submitted after order but before commencement of supply.

In case, the bidder is not able to submit the Type Test Certificate from any Govt. laboratory or from a NABL accredited laboratory for any size of cable, the same shall be conducted by the bidder free of cost without any additional financial liability on utility. For this purpose, Type test Report of a phase wire or messenger wire once tested shall be accepted for all other combination. For example, if 1x16 + 25 sq mm and 3x35 + 25 sq mm already tested then this will be valid for 3x16+25 sq mm (as phase wire of 16 sq mm and messenger wire of 25 sq mm are already tested) and for 3x35 + 25 sq mm + 16 sq mm (as phase wire of 35 & 16 sq mm and messenger wire of 25 sq mm are already tested).

15. SUBMISSION OF ISI LICENSE FOR IS14255:1995

The Manufacturer are required to submit duly attested photo copy of the valid ISI License up to the date of delivery for supply of these AB cables/wires and they should also submit GTP failing which, the offer would be ignored.

16. IMPORTANT:

In absence of valid ISI License/GTP duly filled in/and copy of type test certificate of Govt. approved Laboratory, duly attested by authorized person, offer will be liable to be ignored without any further correspondence.

17. ISI MARKING:

The material supplied shall be conforming to Indian Standard Specification and also with ISI marking as applicable and even after inspection of the lot, if the materials received at site is found without ISI marking, the lot shall be rejected and no further correspondence shall be entertained in this regard.

Exact details of marking/embossing, color of outer sheath etc. will be as per the detailed purchase order.

GUARANTEED TECHNICAL PARTICULARS (G.T.P.)

Technical information and Guaranteed Technical Particulars (G.T.P.) for LT Aerial Bunched Cable (XLPE insulated only) of sizes:

- 1.01 1X16 (Ph) + 1X25 (bare messenger cum neutral) SQ. MM.
- 1.02 1X16 (Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting)SQ. MM.
- 1.03 3X16(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 1.04 3 X 16(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 1.05 1X25(Ph)+1x25 (bare messenger cum neutral) SQ. MM.
- 1.06 1X25(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 1.07 3X25(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 1.08 3 X 25(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 1.09 1X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 1.10 1x35(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
- 1.11 3X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
- 1.12 3X35 (Ph) + 1x25 (bare messenger cum neutral)+ 1x16 (insulated Street lighting) SQ. MM.
- 1.13 3X50(Ph)+1X35 (bare messenger cum neutral) SQ. MM.
- 1.14 3X50 (Ph)+1x35 (bare messenger cum neutral) +1x16 (insulated Street lighting) SQ. MM.
- 1.15 3X95(Ph)+1X70 (bare messenger cum neutral) SQ. MM.
- 1.16 3X95(Ph)+1X70 (bare messenger cum neutral) SQ. MM.+1x16 (insulated Street lighting)SQ. MM.

PART – A

Manufacturer has to confirm following important requirements:

Sr. No.	Particulars	confirmation
1	AB Cable shall be manufactured and supplied Confirming to IS: 14255/1995 with latest Amendment if any	Yes
2	Cable drums/label shall bear ISI Mark	Yes
3	ISI License shall remain valid till order is Completed	Yes
4	Colour of XLPE Insulation – Black	
4a	1X16 + 1X25 SQ. MM.	Yes
4b	1X16 + 1X25 + 1x16 SQ. MM.	Yes
4c	3X16+1X25 SQ. MM.	Yes
4d	3 X 16 +1x25 + 1x16 SQ. MM.	Yes
4e	1X25+1x25 SQ. MM.	Yes
4f	1X25 + 1X25 + 1x16 SQ. MM.	Yes
4g	3X25+1X25 SQ. MM.	Yes
4h	3 X 25 +1x25 + 1x16 SQ. MM.	Yes
4i	1X35+1X25 SQ. MM.	Yes

4j	1x35 + 1X25 + 1x16 SQ. MM.	Yes
4k	3X35+1X25 SQ. MM.	Yes
4l	3X35 + 1x25 + 1x16 SQ. MM.	Yes
4m	3X50+1X35 SQ. MM.	Yes
4n	3X50 +1x35 +1x16 SQ. MM.	Yes
4o	3X95+1X70 SQ. MM.	Yes
4p	3X95+1X70 +1x16 SQ. MM.	Yes
5	Shape – compacted	Yes
6	Standard length in case 500 mtrs+ 5 % tolerance longer length acceptable	Yes
7	Non-Standard length 50% of Std. length up to 10%of ordered quantity	Yes
8	Packing shall contain only one Length.	Yes
9	Packing material: Wooden drums as per IS: 10418/1982 duly painted	Yes
9a	1X16 + 1X25 SQ. MM.	Yes
9b	1X16 + 1X25 + 1x16 SQ. MM.	Yes
9c	3X16+1X25 SQ. MM.	Yes
9d	3 X 16 +1x25 + 1x16 SQ. MM.	Yes
9e	1X25+1x25 SQ. MM.	Yes
9f	1X25 + 1X25 + 1x16 SQ. MM.	Yes
9g	3X25+1X25 SQ. MM.	Yes
9h	3 X 25 +1x25 + 1x16 SQ. MM.	Yes
9i	1X35+1X25 SQ. MM.	Yes
9j	1x35 + 1X25 + 1x16 SQ. MM.	Yes
9k	3X35+1X25 SQ. MM.	Yes
9l	3X35 + 1x25 + 1x16 SQ. MM.	Yes
9m	3X50+1X35 SQ. MM.	Yes
9n	3X50 +1x35 +1x16 SQ. MM.	Yes
9o	3X95+1X70 SQ. MM.	Yes
9p	3X95+1X70 +1x16 SQ. MM.	Yes
10	Following shall be embossed on cable & Marking on drum shall be as per IS: 14255/1995	Yes
10a	Purchaser (Employee)	Yes
10b	1100 Volts	Yes
10c	IS:14255/1995	Yes
10d	Year of manufacture	Yes
10e	Trade Mark	Yes
11	Conductor –	
11a	For Phase 16 mm ² ,25 mm ² , 35 mm ² , 50 mm ² & 95 mm ² Aluminium as per	Yes

	IS 8130/1984	
11b	For Messenger wire 25 mm ² , 35 mm ² & 70 mm ² Aluminium Alloy as per IS 398/Pt.IV/1994	Yes
12	Maximum Conductor resistance at 20°C For Phase Conductor	
12a	16 mm ² Conductor – 1.91 Ohm/KM	Yes
12b	25 mm ² Conductor – 1.20 Ohm/KM	Yes
12c	35 mm ² Conductor – 0.868 Ohm/KM	Yes
12d	50 mm ² Conductor – 0.641 Ohm/KM	Yes
12e	95 mm ² Conductor – 0.320 Ohm/KM	Yes
	For messenger conductor	
12e	25 mm ² Conductor – 1.380 Ohm/KM	Yes
12f	35 mm ² Conductor – 0.986 Ohm/KM	Yes
12g	70 mm ² Conductor – 0.492 Ohm/KM	Yes
13	Minimum average XLPE Insulation thickness for AB Cable	
13a	16 mm ² - 1.2 mm	Yes
13b	25 mm ² - 1.2 mm	Yes
13c	35 mm ² - 1.2 mm	Yes
13d	50 mm ² - 1.5 mm	Yes
13f	95 mm ² - 1.5 mm	Yes
14	Volume resistivity of insulation	
14a	At 27°C – 1 x 10 ¹³ Ohm-cm. Min	Yes
14b	At 70°C – 1 x 10 ¹¹ Ohm-cm. Min	Yes
15	Tensile strength of Insulation & sheath -12.5 N/mm ² Min.	Yes
16	Elongation at break of Insulation and Sheath –200% Min.	Yes
17	Overall tolerance in supply of ordered total quantity shall be ± 2 % (Plus and minus two %)	Yes

PART- B

Manufacturer has to furnish below details about material for information:

Sr. No.	Particulars				confirmation
1	ISI License for IS:14255/1995				Yes
1a	Number				
1b	Date of expiry				
2	Approximate weight of 1000 meters length (Weight in Kgs.)				
2a	Size of cable	Alum.	Alu. Alloy	XLPE	Total
	1X16 + 1X25 SQ. MM.				
	1X16 + 1X25 + 1x16 SQ. MM.				
	3X16+1X25 SQ. MM.				
	3 X 16 + 1x25 + 1x16 SQ. MM.				
	1X25+1x25 SQ. MM.				
	1X25 + 1X25 + 1x16 SQ. MM.				
	3X25+1X25 SQ. MM.				
	3 X 25 + 1x25 + 1x16 SQ. MM.				
	1X35+1X25 SQ. MM.				
	1x35 + 1X25 + 1x16 SQ. MM.				
	3X35+1X25 SQ. MM.				
	3X35 + 1x25 + 1x16 SQ. MM.				
	3X50+1X35 SQ. MM.				
	3X50 + 1x35 + 1x16 SQ. MM.				
3X95+1X70 SQ. MM.					
3X95+1X70 + 1x16 SQ. MM.					
3	Cable Conductor, Circular Compacted?				Yes

PART – C (ENCLOSURES)

Manufacturers have to enclose following documents and has to confirm for the same

Sr. No.	Particulars	confirmation
1	ISI License	Yes
2	Proof if applied for renewal of ISI License	Yes
3	TYPE TEST CERTIFICATE: Type test certificate from Govt. of India approved Laboratory	Yes
	Size of AB Cable	
	a Name of Lab. & City Name	
	b T.R. No.	
c Date		
4	List of plant and machinery	Yes
5	List of testing facility available	Yes
6	List of orders pending/executed	Yes
6a	with Employer	Yes
6b	with agencies other than Sr. no. 6(a)	Yes

13. XLPE Power Cables (11kV&33 kV)

SECTION I

STANDARD TECHNICAL REQUIREMENT

1.0 SCOPE:

This section covers the standard technical requirements of design, manufacturing, testing, packing and dispatching of 11 kV and 33 kV XLPE HT Power Cable.

2.0 APPLICABLE STANDARDS

The materials shall conform to the latest editions of the following Indian/International Standards :

IS 7098 Part 2 : 1985 XLPE insulated PVC sheathed cables For working voltages from 3.3 kV up to and including 33 kV

IS 5831 : 1984 PVC Insulation and Sheath of electric Cables

IS 8130:1984 Conductors for insulated electric cables and flexible cords. IS 613:1984 Copper rods and bars for electrical purposes.

IS 3975:1988 Mild steel wires, formed and tapes for armouring of cable. IS 10810:1984 Method of tests for cables.

IEEE-383:1974 Standard for type test of class IE electric cables, field splices, and connections for nuclear power generating stations.

ASTM-D2843,1993 Standard test method for density of smoke from burning or decomposition of plastics.

ASTM-D2863, 1991 Standard test method for measuring minimum oxygen concentration to support candle - like combustion of plastics (oxygen index).

NEMA-WC5,1992 Thermoplastic Insulated Wire and cable for the transmission and distribution of Electrical Energy.

IEC:754 Test on gases evolved during combustion of electric cables -

(Part-1):1994 Determination of the amount of halogen acid gas evolved during combustion of polymeric materials taken from cables.

IEC:332 Test on electric cables under fire conditions

(Part I):1993 Test on a single vertical insulated wire or cable. IS 3961 Recommended current rating for cables -

(Part II):1967 PVC insulated and PVC sheathed heavy duty cables.

IS 10418:1982 Drums for electric cables.

3.0 GENERAL REQUIREMENTS

All cables shall be suitable for high ambient, high humid tropical Indian Climatic conditions. Cables shall be designed to withstand the mechanical, electrical and thermal stresses under the unforeseen steady state and transient conditions and shall be suitable for proposed method of

installation.

Conductor shall be of uniform, of good quality, free from defects Aluminium copper.

Insulation shall be Cross Linked Polyethylene (XLPE) .

For 33 kV and 11 kV cables, conductor screen and insulation screen shall both be extruded, semi-conducting compound and shall be applied along-with XLPE insulation in a single operation by triple extrusion process. Method of curing for 33 kV cable shall be "Dry curing/ gas curing " only, whereas for 11 kV and 3.3 kV cables it shall be "Dry curing/ gas curing / Steam curing".

Extruded Semi-conducting screening and metallic screening of copper tape shall be generally as per IS 7098 (Part-II) with latest amendments. The semi conducting compound shall be suitable for the operating temperature of the cable and compatible with the insulating material.

The insulation screen shall be an extruded layer of black semi-conducting compound and continuously covers the whole area of insulation. The semi-conducting screens should be effectively cross linked to achieve 90 ° C cable rating. The contact surface between insulation and insulation screen shall be smooth and free from protrusion and irregularities.

The interface between insulation and insulation screen shall be free of any voids. Insulation screen shall be strippable type.

The metallic screen shall consist of a layer of copper cable applied in helical form.

Inner sheath - All armoured and multi-core un-armoured cables shall have distinct extruded inner PVC sheath of black colour.

Armouring - Material for armour for Single Core Cable shall be Aluminum wire. For Multicore cable it shall be GS wire / flat. Armouring shall be as per relevant IS and it shall have minimum 90% coverage.

Breaking Load of the joints shall be minimum 95% of the normal armour.

Outer Sheath – It shall be of black colour PVC (type ST2 as per IS 5831) with Cable size and Voltage grade embossed on it. Sequential marking shall be at every 1 (one) Meter distance. Word "FRLS" shall also be embossed on it at every 5 (Five) meter distance.

FRLS Properties - All cable shall be Flame Retardant, Low Smoke (FRLS) type. Outer sheath shall have the following properties –

Acid Gas Generation – Max 20% (as per IEC 754-1)

Smoke density rating: 60% (As per ASTM D 2843)

Flammability test - As per Swedish chimney test F3 as per SEN 4241475

As per IEC 332 part-3 (Category B)

Minimum bending radius shall be 10 D

Repaired cables shall not be acceptable.

4.0 CURRENT RATING OF CABLES

- 1) Normal current rating shall not be less than that covered by IS 3961. Vendor shall submit data in respect of all cables in the prescribed format.
- 2) Tables given de-rating factors for various conditions of cable installation including the following, for all types of cables shall be furnished.

- Variation in ambient air temperature. - Variation in ground temperature.
 - Depth of laying.
 - Cables laid in the ground - Cables laid in trench
 - Cables laid in ducts - Soil resistivity.
 - Grouping of cables.
- 3) The value of short circuit withstand current ratings of all cables shall be indicated for a short circuit for 1 second duration and should also specify the maximum temperature during short circuit.
 - 4) The following factors shall also be accounted for, while specifying the maximum short circuit withstand of the cables.
 - 5) Deformation of the insulation, due to thermo-mechanical forces produced by the short circuit conditions, can reduce the effective thickness of insulation.
 - 6) Conductor and core screens can be adversely affected with loss of screening effect. Likewise the thermal properties of the outer sheath material can be the limitation.
 - 7) It is essential that the accessories which are used in the cable system with mechanical and/or soldered connections are suitable for the temperature adopted for the cables.
 - 8) Formula for calculating short circuit current for different duration or curve showing short time current v/s time for different sizes of cables shall be furnished by vendor.

5.0 CABLE DRUMS

- 5.1 Cables shall be supplied in non-returnable wooden or steel drums of heavy construction and drum shall be properly seasoned, sound and free from defects. Wood preservative shall be applied to the entire drum.
- 5.2 All Power Cables shall be supplied in drum length of 1000 m. Each drum shall contain one continuous length of cable. Owner shall have the option of rejecting cable drums with shorter lengths. The cable length per drum is allowed a tolerance of $\pm 5\%$. The tolerance allowed on total quantity of each size is as given below.

3.250 meters for cable length upto 10 kms.

3.3100 meters for cable length more than 10 kms. and up to 20 kms.

3.4150 meters for cable length more than 20 kms.

Where the ordered quantity is not multiple of 1000 m and the incremental quantity is very small, the same may be included in one of the drums. Otherwise, an additional length for the incremental quantity will be supplied.

- 5.3 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.
- 5.4 A clear space of at least 40mm shall be left between the cables and the logging.
- 5.5 Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of the cable, net and gross weight stenciled 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 wordings shall be marked on one end of the reel indicating the direction in which it should be rolled.
- 5.6 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 PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

6.0 TESTS

6.1 Type Tests

The following shall constitute type tests:

- i) Tests on conductor
 - a. Annealing test (for copper)
 - b. Tensile tests (for aluminium)
 - c. Wrapping tests (for aluminium)
 - d. Resistance test
- ii) Tests for armouring wires/strips
- iii) Test for thickness of insulation and sheath
- iv) Physical tests for insulation
 - a. Tensile strength and elongation at break
 - b. Ageing in air oven
 - c. Hot test
 - d. Shrinkage test
 - e. Water absorption (gravimetric)
- v) Physical tests for out sheath
 - a. Tensile strength and elongation at break
 - b. Ageing in air oven
 - c. Hot test
 - d. Shrinkage test
- vi) Bleeding and blooming tests (for outer sheath)
- vii) Partial discharge test
- viii) Bending test
- ix) Dielectric power factor test
 - a. As a function of voltage
 - b. As a function of temperature
- x) Insulation resistance (volume receptivity) tests
- xi) Heating cycle test
- xii) Impulse withstand test
- xiii) High voltage test
- xiv) Flammability test

6.2 Acceptance tests

The following shall constitute acceptance tests:

- a. Annealing test (for copper)

- b. Tensile test (for aluminium)
- c. Wrapping tests (for aluminium)
- d. Conductor resistance test,
- e. Test for thickness of insulation
- f. Hot set test for insulation,
- g. Tensile strength and elongation at break test for insulation and sheath
- h. Partial discharge test (for screened cables only)
- i. High voltage test and
- j. Insulation resistance (volume resistivity) test

6.3 Routine test

The following shall constitute routine tests:

- i) Conductor resistance test
- ii) Partial discharge test (for screened cables only) and
- iii) High voltage tests.

6.4 Optional tests

Cold impact tests for outer sheath (IS:5831-1984) shall constitute the optional tests.

SECTION II

SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.

1.0 SCOPE

This section of the specification covers project information, site condition, desired Technical parameters and quantity of XLPE Cable.

1.1 Project Information

- a. Customer :
- b. Engineer/Consultant :
- c. Project Location :
- d. Transport facilities
 - i) Nearest Railway station : /Gauge
 - ii) Distance from site :
- e. Access Roads :

1.2 SITE CONDITIONS

- (i) Ambient air temp. (max.) °C :
- (ii) Ambient air temp. (min.) °C :
- (iii) Design ambient temp. °C :

1.2.1 Relative humidity for design : purposes

- 1.2.2 Height above mean sea level in : meters
- 1.2.3 Earth quake data

- i) Seismic zone : IS:1893-84
- ii) Seismic acceleration : As per IS 2.2.4

- 1.2.4 Wind data
 Site Wind Pressure Kg/m² : As per IS 2.3

1.3 System Particulars

a.	Line Voltage (kV)	11/33
b.	Highest System Voltage (kV)	12/36
c.	Number of Circuits	1
d.	Frequency	HZ50
e.	Neutral	effectively earthed
f.	Short circuit level (KA)	22.77 KA, 31.8KA / 22.5KA,45KA

1.4 SPECIFIC TECHNICAL REQUIREMENTS

Technical Parameters of the cable shall be as follows:

S. No.	PARTICULAR	Unit	DATA	DATA
1	Rated Voltage	kV	6.35/11	19.0/33
2	Type of Insulation	-	XLPE	XLPE
3	Single core/ Multi core	-	Single/Three core	Single/Three core
4	Armoured / Unarmoured	-	Armoured	Armoured
5	Material of Conductor	-	Aluminium/Copper	Aluminium/Copper
6	System	-	11 kV Earthed	33 kV Earthed
7	Highest System Voltage	kV	12	36
8	Conductor size	sq. mm	120, 150, 185, 240, 300	150, 185, 240, 300, 400
9	Material		Stranded Aluminium/copper	Stranded Aluminium/copper
10	Shape of Conductor		Circular	Circular
11	Short Circuit Current	kA	13.12, 18.35 for 3 secs.	13.12, 26.24 for 3 secs
12	Power Frequency Withstand Voltage	KV rms	28	70
13	Lightning Impulse Withstand Voltage	kVp	75	170
14	Continuous Withstand Temperature	Deg C	90	90
15	Short Circuit withstand Temperature	Deg C	250	250
16	Oxygen Index		Min 29 (as per ASTM D 2863)	Min 29 (as per ASTM D 2863)
17	Acid Gas Generation		Max 20% (as per IEC 754-1)	Max 20% (as per IEC 754-1)
18.	Smoke Density Generation		60% (As per ASTM D 2843)	60% (As per ASTM D 2843)
19.	Flammability Test		As per Swedish Chimney test	As per Swedish Chimney test

SECTION-III
 GUARANTEED TECHNICAL PARTICULARS

Sl. No.	Item Particulars	Unit
1	Manufacturers Name & Address	
2	Country of manufacturer	
3	Type of cable	
4	Applicable standards for manufacturing	
5	Applicable standards for testing	
6	Rated voltage	kV
7	Maximum service voltage	kV
8	Maximum continuous current carrying capacity per cable when lain in air at an ambient air temperature of 50 deg. (single core cables solid bonded)	A
9	Maximum continuous current carrying capacity per cable when lain in ground at a depth of 1.0 m (ground temp. 40 deg. C and soil thermal resistivity of 150 deg.c/watt/cm max. Conductor temp. 90 deg. C) (single core cables solid bonded)	A
10	Maximum continuous current carrying capacity per cable when drawing into duct./pipes (single core cables solid bonded)	A
11	Maximum continuous current carrying capacity per cable when lain in covered RCC trenches at an ambient temperature of 50 Deg. C laying conditions to be specified (Single core cables solid bonded)	A
12	Short circuit withstand capacities for 1 second of (With a conductor temperature of 90 Deg. C at the commencement	
i)	Conductor	KA
ii)	Screen	KA
iii)	Armour	KA
13	Conductor	
i)	Material & Grade	
ii)	Nominal cross – sectional area	sq.mm
iii)	No. of strands	
iv)	Diameter of each strand (Nominal)	mm
v)	Max. DC resistance of conductor at 20 Deg. C	ohm/km
vi)	Max. AC resistance of conductor at 90 Deg. C	ohm/km
14	Reactance of cable at normal frequency (Approx)	ohm/km
15	Electrostatic capacitance at normal frequency	micorfarads per km
16	Charging current	
17	Loss tangent at normal frequency at U ₀	
18	Conductor screen	
i)	Material	
ii)	Nominal thickness	mm
19	XLPE Insulation	
i)	Composition	
ii)	Type of curing	
iii)	Thickness of insulation (nominal)	mm
iv)	Tolerance on thickness	mm
v)	Dielectric constant at normal frequency	
vi)	Specific insulation resistance at 20 deg. C	ohm/km
vii)	Min. Volume resistivity at 20 deg. C	
viii)	Min. volume resistivity at 90 deg. C	

ix)	Min. Tensile strength	kg/sq.cm
x)	Min. Elongation percentage at rapture	%
xi)	Identification of cores	
20	1.2/50 microsecond impulse wave withstand voltage	kVp
21	5 min. power frequency withstand voltage	kV
22	Max. Dielectric stress at the conductor	kV/cm
23	Max. Dielectric stress at the conductor screen	kV/cm
24	Insulation screen	
i)	Material	
ii)	Extruded/wrapped	
iii)	Nominal thickness	mm
iv)	Colour	
25	Metallic screen	
i)	Material / composition	
ii)	Nominal radial thickness / dia	
26	Nominal diameter over metallic screen	mm
27	Nominal radial clearance allowed under metal sheath	mm
28	Type and material of filler	
29	Armour	
i)	Material and type	
ii)	Dia	

14. 10kVA 1-Phase, 16 KVA (1/ 3-Phase) & 25 KVA 3-Phase L.T. Distribution Box (with MCCBs)

1. SCOPE:

This specification covers the design, manufacture, inspection, testing at manufacturer place and supply of L.T. Distribution Box with energy meter. Distribution Boxes shall be used for controlling the L.T. feeders from the L.T. side of Distribution Transformers. The system shall be A.C. 3phase, 4 wires, 433V or AC single phase 2 wire, 230V, 50 Hz with effectively grounded neutral.

2. SERVICE CONDITIONS:

The equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the climatic conditions of the State.

3. SYSTEM DETAILS:

Distribution Boxes are meant for metering, control and protection of Distribution Transformers with relevant parameters as under:

S.No.	Transformer Capacity kVA	Full Current Amps	Incoming Circuit Configuration	Outgoing Circuits Configuration
1	10 KVA (1-Phase)	43 Amp	45 A SPN MCCB	2 x 32A SP MCCB
2	16 KVA (1-Phase)	70 Amp	80 A SPN MCCB	2 x 50 A SP MCCB
3	16 KVA (3-Phase)	22 Amp	25 A TPN MCCB	6 x 16 A SP MCCB
4	25 KVA (3-Phase)	34 Amp	40 A TPN MCCB	6 x 25A SP MCCB

Each Distribution box shall have provision for fixing of three phase tri-vector energy meter/single phase meter for DT metering depending upon capacity and type of transformer, 1No. single pole Neutral (SPN)/Three Pole Neutral (TPN) MCCB at incoming and 2 & 6 Nos. single pole MCCB at outgoing circuit as per above table. Incoming and Outgoing MCCB shall be connected through insulated connectors. Cable from the Distribution Transformer shall be connected to the incoming MCCB through energy meter. Cables from the outgoing terminals of the incoming MCCB shall be connected respectively to the R-Y-B Phase and Neutral terminals of the insulated bus bars or insulated Multiple Outgoing Connectors. Cables from insulated bus bars or insulated Multiple Outgoing Connectors shall be connected to the outgoing MCCBs. Aluminium cable of 16mm² for 10 KVA / 16KVA and 35mm² for 25KVA transformer shall be used. Cable shall be fixed with bus bar or connectors with minimum two screws of size not less than M6. Insulation provided shall be such that no live part including the screws for holding the cable shall be accessible by hand/finger.

4. MCCB:

MCCB shall be of reputed make and shall conform to latest IS. MCCB shall be of fixed rating type. MCCB shall have rated service short circuit breaking capacity of 10 KA at 0.4 P.F. (lag) with rated insulation voltage of 660 V. The time current characteristics of MCCB shall be as per the following details:

Multiple of normal Current Setting	Tripping Time
1.05	More than 2.5 hrs.
1.2	More than 10 minutes and less than 2 hrs.
1.3	Less than 30 minutes

1.4	Less than 10 minutes
Multiple of normal Current Setting	Tripping Time
2.5	Less than 1 minute
6.0	Less than 5 Seconds

For above test, the reference calibration temperature of the MCCB shall be 50°C.

5. ENCLOSURE:

- 5.1 The enclosure shall be made up of CRCA MS sheet of 18 SWG sheet thickness for 10/16KVA single phase and of 16SWG for 16/26KVA three phase. The manufacturing process of Box shall be Deep Drawn Process. No welding joints in the body / doors of box are permitted in Deep Drawn Process.
- 5.2 The inside dimensions of Distribution Box shall be 300 x 500 x 160mm for 10 & 16 kVA single phase transformer and 1000 x 500 x 170 mm for 16 & 25 kVA three phase Transformer. However, the dimensions of the box is for reference only, internal clearance as per our requirement shall be strictly maintained. Overall dimensions of the box shall be such that the box will withstand temperature rise limits as per IS and Company's Specification and to have sufficient space for working during maintenance. The size of the box will depend on the size of Electrical components and other relevant provision made in IS:13947/(P1,2&3), IS 2086 and IS:4237 with latest amendment if any. Adequate slope on the top of box (as shown in the drawing) shall be provided to drain out rainwater from the top. The body and door of enclosure shall be individually in one piece without any welding, except for fixing of the accessories like hinges, clamps, mounting clamps, bolts etc. which shall be spot welded or MIG welded only. The door of Distribution box shall be fixed on three tamper proof inside hinges not visible from outside. Hinges shall be welded from inside of the box and door shall be fixed with the two screws in each hinge. Hinges shall be made from 1.6mm MS sheet with hinge pin of diameter 3mm. The hinge pin shall have head on top so that it does not fall down during the normal usage. Base and door shall have flange / collars as shown in drawing. Collar of Base and door shall overlap by minimum 8mm. Rubber gasket shall be provided in between base and doors, such that it provides proper sealing between the door and base of box to avoid ingress of water. Degree of protection shall be IP- 33 as per IS-13947 (amended up to date). Rubber Gasket shall be fixed with suitable adhesive. Two numbers 'U' shaped latch arrangement shall be provided to Seal the door with body for 10/16KVA single phase and three numbers 'U' shaped latch arrangement shall be provided for 16/25KVA three phase. 2.5mm & 8mm diameter hole shall be provided in U-shaped latch for sealing wires & padlock. Holes provided for sealing & padlock should be aligned when latch is in closed position. 'U' shaped latch arrangement shall be made from 1.6 mm thick MS sheet and shall be welded from inner side of the box. U-latch shall be joined with stainless steel rivet.
- 5.3 Viewing window opening of 80mm x 90mm shall be provided with toughened glass of 5mm thickness as shown in drawing. Size of glass shall be 100mm x 110mm. Glass shall be provided with a wraparound single piece rubber gasket (without joint) having minimum depth of 8mm made from good quality rubber so that it can withstand weather effect. Glass along with rubber gasket shall be fixed from inside of the door of distribution box with powder coated glass holder made of 20 SWG MS sheet without any welding joint and by draw process. Glass holder shall be fixed with minimum four welded screws & nuts from inside and not visible from outside.
- 5.4 Mounting arrangement of the meter shall be as shown in the drawing. It should be raised from the base of box by 15mm (minimum). It should be suitable for different makes of meters. Galvanized/Zinc Plated adjustable strip shall be provided on meter mounting arrangement for fixing of the meter. Three

- mounting MS screws, one for upper hanger (M4 threads x length 12mm) & two (M4 threads x 25 or 35mm length) in moving slotted flat shall be provided for fixing of the meter.
- 5.5 Two sets of Louvers (One set on each side) shall be provided. The perforated sheet of 20 SWG CRCA MS shall be welded from inside of the louvers.
- 5.6 The surface of the enclosure shall be properly Pre-treated / Phosphated in a 7-Tank process and shall be applied with a powder coating of about 40 micron thickness. The powder coating shall be of Light Admiralty Grey colour shade (IS-5:1993 Colour No. 697). Powder coating shall be suitable for outdoor use. Rating and Type of distribution box shall be printed or embossed on the door of the distribution box.
- 5.7 EC grade Aluminium Bus bars of 100mm² (minimum) for Phase and Neutral, capable of carrying full load current shall be provided. Bus bar shall be completely insulated such that no live part including screws are accessible by hand/finger after fixing of cables. Insulation shall be Fire retardant. Bus bars shall be isolated with respect to body.
- 5.8 Two earthing bolts of diameter 10mm and 25mm long shall be welded from inside of the box and shall be provided with 2 nuts & washer. Earth marking shall be duly embossed near the earth bolts. There shall be no powder coating on the earthing bolts.
- 5.9 One No. Incoming & 2 Nos. outgoing cable holes shall be provided as shown in drawing. Cable holes shall be provided with superior quality rubber cable glands of internal diameter 30mm. Rubber glands shall be made such that internal diameter of glands provided for cables should be closed with the rubber film of minimum 1mm thickness. Cable will go through the glands by piercing the film of the glands.
- 5.10 For mounting of box on pole, four holes shall be provided the back side of the box as shown in drawing.
- 5.11 Danger marking shall be provided on the box in red color.
- 5.12 Name of Utility and name of scheme i.e. DDUGJY shall be embossed on the distribution box.
- 5.13 Each distribution box shall be supplied with proper packing in 3 ply corrugated box.
- 5.14 Tolerance permissible on the overall dimensions of box shall be $\pm 3\%$.
6. FINISHING OF DISTRIBUTION BOX:
The surface of the box shall be properly pretreated / phosphated in 7-tank process and shall be applied with powder coating. The process facility shall be in house of the manufacturer to ensure proper quality for outdoor application.
7. ACCEPTANCE TESTS :
Following acceptance tests shall be carried out while inspecting lot of material offered.
- a. Visual Examination:
The Distribution box shall be inspected visually, externally and internally for proper Powder Coating layer, fitting of all the components in accordance with technical Specification.
 - b. Verification of dimensions:
Verification of dimensions, external / internal clearances will be carried out as per technical specifications.
 - c. Verification of fittings:
Components like insulated bus bars, MCCBs, Hinges, Rubber Glands etc will be verified as per technical specification.

- d. High voltage withstand test at 2.5KV:
The A.C. voltage of 2.5KV, 50HZ shall be applied for one minute as follows:
- i) Between Live Parts of each insulated bus bar
 - ii) Between each insulated bus bar and earthing Screw/bolts
 - iii) On bus bar insulation.
 - iv) On PVC coating of PVC cables.
- There shall not be any puncture or flash over during this test.
- e. MCCB:
Time current characteristics of each rating of MCCB shall be checked as per the requirement of the specifications.
- f. Current Carrying Capacity:
The current of 200 Amp shall be applied for 30 minutes through high current source on each insulated bus bar. There shall not be overheating of the insulated bus bars during this test.

8. TESTING & MANUFACTURING FACILITIES:

The Tenderer must clearly indicate what testing and manufacturing facilities are available in the works of manufacturer and whether the facilities are adequate to carry out all Routine & Acceptance Tests. These facilities should be available to inspection Engineers, if deputed to carry out or witness the tests in the manufacturer's works. The tenderer must have all the in-house testing facilities to carry out the acceptance tests on the Box.

9. TESTS:

The Distribution box shall comply with the requirement of IP33. Each type of LV Switchboard shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards and during manufacture and on completion.

i) Routine Test

The tests shall be carried out in accordance with IS 13947 and 8623 include including but not necessarily limited to the following:

- (a) Visual Check
- (b) Verification of Component Rating
- (c) Other Checks
 - i) Easy Accessibility and Maintenance
 - ii) Color Coding provided by colored tapes.
 - iii) Bus bar dimensions
 - iv) Degree of Protection check by paper.
- (d) Dimension check
- (e) Insulation Resistance Tests
- (f) Mechanical Operation Tests

- (g) Bus bar support and clearances
- (h) Continuity of circuits and Function
- (i) Powder Coating
- (j) Overload Release setting of the Circuit Breakers

ii) Type Test

The box shall be fully type tested as per the requirement of IS 13947 (Part-1):1993 with latest amendment. The type test shall be carried out from the Govt. approved laboratories duly accredited by National Board of Testing & Calibration Laboratories (NABL) of Govt. of India.

10. Prototype & Drawings:-

The manufacturer has to manufacturer the prototype Unit for each rating as per this specification before bulk manufacturing. The manufacturer should intimate the readiness of prototype to employer. The Project Manager will inspect the prototype for approval. The manufacturer should submit the final drawings in line with this specification and prototype to employer for approval before bulk manufacturing. The approval of prototype & drawings shall be a responsibility of manufacturer/Contractor. Tentative drawing of box is enclosed herewith.

20 63,100,200 & 315 kVA L.T. Distribution Box

1. SCOPE:

This Specification covers the design, manufacture, testing at works and supply of Distribution Boxes made out of CRCA MS for controlling the L.T. feeders from the L.T. side of Distribution Transformers. The system shall be A.C. 3 phase, 4 wire, 433 V, 50 HZ with effectively grounded neutral.

2. SERVICE CONDITIONS:

The equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the tropical conditions as specified by employer which is as hereunder;

- 2.1 Maximum ambient temperature (Degree C)
- 2.2 Maximum temperature in shade (Degree C)
- 2.3 Minimum Temperature (Degree C)
- 2.4 Relative Humidity (percent)
- 2.5 Maximum Annual rain fall (mm)
- 2.6 Maximum wind pressure (kg/sq.m)
- 2.7 Maximum altitude above mean sea level (Meter)
- 2.8 Isoceranic level (days per year)
- 2.9 Siesmic level (Horizontal Acceleration)

Moderately hot and humid tropical climate conducive to rust and fungus growth

3. SYSTEM DETAILS:

Distribution Boxes are meant for control and protection of Distribution Transformers with relevant parameters as under:-

S.N.	Particulars	Details			
1.	KVA rating	63 KVA	100 KVA	200 KVA	315 KVA
2.	Voltage	433 V, 3 Ph, (3x 250 V)			
3.	Frequency	50 HZ			
4.	Phases	3 phase, solidly grounded neutral			
5.	Approximate full load current of transformer	84 A	133 A	270 A	440 A
6.	No. of Outgoing circuits	2 nos		3 nos	4 nos

3.4 Applicable Standards:

IS :13947/ (Part 3) (amended upto date) for Isolator (Switch Disconnecter)

IS: 13947/ (Part2)(amended upto date) for L.T. MCCBs.

IS: 8623 (amended upto date) for enclosure Box & for degree of protection provided by enclosures of electrical equipments.

IS: 4237, IS:8623 (amended upto date) – for general requirement of L.T. switchgears.

IS 13703 (Part I & II amended upto date) for HRC Fuse Base and HRC Fuse Link.

IS: 5 /2007 - Colours of Ready Mixed paints and Enamels.

IS: 13871/1993 (amended upto date) – Powder coatings – specifications

IS : 6005/1998 (amended upto date) – Code of Practice for phosphating of iron and steel.

IS: 13411/1992 (amended upto date) – Glass Reinforced Polyester Dough Moulding Compounds

3.5 MANUFACTURE/CONSTRUCTION OF BOXES:

Distribution Boxes shall have Isolator (Switch Disconnecter) and HRC fuse base with links on incoming circuit and single pole MCCBs & Link Disconnecter on outgoing circuits with necessary interconnecting Bus Bars/ Links.

Standard General Arrangement of Isolators, HRC fuse base with links, MCCBs, Link Disconnecter, Neutral Links, Bus Bars, connecting links, Cable termination arrangement etc inside the Box is shown in the enclosed drawings.

3.6 INCOMING CIRCUIT –

6.1 Isolator (Switch Disconnecter) -

Each distribution box shall have one triple pole Isolator (Switch Disconnecter), conforming to relevant latest IS. The supplier shall indicate makes and types of offered isolator in GTP. The supplier shall submit Type Test Report of the Isolator as specified in Cl. No. 12.3 (II) for approval of Employer before commencement of supply. The Switch disconnecter to be provided in the Distribution Box will be as per Employer specification.

The Isolator should be front operated triple pole type. The casing of Isolator shall be of non-tracking, heat resistant insulating material of Dough Moulding Compound (DMC) of D₃ Grade as per IS:13411 (amended upto date), no separate enclosure is required. Isolator Base should withstand the breaking capacity of 80 kA. To extinguish the arc immediately in isolators, in each phase arc-chutes with minimum 12 strips shall be provided.

The isolator should be front operated triple pole type. The isolator shall be robust in construction and easy for operation. The handle of the isolator should be detachable easily for security purpose while working on L.T. circuits.

The characteristics of Isolator shall be as follows:

S.N.	Characteristics	Rating			
		63 KVA	100 KVA	200 KVA	315 KVA
1.	Basic uninterrupted duty	200 A		600A	
2.	Mechanism	Manual quick make quick break			
3.	Standard applicable	IS : 13947 amended upto date			
4.	Utilization category	AC –23 A			
5.	Mechanical Endurance	As per IS 13497 amended upto date			
6.	Electrical Endurance	As per IS: 13947 amended upto date			
7.	Rated Duty	Uninterrupted			
8	Making /Breaking capacity	Not less than requirement of AC –23 A category			
9.	Two seconds rating	4 KA		8 KA	
10.	Rated insulation voltage	660 V			

The terminal connector strips of the isolator shall be projecting out of isolator of 80 mm (minimum) in length on cable connection side and 60mm (minimum) on HRC fuse base side as shown

in the drawings. In 63 /100/200/315 KVA distribution box, the cross section of the strips on outside of the isolator shall be provided as below:

63/100 KVA -	25X5 mm.
200 KVA-	50X 6 mm
315 KVA-	50X 6 mm

The material of isolator strips shall be EC grade tin-plated copper. The terminal strips shall be continuous from the point of contact separation inside the Isolator with cross section as mentioned above throughout the length. Gap of 50mm shall be maintained between each terminal throughout the length.

6.2 HRC FUSE

HRC Fuse of suitable capacity shall be provided between outgoing terminal of Switch Disconnecter (Isolator) and incoming Busbar to facilitate electrical breaking of the circuit. Each Distribution Box shall have 3 Nos. of HRC Fuse Base with HRC Fuse Links (Blade type Contacts).

The supplier shall indicate in GTP, the make, type and capacity of HRC Fuse Base and Fuse Links offered.

(i) HRC FUSE BASE

The base of the HRC Fuse shall be of non-tracking, heat resistant insulating material of Dough Moulding Compound (DMC) of D₃ Grade as per IS:13411/1992. The Fuse Base shall be sturdy in construction.

The extension terminal connector strips of the Fuse Base shall be projecting out on both sides, made with two pieces (half portion of the terminal contact and extension strip should be continuous in one piece), as shown in the drawing. The dimensions shall be as shown in the drawing. The material for both strips shall be tin plated EC Grade copper. HRC Fuse Base & fuse link should have withstand the breaking capacity of 80 kA.

HRC Fuse base shall be suitable for fuse of 200A for 63/100 KVA distribution box and 400 A for 200 KVA and 630A for 315 kVA distribution box.

(ii) HRC FUSE LINK

The HRC Fuse Links shall be sturdy in construction of "Din Type". Breaking Capacity shall be 80 kA. For fault indication red pop up indicator should come out instantly on fusing. Manufacturer's name, current rating, breaking capacity and type shall be marked on HRC fuse link.

HRC Fuse link Current rating for 63/100 /200/315 KVA distribution box shall be as follows:

63 KVA	- 100 A
100 KVA	- 160 A
200 KVA	- 315 A.
315 KVA	- 500 A

The supplier shall submit Type Test Report of the HRC fuse base and HRC fuse link as specified in Cl. No. 12.3 (III) for approval of Employer before commencement of supply. The HRC fuse base with links to be provided in the Distribution Box will be as per Employer approval given in the detailed purchase order.

3.7 OUTGOING CIRCUITS:

(i) MCCBs

Each distribution box shall have 6 nos. of single-pole MCCBs in 63 KVA /100 KVA Box, 9 nos of single-pole MCCBs in 200 KVA box and 12 nos of single-pole MCCBs in 315 KVA box to protect outgoing circuits. MCCB shall be of reputed make and shall confirm to latest IS. The supplier shall indicate the

makes and types of MCCBs offered in GTP. The supplier shall submit Type Test Report of the MCCB as specified in Cl. No. 12.3 (IV) for approval of Employer before commencement of supply. The MCCBs to be provided in the Distribution Box will be as per Employer approval as given in the detailed purchase order.

MCCB shall have quick make quick break mechanism. Making of MCCB shall only be manual but breaking of MCCBs shall be electrical as well as manual.

The detailed specification for MCCBs shall be as under.

S.No.	Particulars	Details			
		1.	KVA rating	63 KVA	100 KVA
2.	Rated current	150 A		200 A	
3.	Fixed overload release setting (A)	60 A	90 A	120 A	120 A
4.	No. of poles	Single pole			
5.	Rated service short circuit breaking capacity (kA) which is equal to ultimate breaking capacity as per IS 13947 (amended upto date)	10 KA at 0.4 p.f . (lag)			
	The sequence of operation for this test shall be, O - t - CO - t - CO, and t = 3 min.). The test shall be done at 250V at 0.4 p.f. (lag). Voltage rating phase to phase 433 V and phase to earth 250V.				
6.	Power factor for short circuit (Max.)	0.4 lag			
7.	Utilization category	A			
8.	Rated Insulation Voltage	660 V			

The Busbar dropper and Terminal connection strip of Link Disconnecter shall be placed in contact terminal of MCCB as shown in the drawing.

The rated service short circuit breaking capacity as specified above, shall be based on the rated service short circuit test carried out at specified power factors.

To extinguish the arc immediately in MCCBs, arc-chutes with minimum 8 strips shall be provided.

While the above stipulation regarding the test power factor and the sequence of operation shall be binding, the other procedure for making the short circuit test and circuit etc. shall generally be in accordance with the Indian Standard applicable to the type of circuit breakers under test.

7.2 TIME CURRENT CHARACTERISTICS of MCCBs:

The L.T. MCCBs shall have time current characteristics as follows:

Multiple of normal Current setting	Tripping time
1.05	More than 2.5 hrs.
1.2	More than 10 minutes and less than 2 hrs.
1.3	Less than 30 minutes
1.4	Less than 10 minutes
2.5	Less than 1 minute
4.0	Not less than 2 seconds
6.0	Less than 5 seconds
12.0	Instantaneous (less than 40 milli seconds.)

For above time/current characteristic, the reference calibration temperature of the breaker shall be 50°C. Deration, if any, up to 60°C. Ambient temperature shall not exceed 10% of the current setting indicated above.

c. **LINK DISCONNECTOR :**

Link Disconnecter of 200 A capacity shall be provided between outgoing terminal of MCCB & cable connection to facilitate mechanical breaking (manual isolation) of the circuit. 63 /100 kVA Distribution Box shall have 6 Nos. of link Disconnectors, 200 kVA distribution box shall have 9 nos of link Disconnectors and 315 kVA distribution box shall have 12 nos of link Disconnectors.

The supplier has to indicate the makes and types of Link Disconnecter offered in GTP. The supplier shall submit Type Test Report of Link Disconnecter as specified in Cl.No. 12.3 (V) for approval of Employer before commencement of supply. The link Disconnectors to be provided in the Distribution Box will be as per EMPLOYER's approval as given in the detailed purchase order.

The base of the Link Disconnecter shall be of non-tracking, heat resistant insulating material of Dough Moulding Compound (DMC) of D₃ Grade as per IS:13411 (amended upto date). The Link Disconnecter shall be sturdy in construction and easy in operation.

The link of Link Disconnecter shall be of Tin-plated E.C. grade copper. The construction of the Link Disconnecter shall be such that it shall be hinged type on cable connection end and disconnectable at the MCCB end. The disconnection will be with the help of special handle/puller. One handle/puller shall be supplied alongwith each Distribution Box. The terminal connector strips of the Link Disconnecter of 25 x 3 mm cross section, shall be projecting out of Link disconnecter for minimum length of 80 mm. on cable connection side and 40 mm on MCCB outgoing side. The cross section of knife edge link shall be 20 x 5 mm. The material for both the strips and links shall be tin-plated E.C. grade copper. The size of bimetallic lugs hole & the hole on the disconnectors strip on cable side should be same.

3.8 **BUSBARS AND CONNECTIONS:**

The Incomer feeder should be on right side of the distribution box and all outgoing feeders will be on left side of the distribution box, with phase sequence RYB to be maintained. The phase busbars, incoming droppers and feeder droppers from busbars shall be of EC Grade Aluminium. The phase busbar strips shall be of size 25X8 mm for 63 KVA/100 KVA and 40X10 mm for 200 and 40X15 for 315 KVA box. Feeder droppers shall be 25X8 mm. Incomer dropper of 25 x 8 mm cross section for 63 /100 KVA box and 40 x 10 mm cross section for 200KVA box and 40X15 for 315 KVA box be provided. All busbars and droppers shall be properly drilled and de-burred. Each bus bar shall be of one single strip without any joint.

Busbars shall be provided with durable PVC insulating sleeves of standard colour code for different phases. Corrugated/Spring & Plain washers shall be used for Nut-Bolt connections.

Busbars shall be mounted on suitable size support insulators which should be tightened from inside. i.e. once fitted , should not be able to removed.

Minimum clearances, wherever shown, shall be as per General Arrangement Drawing enclosed with this specifications. Other clearances shall be as per requirement of IS: 4237amended upto date.

3.9 **ENCLOSURE:**

9.1 The Box & Doors shall be made up of CRCA MS sheet of 2mm thickness.

9.2 The manufacturing process of Box shall be Deep Drawn process.

9.3 In case of Deep drawn type distribution boxes, the rounding of corners and slope on Top shall be as shown in the drawing. No joints in the body of the Box are permitted in Deep Drawn Process.

9.4 The welding process of distribution boxes shall be done by MIG (Metal Inert Gas) welding and workmanship/finishing should be good enough.

- 9.5 For Deep Drawn Box: the general clear dimensions of 63 / 100 KVA DistributionBox shall be 1000 x 1010 x 325 (LXHXW)mm. The center height of distribution box on front side shall be 1000 mm The general clear dimensions of 200 kVA distribution box shall be 1305 x 1050 x 325 (LXHXW) mm and for 315 kVA distribution box shall be 1545 x 1050 x 325 (LXHXW) mm. The center height of the distribution box on front side shall be 1050 mm
- 9.6 The Base and doors of enclosure shall be individually in one piece without any welding, except for fixing of the accessories like hinges, clamps, mounting clamps, bolts etc.
- A. 63/100 kVA boxes shall have two doors as shown in the drawing fixed on right & left side of the box with four hinges provided from inside of box. On closing of doors, right door shall rest on the left door. Hinges shall not be visible and approachable after closing the box.
- B. 200/315 kVA boxes shall have two doors as shown in drawing fixed on right side & left side of the box with four hinges on both sides shall be provided from inside of box. On closing of doors, right door shall rest on the left door. Hinges shall not be visible and approachable after closing the box.

Base and doors shall have flange / collars as shown in drawing. Collar of Base and doors shall overlap by 10mm. Rubber gasket of suitable size shall be provided in between base and doors, such that it provides proper sealing between the door and base of box to avoid penetration of dust & ingress of water. Degree of protection shall be IP- 33 as per IS-8623 (amended up to date). Rubber Gasket shall be fixed with suitable adhesive. Four hinges on each side shall be provided from inside of the box to fix the doors. Hinges shall be minimum 50 mm in length & made from 2mm thick sheet. Hinge stainless steel pin diameter shall be 4mm. The hinges shall not be visible from outside.

- 9.7 The MCCBs, Link Disconnecter, Isolator and HRC fuse base with link shall be housed inside the enclosure. Isolator operating handle shall be accessible only after opening of the doors.
- 9.8 Four set of Louvers (two sets on each side) of suitable size shall be provided as shown in drawing. The louvers shall be provided such that heat dissipation is proper. The perforatedsheet of 20 SWG with 2.5 mm holes shall be welded from inside of the louvers.
- 9.9 Mounting of components inside the enclosure shall allow free air circulation keeping the clearances as per drawings attached with specification.
- 9.10 Locking Arrangement to the Box:
 The doors shall be closed with a push fit locking arrangement such that on pressing/pushing the right door, the distribution box gets locked from inside from top & bottom. This arrangement shall be operational for opening of the door with a handle provided outside the door. Handle shall be removable type only. A Nylon washer shall be provided between the handle and door to avoid penetration of water. One central lock with brass levers shall be provided inside the door. Key way shall be provided on the door for operating the central lock from outside. Key way shall be provided with cover.
- 9.11 A suitable cable termination arrangement with support insulators shall be provided on Isolators and Link Disconnectors. The bimetallic lugs of adequate size, as per enclosed specification & drawing, shall be provided. Clearances, Creepages and convenience in making connections shall be ensured.
- 9.12 EC grade Aluminium Neutral Busbar of 300 x 25 x 8 mm for 63/100 KVA box and 525 x 40 x 10 mm for 200 KVA and 40 x 15mm for 315 KVA Box capable of carrying for full load current. Neutral Busbar shall be isolated with respect to body. The bimetallic lugs of adequate size, as per enclosed specification & drawing, shall be provided. Neutral Busbar shall be as shown in the drawing attached with the specifications.
- 9.13 Bolts of M10 mm and 35 mm length with 2 Nos. plain washer and two Nos. nut are to be provided on both the sides for earthing of the distribution box. Earthing bolt is to be fixed on U-structure (Earth Clamp) welded on both sides of the distribution box. Thickness of earth clamp shall be 2mm. The top surface of the earth clamp shall be properly Zinc plated. Earthing nut bolt and washer should be zinc plated. There should be no powder coating on top surface of the earthing clamps.

- 9.14 Three bottom plates for 63/100 KVA and 4 bottom plates for 200 KVA and 5 bottom Plates for 315 KVA shall be provided for incoming and outgoing cables as shown in the drawing. Bottom plate of size 125mm x 125mm fixed with four screws from inside shall be provided for incoming and outgoing cables. Bottom plates shall be provided with suitable holes and rubber glands for the cables. Rubber glands shall be made such that internal diameter of glands provided for cables should be closed with the rubber film of minimum 1mm thickness. Cable will go through the glands by cutting the film of the glands. Bottom plates shall also be provided with cable clamps as shown in drawing.
- 9.15 Necessary fixing arrangement shall be provided at the back of the enclosure to ensure proper fixing on double pole structure by means of suitable clamps at 4 places.
- 9.16 Danger marking shall be provided in red colour on the right door of the distribution box. Marking shall be scratch proof and properly readable.
- 9.17 All the components inside the Box shall be mounted on CRCA MS strips of 2mm thickness. The mounting strips shall be provided with required bends or ribs to give the extra strength and shall be powder coated or zinc plated.
- 9.18 All joints of current carrying parts shall be bolted with 8.8 grade High Tensile MS Nuts & Bolts, Corrugated/spring & Plain Washers. The nuts & bolts should be of hexagonal type. All the nuts, bolts & washers should be properly zinc plated.
- 9.19 Each distribution box shall be supplied with proper packing in five ply - corrugated box.
- 9.20 Name plate having details such as Month & year of manufacturing, , Sr.No, and rating of Distribution box, XXXXX"Name of Employer" shall be riveted on the Distribution box door. Name of Manufacturer shall be duly embossed on the door of the distribution box. The name plate should be of stainless steel of thickness 1 mm.
- 9.21 Incoming and outgoing circuit should be duly highlighted with paint by stencil printing.
- 9.22 Adequate slope on the top of box shall be provided to drain out rainwater from the top.
- 9.23 3 Nos. MCCBs and 3 Nos. HRC fuse links in spare should be invariably provided with each box.
- 9.24 Good-quality plastic sticker leaflet should be pasted inside of distribution box door. The matter of instruction leaflet shall be provided by the employer. All the instructions in leaflet should be in Hindi/English/Local language.

3.10 CABLE TERMINATION:

Adequate size of Bimetallic lugs shall be provided for 3½ core, LT XLPE cable on incoming side and outgoing side for 63/100/200/315 KVA boxes as below :

	Incoming side	Outgoing Side
63 KVA	70 sq.mm	50/ 70 sq.mm
100 KVA	150 sq.mm	50/70 sq.mm
200 KVA	300 sq.mm	150 sq.mm.
315 KVA	300 sq.mm	150 sq.mm.

- 3.11 LUG : Bimetallic lug should be made for electrolytic grade aluminum. Each lug should be copper coated by electrolytic process and rich layer of tin should be mounted through out the lug to protect from Galvanic Corrosion. The lugs shall be such that the rich layer of tin should not peel off during operation. Individual lot should be pre filled with conductive inhibition compound and lug should be duly capped to prevent oozing of compound. The ductility of material should be such that flow ability of material be adequate to flow in to the strand of the conductor and withstand on crimping pressure of 8500 PSI. The cut cross section of the joints shall be homogeneous.

3.12 FINISHING OF DISTRIBUTION BOX:

The outer side and inside surface of the box shall be properly Pre-treated /Phosphated in seven tank process as per IS: 6005 and shall be applied powder coating of minimum 40 micron thickness. The Colour shade of light Admiralty gray (as per employer requirement) for 63, 100, 200 and 315 KVA box as per IS: 5/2007 (Colours of Ready Mixed paints and Enamels) shall be applied inside & outside surface of the box or as per state practice. Powder coating shall be suitable for outdoor use, conforming IS: 13871 (amended upto date) – Powder coatings. The process facility shall be in-house to ensure proper quality for outdoor application.

3.13 TESTS & TEST CERTIFICATES:

In case of bought out items, routine and acceptance tests as per relevant IS and this specification shall be carried out at the original manufacturers' works.

a) Routine Test (Carried out on all boxes):

- Overall Dimensions Checking.
- Insulation Resistance Tests.
- High Voltage Test at 2500 V, 50 Hz AC for one minute.

12.1.4. Operation Test on MCCB/Isolator/Link Disconnecter / HRC fuse base and fuse links.

b) Acceptance Tests (on complete Distribution Box):

Following tests shall be carried out as per acceptance tests in addition to routine tests on one random sample of each rating out of the lot offered for inspection:

i) Temperature rise test on one sample of each rating.

Temperature rise test will be carried out as per the procedure given below:

For temperature rise test, a distribution box with all assembly of MCCBs / Link Disconnectors / Isolator / HRC fuse base with link shall be kept in an enclosure such that the temperature outside the box shall be maintained at 50 ° C.

20% more current than transformer secondary capacity i.e. for 63 KVA Distribution Transformers full load current 84A, 20 % more is 100 A shall be kept in incoming circuit keeping outgoing circuits short, till the temperature stabilizes and maximum temperature rise should be recorded.

ii) Time-Current Characteristics

The MCCB should be tested for time current characteristics at 1.05 & 1.2 times of overload release setting current and should pass the requirement given in clause- 7.2.

c) TYPE TESTS :

1 ON COMPLETE BOX:

a. Temperature rise test:- The temperature rise test should be carried out as per IS: 8623

High voltage test shall be carried out as per IS:8623 amended upto date.

Short Time Withstand Current Test on Distribution Box shall be carried out as per IS 8623 or latest version.

The Distribution Box should be subjected to Short Time Withstand Current Test for 4KA for 2 seconds for 63/100 KVA Box and 8 KA for 2 second for 200/315 KVA box) all the circuits independently. The test should be carried out after by- passing MCCBs.

Degree of protection for IP- 33 on complete box shall be carried out as per IS: 13947/1993 or the latest version thereof.

Time /current characteristic test on MCCBs shall be carried out as per clause 7.2 of this specification as stated above.

2 ON ISOLATOR (SWITCH DISCONNECTOR):

All type tests on Isolator (Switch Disconnecter) as per IS: 13947 (Part III) amended up to date shall be carried out.

3 ON HRC fuses base and HRC fuse links :

All type tests on HRC fuses and HRC fuse links IS 13703 (Part I & II amended upto date) for HRC Fuse Base and HRC fuse link shall be carried out.

4 ON MCCB:

All type tests on MCCB as per IS-13947 amended upto date shall be carried out.

5 ON Link Disconnecter:

Following tests shall be carried out on link disconnecter as per IS:

Short Circuit Withstand Strength

Temperature rise Limits

Mechanical Operations

12.4 TYPE - TEST CERTIFICATES:

The Distribution Box, Isolator (Switch Disconnecter), HRC fuse, HRC Fuse Link and MCCB offered shall be fully type tested as per relevant IS and this specification. The Supplier shall furnish detailed type test reports before commencement of supply. The detailed Type Test Reports shall be furnished with relevant oscillogram and certified Drawings of the equipment tested. The purchaser reserves the right to demand repetition of some or all the Type Tests in presence of purchaser's representative at purchaser's cost.

All the type tests shall be carried out from laboratories accredited by National Accreditation Board of Testing And Calibration Laboratories (NABL), Department of science & technology , Govt. of India to prove that the complete Box, Isolator, HRC fuse, Link Disconnecter & MCCB meet the requirements of the specification. The Manufacturer should also furnish certificate from laboratories that laboratories are having all the requisite test facility available in house. The type test Reports conducted in manufacturers own laboratory and certified by testing institute shall not be acceptable.

The Supplier should furnish the particulars giving specific required details of Distribution Boxes, MCCBs, Isolator and Link Disconnecter.

3.14 TESTING & MANUFACTURING FACILITIES :

Supplier must be an indigenous manufacturer. The Supplier must clearly indicate what testing facilities are available in the works of manufacturer and whether the facilities are adequate to carry out all Routine & Acceptance Tests. These facilities should be available to Employer's Engineers, if deputed to carry out or witness the tests in the manufacturer's works. The supplier must have all the in-house testing facilities to carry out the acceptance tests on the Box.

The supplier shall furnish detailed process of manufacturing & Powder coating.

3.15 PROTOTYPE & DRAWINGS:-

The manufacturer has to manufacturer the prototype Unit for each rating as per this specification before bulk manufacturing. The manufacturer should intimate the readiness of prototype to employer. The Project Manager will inspect the prototype for approval. The manufacturer should submit the final drawings in line with this specification and prototype to employer for approval before bulk manufacturing. The approval of prototype & drawings shall be a responsibility of manufacturer/Contractor. Tentative drawing of box is enclosed herewith.

21 11kV Porcelain Insulators and Fittings
Part-I : INSULATORS

1. SCOPE

This specification covers details of porcelain insulators (Pin and Strain Insulators) for use on 11 KV overhead power lines in rural electric distribution system.

2. APPLICABLE STANDARDS

Except when it conflicts with the specific requirements of this specification, the insulators shall comply with IS:731 and IS:3188 as amended from time to time.

3. GENERAL REQUIREMENTS

3.1 The porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed.

3.2 Unless otherwise specified, the glaze shall be brown in colour. The glaze shall cover all the porcelain parts of insulators except those areas which serve as support during firing or are left unglazed for the purpose of assembly.

3.3 The design of insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. The porcelain shall not engage directly with hard metal.

3.4 Cement used in construction of insulators shall not cause fracture by expansion or loosening by contraction and proper care shall be taken to locate the individual parts correctly during cementing. The cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible.

3.5 The insulators should preferably be manufactured in automatic temperature - controlled kilns to obtain uniform baking and better electrical and mechanical properties.

4. CLASSIFICATION AND DIMENSIONS

4.1 Both pin and strain insulators shall conform to Type B of IS:731.

4.2 The dimensions of pin insulators shall be as shown in Fig. 1.

4.3 The strain insulators shall be of Ball and Socket type or Tongue and Clevis type, as required by the Purchaser. The dimensions of these insulators shall be as per Fig. 2.

5. TEST VOLTAGES

5.1 The test voltages of insulators shall be as under:

Highest System voltage	Visible Discharge Test	Wet Power Frequency withstand Test	Power Frequency withstand test		Impulse voltage withstand Test
			Pin Insulator	Strain Insulator	
KV(rms)	KV(rms)	KV(rms)	KV(rms)	KV(rms)	KV(Peak)
12	9	35	105	1.3 times of the actual dry flash over voltage of the Insulator	75

6. FAILING LOAD

- 6.1 Mechanical Failing Load (For Pin Insulators only) The insulators shall be suitable for a minimum failing load of 5 KN applied in transverse direction.
- 6.2 Electro-Mechanical Failing Load (For Strain Insulators) The insulators shall be suitable for a minimum failing load of 45 KN applied axially.

7. CREEPAGE DISTANCE

The minimum creepage distance shall be as under :

Highest System Voltage	Normal and Moderately polluted atmosphere	Heavily Polluted atmosphere	
		Pin insulator	Strain insulator
KV	mm	mm	Mm
12	230	320	400

Note : Higher value of creepage distance has been specified for strain insulators as these are normally used in horizontal position in 11 KV lines.

8. TESTS

The insulators shall comply with the following tests as per IS:731 :-

8.1 Type Tests

- a) Visual examination
- b) Verification of dimensions
- c) Visible discharge test
- d) Impulse Voltage Withstand Test
- e) Wet Power Frequency Voltage Withstand Test
- f) Temperature cycle test

- g) Mechanical Failing load test (for Pin Insulators only) to be carried out as per procedure described at Sub-clause 8.4
- h) 24-hour Mechanical strength Test for Strain Insulators
- i) Puncture Test
- j) Porosity Test
- k) Galvanising Test
- l) Electro-mechanical failing load test (for Strain insulators only) to be carried out as per procedure described at Sub-clause 8.4.
- m) Thermal Mechanical Performance Test (for Strain insulators only) to be carried out as per procedure described at Sub-clause 8.4

8.2 ROUTINE TESTS:

- a) Visual examination
- b) Mechanical routine test (for strain insulator only)
- c) Electrical routine test (for strain insulator only)
- d) Hydraulic Internal Pressure test on shells for strain insulators to be carried out as per procedure described at Sub-clause 8.4

8.3 ACCEPTANCE TEST:

- a) Verification of Dimensions
- b) Temperature cycle Test
- c) Electro-mechanical failing load test (for strain insulators only) to be carried out as per procedure described at Sub-clause 8.4
- d) Puncture test (for strain insulators only)
- e) Porosity test
- f) Galvanising test

8.4 Following procedure shall be used for conducting tests on insulators :

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

The test shall be carried out on 100% shells before assembly. The detail and methodology for conducting this test has been illustrated at attached Annexure – 1.

2 Thermal Mechanical Performance Test (if applicable)

Thermal Mechanical Performance Test shall be performed in accordance with IEC- 383-1-1993 Clause 20 with the following modifications:

- (1) The applied mechanical load during this test shall be 70% of the rated electromechanical or mechanical value.
- (2) The acceptance criteria shall be
 - (a) X greater than or equal to $R + 3S$.

Where

X- Mean value of the individual mechanical failing load.

R- Rated electro-mechanical / mechanical failing load.

S- Standard deviation.

(b) The minimum sample size shall be taken as 20 for disc insulator units.

(c) The individual electromechanical failing load shall be at least equal to the rated value. Also puncture shall not occur before the ultimate fracture.

3 Electromechanical/Mechanical Failing Load Test.

This test shall be performed in accordance with clause 18 and 19 of IEC 383 with the following acceptance

- (i) X greater than or equal to $R + 3S$, Where
X- Mean value of the electro-mechanical/mechanical/ failing load.
R- Rated electro-mechanical / mechanical failing load.
S- Standard deviation.
- (ii) The minimum sample size shall be taken as 20 for disc insulators units. However, for larger lot size, IEC 591 shall be applicable.
- (iii) The individual electro-mechanical/mechanical failing load shall be at least equal to the rated value. Also electrical puncture shall not occur before the ultimate fracture.

9. MARKING

9.1 Each insulator shall be legibly and indelibly marked to show the following :

- a) Name or trade mark of manufacturer
- b) Month and year of manufacture
- c) Minimum failing load in KN
- d) ISI certification mark, if any

9.1.1 Markings on porcelain shall be printed and shall be applied before firing.

10. PACKING

All insulators (without fittings) shall be packed in wooden crates suitable for easy but rough handling and acceptable for rail transport. Where more than one insulator is packed in a crate, wooden separators shall be fixed between the insulators to keep individual insulators in position without movement within the crate.

11. INSPECTION

11.1 All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification.

11.2 The purchaser has the right to have the tests carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

Part-II : INSULATOR FITTINGS

1. SCOPE

This specification covers details and test requirements for (i) Pins for 11 KV Insulators, (ii) Helically Formed Pin Insulator Ties (iii) Fittings for Strain Insulators with Helically Formed Conductor Dead-Ends and (iv) Fittings for Strain Insulators with conventional Dead-End Clamps.

2. APPLICABLE STANDARDS

Pins shall comply with the requirements of IS:2486 (Pt.I & II). Helically formed fittings shall comply with IS:12048-1987. Fittings for strain insulators shall comply with the requirements of IS:2486Pt.I to IV.

3. PINS FOR INSULATORS

3.1 General Requirements

The pins shall be of single piece obtained preferably by the process of forging. They shall not be made by joining, welding, shrink fitting or any other process using more than one piece of material. The pins shall be of good finish, free from flaws and other defects. The finish of the collar shall be such that a sharp angle between the collar and the shank is avoided. All ferrous pins, nuts and washers, except those made of stainless steel, shall be galvanised. The threads of nuts and tapped holes, when cut after galvanising shall be well oiled or greased.

3.2 Dimensions

Pins shall be of small steel head type S 165 P as per IS:2486 (Part-II) having stalk length of 165mm and shank length of 150mm with minimum failing load of 5 KN. Details of the pins are shown in Fig. 3.

3.3 Tests

Insulator pins shall comply with the following test requirements as per IS:2486 (Part-I)-1993 or latest version thereof:

3.3.1. Type Tests

- a) Checking of threads on heads
- b) Galvanising test
- c) Visual examination test
- d) Mechanical test

3.3.2 Acceptance Tests

- a) Checking of threads on heads
- b) Galvanising test
- c) Mechanical test

3.3.3 Routine Test

Visual examination test

4. HELICALLY FORMED PIN INSULATOR TIES

4.1 Helically formed ties used for holding the conductor on the pin insulator (Fig.4) shall be made of aluminium alloy or aluminised steel or aluminium-clad steel wires and shall conform to the requirements of IS:12048-1987.

4.2 The ties shall be suitable for pin insulator dimensions as per Fig. 1 of Pt. I and conductor sizes to be specified by the purchaser.

Note : Helically formed insulators ties are made to suit specific sizes of conductors, which should be clearly specified by the purchaser.

4.3 Elastomer pad for insulator shall be used with the ties to avoid abrasion of the conductor coming into direct contact with the insulator.

4.4 Tests

The ties shall be subjected to the tests specified in IS:12048-1987.

5. FITTINGS FOR STRAIN INSULATORS WITH HELICALLY FORMED CONDUCTOR DEAD-ENDGRIPS

5.1 Fittings for Strain Insulators of Tongue & Clevis Type

5.1.1 The fittings shall consist of the following components:

- a) Cross arm strap conforming to IS: 2486 (Pt.II)-1989.
- b) Aluminium alloy die cast thimble-clevis for attaching to the tongue of strain insulator on one end and for accommodating the loop of the helically formed dead-end fitting at the other end in its smooth internal contour. The thimble shall be suitable for all sizes of conductors ranging from 7/2.11mm to 7/3.35mm ACSR. The thimble clevis shall be attached to the insulator by a steel cutter pin used with a non-ferrous split pin of brass or stainless steel. The thimble shall have clevis dimensions as per IS:2486 (Pt.II)-1989.
- c) Helically formed dead-end grip having a pre-fabricated loop to fit into the grooved contour of the thimble on one end and for application over the conductor at the other end. The formed fitting shall conform to the requirement of IS:12048-1987.

Note : As the helically formed fittings are made to suit specific sizes conductors, the purchase should clearly specify the number of fittings required for each size of conductor.

5.1.2 Nominal dimensions of the T&C type insulator fittings are shown in Fig. 5.

5.2 Fittings for Strain Insulators of Ball & Socket Type

5.2.1 The fittings shall consist of the following components:

- a) Cross arm strap conforming to IS:2486 (Pt.II)-1989.
- b) Forged steel ball eye for attaching the socket end of the strain insulator to the cross arm strap. Forgings shall be made of steel as per IS:2004-1978.

- c) Aluminium alloy thimble-socket made out of permanent mould cast, high strength aluminium alloy for attaching to the strain insulator on one end and for accommodating the loop of the helically formed dead-end fittings at the other end in its smooth internal contour. The thimble-socket shall be attached to the strain insulator with the help of locking pin as per the dimensions given in IS:2486 (Pt.II)-1989 and
- d) Helically formed dead-end grip as per clause 5.1.1(c) above.

5.2.2 Nominal dimensions of the Ball & Socket type insulator fittings are shown in Fig. 6.

5.3 Tests

The helically formed fittings for strain insulators shall be subjected to tests as per IS:12048-1987. The other hardware fittings shall be tested as per IS:2486 (Part-I).

6. FITTINGS FOR STRAIN INSULATORS WITH CONVENTIONAL DEAD-END CLAMPS ALTERNATIVE TO FITTINGS COVERED IN CLAUSE 5)

6.1 Fittings for strain insulators with conventional dead-end clamps for use with tongue & clevis or ball & socket type insulators shall consist of the following components :

- a) Cross arms strap conforming to IS:2486 (Pt.II)-1989
- b) Dead-end clamp made of aluminium alloy to suit ACSR conductors from 7/2.11mm to 7/3.35mm. The ultimate strength of the clamp shall not be less than 3000 Kg. The shape and major dimensions of clamps suitable for B&S and T&C insulators are shown in figures 7 & 8 respectively.

6.2 Tests

The fittings shall be subjected to type, routine and acceptance tests in accordance with the stipulations of IS:2486 (Pt.I).

Note: Fittings for strain insulators as stipulated in Clause 5 are preferable to the fittings stipulated in Clause 6 both from the point of view of better quality of construction and ease of application.

7. PACKING

7.1 For packing of GI pins, strain clamps and related hardware, double gunny bags or wooden cases shall be used. The heads and threaded portions of pins and the fittings shall be properly protected against damage.

7.2 The gross weight of the packing shall not normally exceed 50 Kg. Helically formed fittings shall be packed in card-board / wooden boxes. Fittings for different sizes of conductors shall be packed in different boxes and shall be complete with their minor accessories fitted in place and colour codes on tags/fittings shall be marked to identify suitability for different sizes of conductors as per IS:12048-1987.

8. INSPECTION

8.1 All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification.

- 8.2 The purchaser has the right to have the test carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

ANNEXURE-I

HYDRAULIC PRESSURE TEST ON DISC INSULATOR SHELL

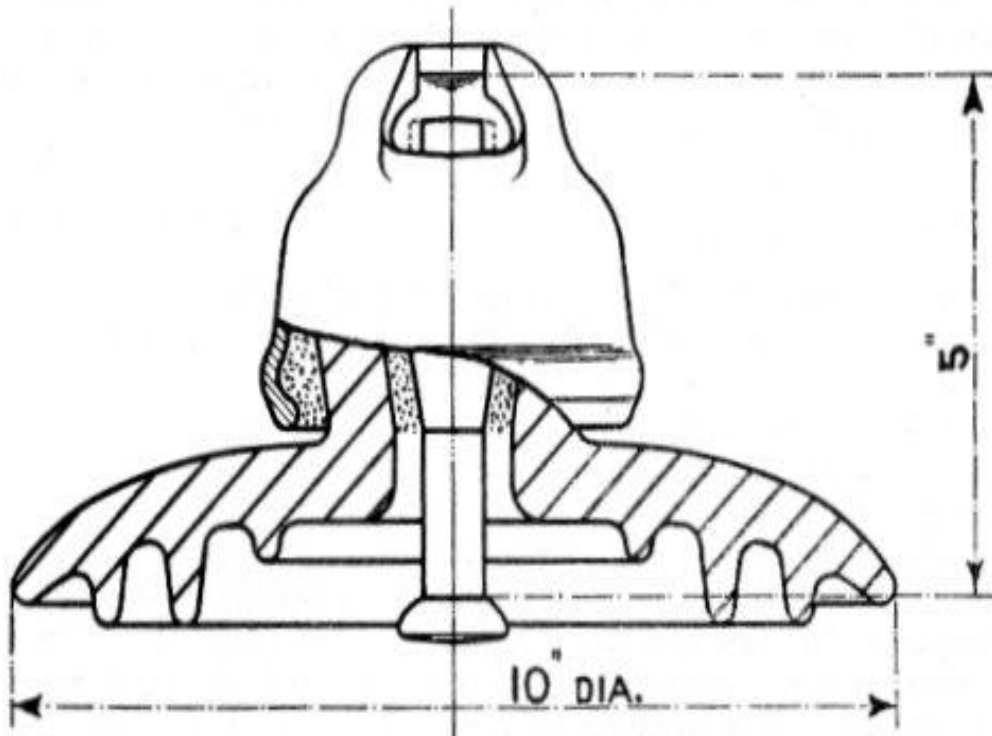


FIG. 10.4.—SUSPENSION INSULATOR.
(Messrs. Buller's, Ltd.)

120 KG C/ M sq +/- 10 on the shell before cap and pinassembly to check the integrity of Porcelain

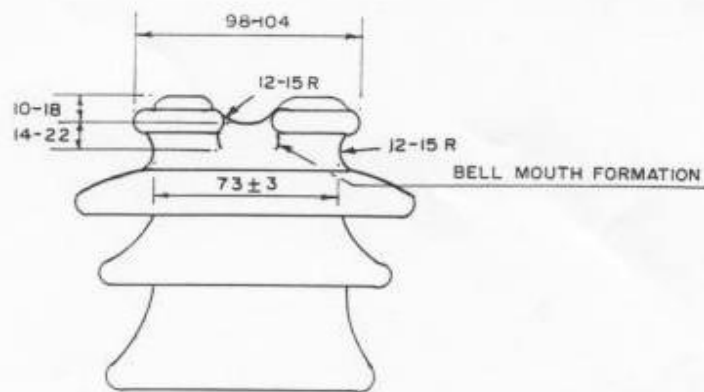


FIG-1.

११ के० वी० पिन विद्युत् रोधक का विस्तार
 DIMENSIONS OF 11 KV. PIN INSULATOR

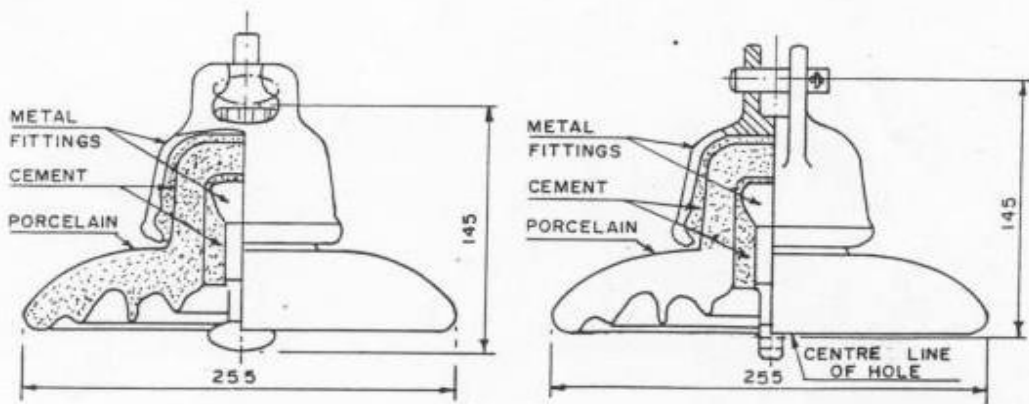
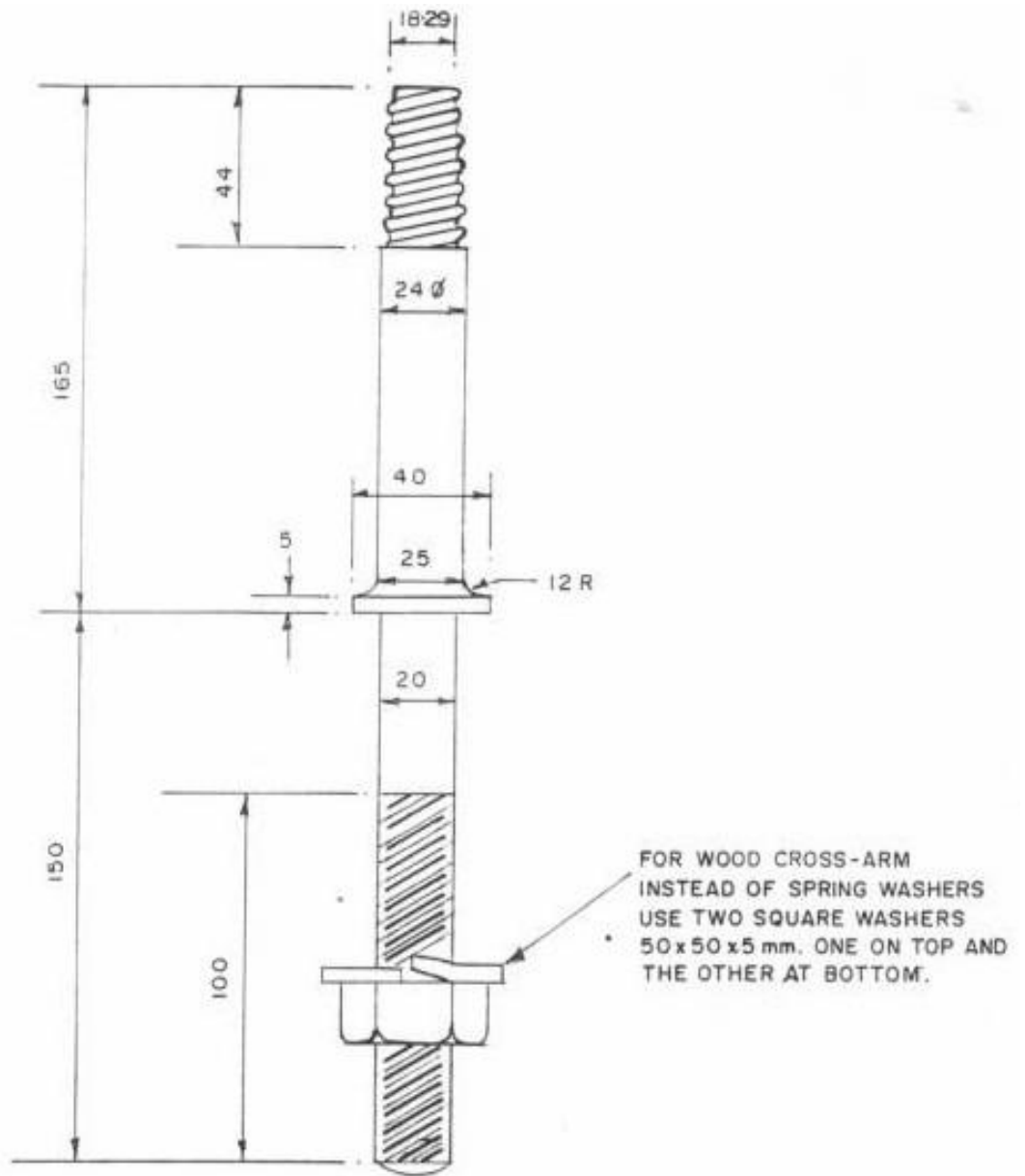


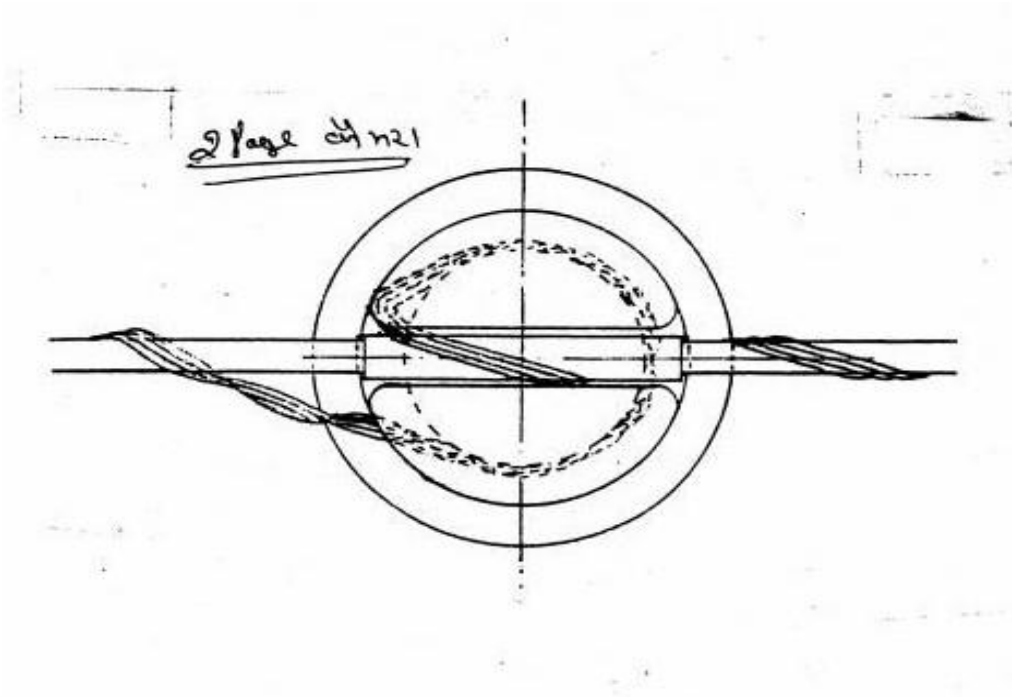
FIG-2A BALL AND SOCKET TYPE. FIG-2. TONGUE AND CLEVIS TYPE.

विकृति विद्युत् रोधक का विस्तार
 DIMENSIONS OF STRAIN INSULATORS



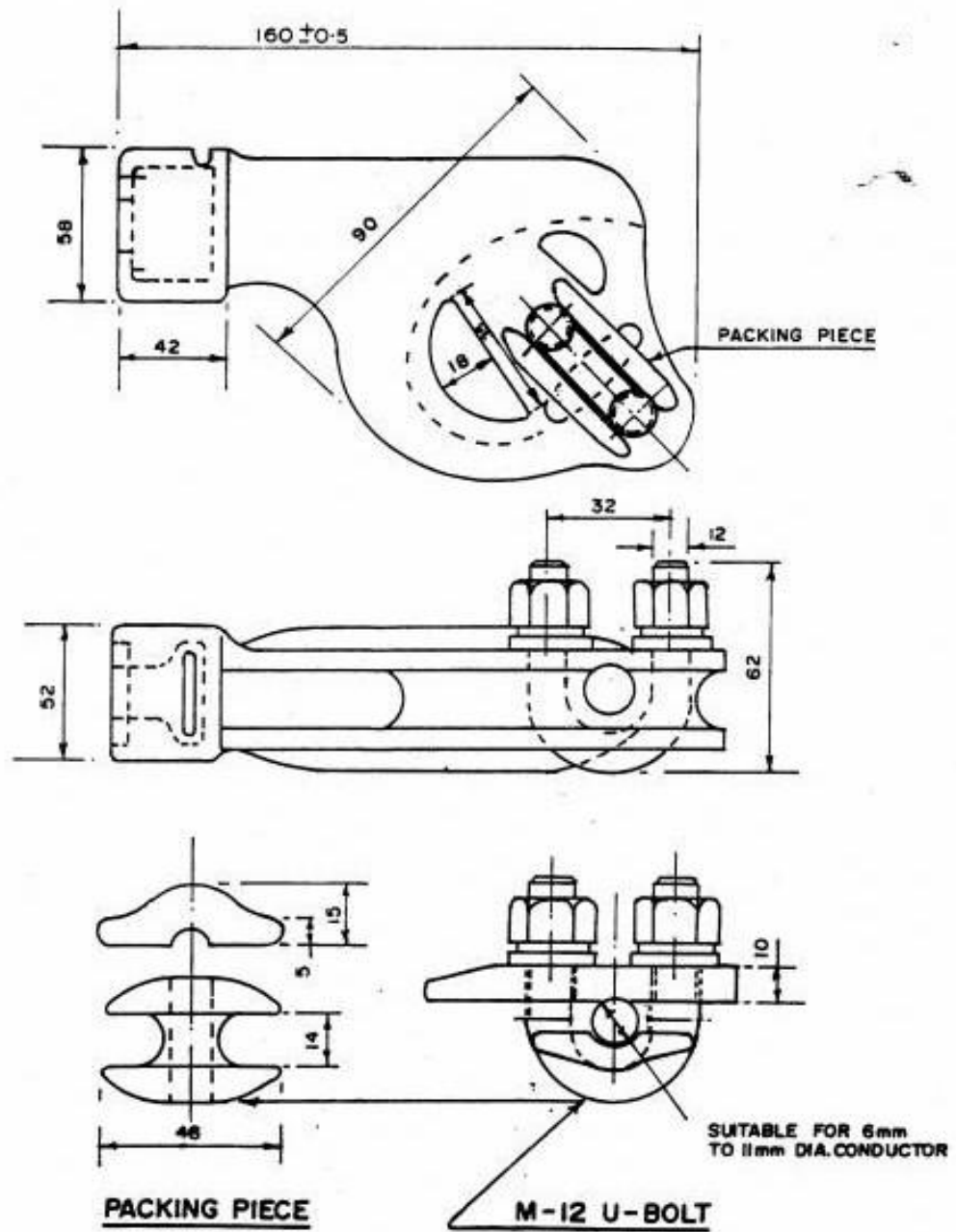
विद्युत रोधक पिन
INSULATOR PIN
(TYPE S 165P)
AS PER IS: 2486 Pt.II.

FIG-3.



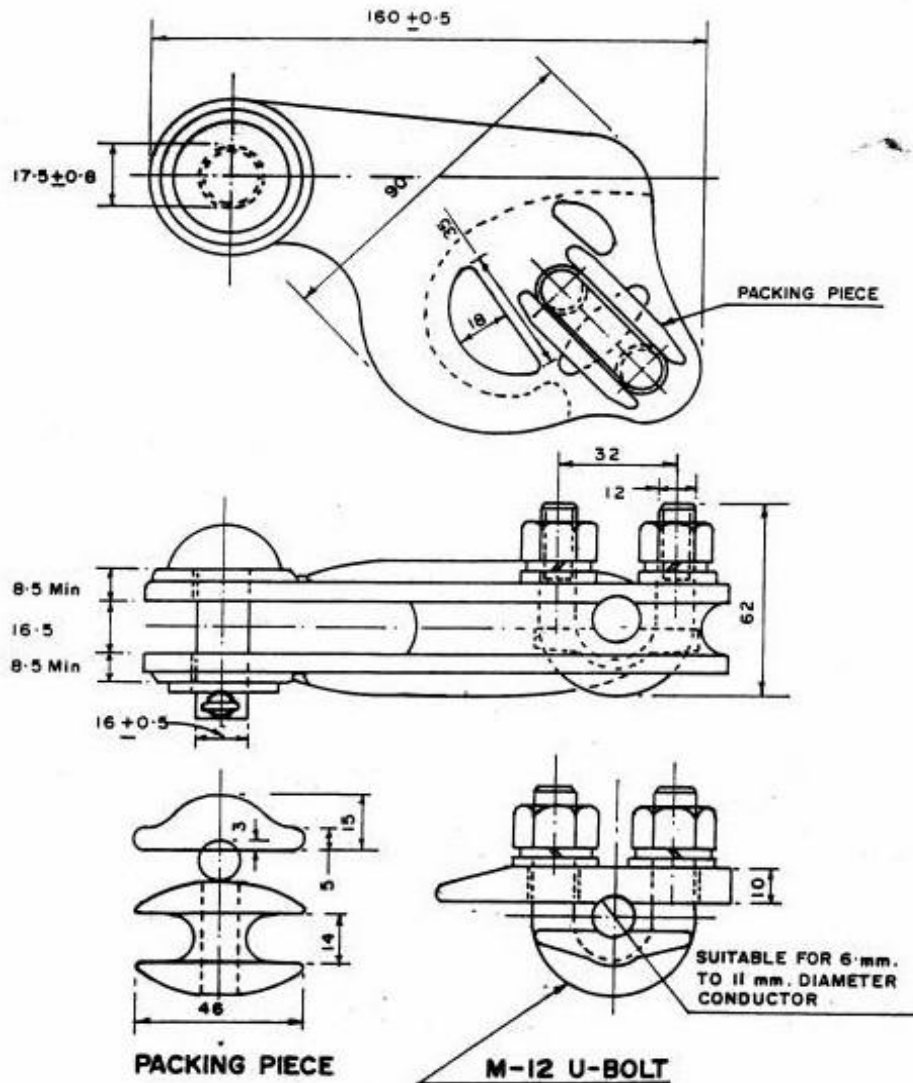
चित्र.४. ११ के.वी. पिन इन्सुलेटर टाई
(सीधी और १०° तक कोणीय स्थिति के लिए उपयुक्त)

FIG:- 4 - 11 KV PIN INSULATOR TIE
(SUITABLE FOR STRAIGHT RUNS AND ANGLE LOCATIONS UPTO 10°)



चित्र- 10. बॉल और सॉकेट प्रकार के विद्युतरोधक के लिए एक वी.वि.कृति (स्ट्रेन) क्लैम्प
 FIG.1-7 - 11KV. STRAIN CLAMP FOR BALL AND SOCKET TYPE INSULATOR.

ALL DIMENSIONS ARE IN mm.



चित्र: ८. टंग और क्लेविस् टाबप विद्युत्रोधक के लिए ११ के. वी. विकृति क्लैम्प
 FIG. 8. 11 KV. STRAIN CLAMP FOR TONGUE AND CLEVIS TYPE INSULATOR.

ALL DIMENSIONS ARE IN mm.

22 Porcelain Insulators and Insulator Fittings for 33 kV Overhead Power Lines

1. SCOPE

This specification covers the details of the porcelain insulators and insulator fittings for use on 33 KV lines in rural electric sub-transmission systems.

2. APPLICABLE STANDARDS

Unless otherwise stipulated in this Specification, the insulators shall comply with the Indian Standard Specification IS:731-1971 and the insulator fittings with IS:2486 (Pt.I)-1971 and IS:2486 (Pt.II)-1974 or the latest version thereof.

3. INSULATORS

3.1 General Requirements

3.1.1 The porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed.

3.1.2 Unless otherwise specified, the glaze shall be brown in colour. The glaze shall cover all the porcelain parts of the insulator except those areas which serve as supports during firing or are left unglazed for the purpose of assembly.

3.1.3 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. The porcelain shall not engage directly with hard metal.

3.1.4 Cement used in the construction of the insulator shall not cause fracture by expansion or loosening by contraction and proper care shall be taken to locate the individual parts correctly during cementing. The cement shall not give rise to chemical reaction with metal fittings, and its thickness shall be as uniform as possible.

3.2 Classification

3.2.1 Only Type 'B' insulators as defined in Indian Standards shall be used.

3.2.2 The string insulators shall only be of ball and socket type.

3.3 Basic Insulation Levels

3.3.1 The test voltages of the insulators shall be as under :

Table (Clause 3.3.1)

Highest System Voltage	Visible Discharge Test	Wet Power Frequency Withstand Test	Power Frequency Puncture Withstand Test		Impulse Voltage Withstand Test
			Pin	String Insulator Units	
KV (rms)	KV (rms)	KV (rms)	KV (rms)	KV(rms)	KV (Peak)
36	27	75	180	1.3 times the actual dry flash	170

				over voltage the Unit.	
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3.3.2 In this specification, power frequency voltages are expressed as peak values divided by $\sqrt{2}$ and impulse voltages are expressed as peak values.

3.3.3 The withstand and flashover voltages are referred to the 'Reference Atmospheric Conditions' as per Indian Standard.

3.4 Mechanical Load

The insulators shall be suitable for the minimum failing loads specified as under :

Pin Insulator Failing loads	String Insulator Units	
	Failing Loads	Commended Pin Ball Shank Diameter
10 KN	45 KN	16 mm

3.5 Creepage Distance

The minimum creepage distance shall be as under :

Highest System Voltage	Normal and Moderately Polluted Atmosphere (Total)	Heavily polluted Atmosphere (Total)
1	2	3
36KV	580mm	840mm

Note : For insulator used in an approximately vertical position the values given in Col.(2) or (3) shall apply. For insulators used in an approximately horizontal position, the value given in Col.(2) shall apply but the value in Col.(3) may be reduced by as much as 20%.

3.6 Tests :

The insulators shall comply with the following tests as per IS:731-1971 and latest version thereof.

3.6.1 Type Tests

- a) Visual examination,
- b) Verification of dimensions,
- c) Visible discharge test,
- d) Impulse voltage withstand test,
- e) Wet power-frequency voltage withstand test,
- f) Temperature cycle test,
- g) Electro-mechanical failing load test

- h) Mechanical failing load test (for those of Type B string insulator units to which electro mechanical failing load test (g) is not applicable).
- i) Twenty four hours mechanical strength test (for string insulators only when specified by the purchaser).
- j) Puncture Test
- k) Porosity test and
- l) Galvanising test

3.6.2 Acceptance Tests

The test samples after having withstood the routine tests shall be subjected to the following acceptance test in the order indicated below :

- a) Verification of dimensions.
- b) Temperature cycle test
- c) Twenty four hours mechanical strength test (for string insulator units only when specified by the purchaser)
- d) Electro-mechanical failing load test.
- e) Puncture test.
- f) Porosity test and
- g) Galvanising test

3.6.3 Routine Test

- a) Visual examination.
- b) Mechanical routine test (for string insulator units only) and
- c) Electrical routine test (for string insulator units only)

3.7 Marking

3.7.1 Each insulator shall be legibly and indelibly marked to show the following :

- a) Name or trade mark of the manufacturer
- b) Month and year of manufacture
- c) Minimum failing load in Newtons
- d) Country of the manufacture and
- e) ISI Certification mark, if any.

3.7.2 Marking on porcelain shall be printed and shall be applied before firing.

3.8 Packing

All insulators (without fittings) shall be packed in wooden crates suitable for easy but rough handling and acceptable for rail transport. Where more than one insulator are packed in a crate, wooden separators shall be fixed between the insulators to keep individual insulators in position without movement within the crate. Disc insulators, however, may be assembled instring and packed inside a crate to prevent movement.

4. INSULATOR FITTINGS

4.1 Pins for Pin Insulators

4.1.1 General Requirements

4.1.1.1 The pin shall be a single piece obtained preferably by the process of forging. It shall not be made by joining, welding, shrink-fitting or any other process from more than one piece of material. It shall be of good finish, free from flaws and other defects. The finish of the collar shall be such that a sharp angle between the collar and the shank is avoided.

4.1.1.2 All ferrous pins, nuts and washer except those made of stainless steel shall be galvanised. The threads of nuts shall be cut after galvanising and shall be well oiled and greased.

4.1.2 Type & Dimensions

4.1.2.1 Pins with large steel head Type L300N as per IS:2486 (Pt.II) having stalk length of 300 mm and shank length of 150 mm with minimum failing load of 10 KN shall be used.

4.1.2.2 The complete details of the pin are given in Fig.1.

4.1.3 Tests

Insulator pins shall comply with the following tests as per IS:2486 (pt.I).

4.1.3.1 Type Tests

- a) Visual examination test
- b) Checking of threads on heads
- c) Galvanising test and
- d) Mechanical test

4.1.3.2 Acceptance Tests

- a) Checking of threads on heads
- b) Galvanising test and
- c) Mechanical test

4.1.3.3 Routine Test

Visual examination

4.2 String Insulator Fittings

4.2.1 General Requirements

4.2.1.1 All forgings and castings shall be of good finish and free of flaws and other defects. The edges on the outside of fittings, such as at the ball socket and holes, shall be rounded.

4.2.1.2 All parts of different fittings which provide for interconnection shall be made such that sufficient clearance is provided at the connection point to ensure free movement and suspension of the insulator string assembly. All ball and socket connections shall be free in this manner but care shall be taken that too much clearance between ball and socket is avoided.

4.2.1.3 All ferrous fittings and the parts other than those of stainless steel, shall be galvanised. Small fittings like spring washers, nuts, etc. may be electro-galvanised.

4.2.2. Type and Dimensions

4.2.2.1 Only ball and socket type insulator sets shall be used. The nominal dimensions of the ball and sockets, ball eye and cross-arm straps are given in Fig. 2. An assembly drawing of the complete insulator string is given in Fig. 3.

4.2.2.2 Strain clamps shall be suitable for ACSR conductors $7/3.35 \text{ mm}^2$ (50 mm^2 Al. area), $7/4.09 \text{ mm}^2$ (80 mm^2 Al. area) and $6/4.72 \text{ mm} + 7/1.57 \text{ mm}$ (100 mm^2 Al. area). The ultimate strength of clamps shall not be less than 41 KN.

4.2.3 Tests

String insulator fittings shall comply with the following tests as per IS:2486 (Pt.I).

4.2.3.1 Type Tests

- a) Slip strength test
- b) Mechanical test
- c) Electrical resistance test
- d) Heating cycle test
- e) Verification of dimensions
- f) Galvanising/Electroplating test, and
- g) Visual examination test

4.2.3.2 Acceptance Tests

- a) Verification of dimensions
- b) Galvanising/Electroplating test, and
- c) Mechanical tests

4.2.3.3 Routine Tests

- a) Visual examination test and
- b) Routine mechanical test

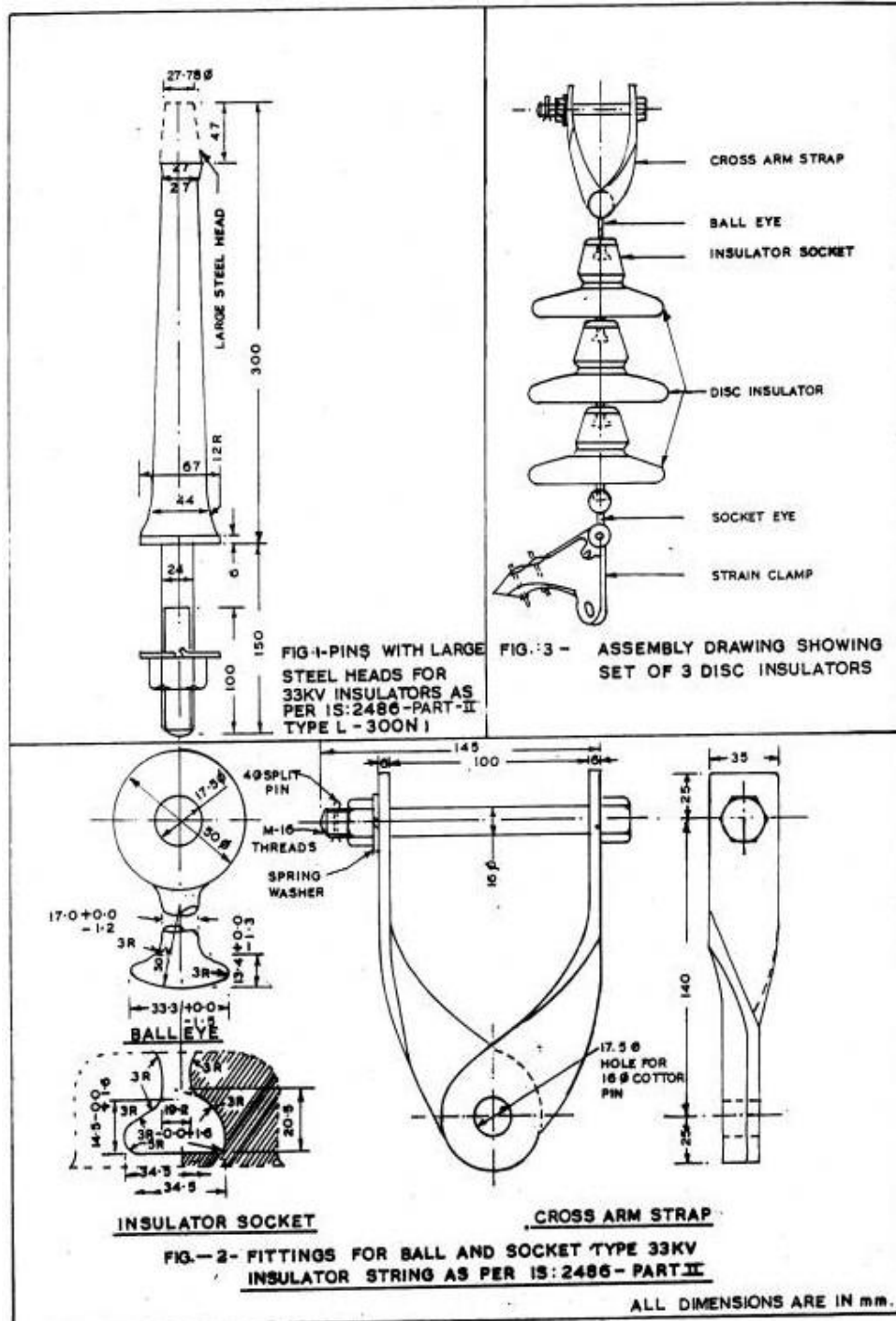
4.2.4 Marking

4.2.4.1 The caps and clamps shall have marked on them the following :

- a) Name or trade mark of the manufacturer and
- b) Year of manufacture

4.3 Packing

- 4.3.1 For packing of GI pins, strain clamps and related hardware, double gunny bags (or wooden cases, if deemed necessary) shall be employed. The heads and threaded portions of pins and the fittings shall be properly protected against damage. The gross weight of each packing shall not normally exceed 50 Kg. Different fittings shall be packed in different bags or cases and shall be complete with their minor accessories fitted in place. All nuts shall be hand-tightened over the bolts and screwed upto the farthest point.
- 4.3.2 The packages containing fittings may also be marked with the ISI certification mark.



23 33 kV and 11 kV Post Insulator

1 GENERAL REQUIREMENTS

- I. The porcelain shall be sound and free from defects, thoroughly vitrified and smoothly glazed.
- II. Unless otherwise specified the glaze shall be brown in colour. The glaze shall cover all the exposed porcelain part of the insulator except those areas which serve as support or required to be left un-glazed.

III. Precaution shall be taken during design and manufacture to avoid the following:

- a) Stress due to expansion and contraction which may lead to deterioration .
- b) Stress concentration due to direct engagement of the porcelain with the metal fittings.
- c) Retention of water in the recesses of metal fitting and
- d) Shapes which do not facilitate easy cleaning by normal methods.

IV. Cement used in the construction of the post insulator shall not cause fracture by expansion or loosening by contraction and proper care shall be taken to locate the individual parts correctly during cementing. Further, the cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible.

V. All ferrous metal parts except those of stainless steel, shall be hot dip galvanized and the uniformity of zinc coating shall satisfy the requirements of IS : 2633. The parts shall be galvanized after mechanising . The finished galvanized surface shall be smooth.

VI. The threads of the tapped holes in the post insulators metal fittings shall be cut after giving anti- corrosion protection and shall be protected against rust by greasing or by other similar means. All other threads shall be cut before giving anti-corrosion protection. The tapped holes shall be suitable for bolts with threads having anti - corrosion protection and shall conform to IS : 4218(Part-I to VI). The effective length of thread shall not be less than the nominal diameter of the bolt.

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

2 CLASSIFICATION

The post insulators shall be of type 'B' according to their construction, which is defined here under :

A post insulator or a post insulator unit in which the length of the shortest puncture path through solid insulating material is less than half the length of the shortest flash over path through air outside the insulator.

3 Standard insulation levels :

I. The standard insulator levels of the post insulator or post insulator unit shall be as under :

Highest system voltage	Visible discharge test	Dry one minute power frequency withstand test.	Wet one minute power frequency withstand test.	Power frequency puncture withstand test.	Impulse voltage withstand test.
12 KV (rms)	9 KV(rms)	35 KV(rms)	35 KV(rms)	1.3 times the actual dry flash over voltage of the unit(KVrms)	75 KV peak
36 KV (rms)	27 KV(rms)	75 KV(rms)	75 KV(rms)	1.3 times the actual dry flash over voltage of the unit(KVrms)	170 KV peak

II. In this standard, power frequency voltage are expressed as peak values divided by $\sqrt{2}$. The impulse voltages are expressed as peak values.

III. The withstand and flashover voltage are referred to the atmospheric condition.

4 TESTS

I. The insulators shall comply with the following constitute the type tests :

- a) Visual examination.
- b) Verification of dimensions.
- c) Visible discharge test.
- d) Impulse voltage withstand test.
- e) Dry power frequency voltage withstand test.
- f) Wet power frequency voltage withstand test.
- g) Temperature cycle tests.
- h) Mechanical strength tests.
- i) Puncture test.
- j) Porosity test.
- k) Galvanising test.

Type test certificates for the tests carried out on prototype of same specifications shall be enclosed with the tender and shall be subjected to the following acceptance test in the order indicated below.\

II. Acceptance test:

The test samples after having withstood routine test shall be subjected to the at least following acceptance test in the order indicated below :

- a) Verification of dimensions.
- b) Temperature cycle tests.
- c) Mechanical strength tests.
- d) Puncture test.
- e) Porosity test.
- f) Galvanising test.

III. Routine tests:

The following shall must be covered under routine tests on each post insulator or post insulator unit.

- a) Visual examination as per Cl. No.- 9.12 of IS : 2544/1973
- b) Mechanical routine test as per Cl. No.- 9.14 of IS : 2544/1973
- c) Electrical routine test as per Cl. No.- 9.13 of IS : 2544/1973

5 MARKING

I. Each post insulator shall be legibly and indelibly marked to show the following.

- a) Name or trade mark of the manufacturer.
- b) Month & year of manufacture.
- c) Country of manufacture.

II. Marking on porcelain shall be printed and shall be applied before firing.

III. Post insulator or post insulator units may also be mark with I.S.I. certification mark.

6 PACKING

All post insulators shall be pack in wooden crates suitable for easy but rough handling and acceptable for rail, transport. Where more than one insulator is packed in a crate wooden separators shall be fixed between the insulators to keep individual insulator in position without movement within the crate.

Table-I

Highest System Voltage in kV	Minimum Creepage distance in mm
	Post insulator
12	320
36	900

ANNEXURE – A

1 Hydraulic Internal Pressure Test on Shells (if applicable)

The test shall be carried out on 100% disc strain insulator shells before assembly. The details regarding test will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Programme.

2 Thermal Mechanical Performance Test

Thermal Mechanical Performance Test shall be performed in accordance with IEC-383-1-1993 Clause 20 with the following modifications:

(1) The applied mechanical load during this test shall be 70% of the rated electromechanical or mechanical value.

(2) The acceptance criteria shall be

(a) X greater than or equal to $R + 3S$.

Where,

X Mean value of the individual mechanical failing load.

R Rated electro-mechanical / mechanical failing load.

S Standard deviation.

(b) The minimum sample size shall be taken as 20 for disc insulator units.

(c) The individual electromechanical failing load shall be at least equal to the rated value. Also puncture shall not occur before the ultimate fracture.

3 Electromechanical/Mechanical Failing Load Test.

This test shall be performed in accordance with clause 18 and 19 of IEC 383 with the following acceptance

(i) X greater than or equal to $R + 3S$

Where,

X Mean value of the electro-mechanical/mechanical/ failing load.

R Rated electro-mechanical / mechanical failing load.

S Standard deviation.

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

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

4 Chemical Analysis of Zinc used for Galvanizing

Samples taken from the zinc ingot shall be chemically analysed as per IS:209. The purity of zinc shall not be less than 99.95%.

5 Tests for Forgings

The chemical analysis, hardness tests and magnetic particle inclusion test for forgings, will be as per the internationally recognised procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Programme.

6 Tests on Castings

The chemical analysis, mechanical and metallographic tests and magnetic particle inclusion for castings will be as per the internationally recognised procedures for these tests. The samplings will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Programme.

24 11 kV/22 kV/33 kV Composite Insulators

1) SCOPE :

This specification covers the design, manufacture, testing and supply of 11KV / 22KV / 33 KV Composite Insulators. The composite insulators shall be of the following type:

- i) Long rod insulators for conductors in tension application at angle / cut points the insulators shall be of tongue & clevis type.
- ii) Line post insulators or pin insulators for straight line locations

2) SERVICE CONDITIONS :

The insulators to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

Maximum ambient temperature (Degree C)	...	50
Minimum ambient temperature (Degree C)	...	3.5
Relative Humidity (%)	...	10 to 100
Maximum Annual Rainfall (mm)	...	1450
Maximum Wind pressure (kg/m.sq.)	...	150
Maximum wind velocity (km/hour)	...	45
Maximum altitude above mean sea level (meter)	...	1000
Isoceraunic level (days/year)	...	50
Seismic level (Horizontal acceleration)	...	0.3 g
Moderately hot and humid tropical climate Conductive to rust and fungus growth		

3) SYSTEM PARTICULARS:

a) Nominal System Voltage	11 kV	22 kV	33 kV
b) Corresponding highest system Voltage	12 kV	24kV	36 kV
c) Frequency	50 Hz with 3% tolerance		
d) Number of phase	3	3	3
e) Neutral earthing	effectively grounded.		

4) STANDARDS :

Unless otherwise specified elsewhere in the specifications insulators shall conform to the latest revisions of all relevant standards available at the time of placement of the order. The standards are listed in Annexure 'A'.

5) GENERAL REQUIREMENTS

- i) The composite insulators shall generally conform to latest Standards as listed in Annexure 'A'
- ii) The Composite Insulators will be used on lines on which the conductors will be A.A.A. Conductor of size up to 200 sq. mm. and ACSR of any size up to Panther (0.2 sq. inch copper equivalent). The insulators

should withstand the conductor tension, the reversible wind load as well as the high frequency vibrations due to wind.

- iii) Supplier must be an indigenous manufacturer and manufacturer of composite insulators of rating 33 kV or above OR must have developed proven in house technology and manufacturing process for composite insulators of above rating OR possess technical collaboration /association with a manufacturer of composite insulators of rating 33kV or above. The Manufacturer shall furnish necessary evidence in support of the above, which can be in the form of certification from the utilities concerned, or any other documents to the satisfaction of the Employer.
- iv) Insulator shall be suitable for both the suspension and strain type of load & shall be of tongue & clevis type. The diameter of Composite Insulator shall be less than 200 mm. The center-to-center distance between tongue & clevis shall be max. 300 mm for 11 kV, 450 mm for 22 kV & 550 mm for 33 kV composite Insulator.
- v) Insulators shall have sheds with good self-cleaning properties. Insulator shed profile, spacing, projection etc. and selection in respect of polluted conditions shall be generally in accordance with the recommendation of IEC-60815/IS: 13134.
- vi) The size of Composite insulator, minimum creepage distance and mechanical strength along with hardware fittings shall be as follows:

Sr. No.	Type of Composite insulators	Nominal System Voltage kV (rms)	Highest System Voltage kV(rms)	Visible Discharge Test Voltage kV(rms)	Wet Power Frequency Withstand Voltage kV(rms)	Impulse Withstand voltage kV(rms)	Minimum Creepage Distance (mm) (Heavily Polluted 25mm/kV)	Center to Center Distance Between Tongue & Clevis (mm)	Min. Failing load kN	Shed Diameter (mm) (min)
i.	Long Rod Insulator	11	12	9	35	75	320	300	45	75-100
		22	24	18	55	125	600	450	70	100
		33	36	27	75	170	900	550	70	100
ii.	Post/Pin Insulator	11	12	9	35	75	320		5	
		22	24	18	55	125	560		10	
		33	36	27	75	170	900		10	

- vii) Dimensional Tolerance of Composite Insulators
The tolerances on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows in line with-IEC 61109:

(0.04d+1.5) mm when d ≤ 300mm.
(0.025d+6) mm when d > 300 mm.
Where, d being the dimensions in millimeters for diameter, length or creepage distance as the case may be. However no negative tolerance shall be applicable to creepage distance.
- viii) Interchangeability:
The composite insulator together with the tongue & clevis fittings shall be of standard design suitable for use with the hardware of any other indigenous make conforming to relevant standards referred above.
- ix) Corona and RI Performance
All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under the operating conditions.

6) TECHNICAL DESCRIPTION OF COMPOSITE INSULATORS

Polymeric Insulators shall be designed to meet the high quality, safety and reliability and are capable of withstanding a wide range of environmental conditions.

Polymeric Insulators shall consist of THREE parts, at least two of which are insulating parts:-

- (a) Core- the internal insulating part
- (b) Housing- the external insulating part
- (c) Metal end fittings.

i) CORE

It shall be a glass-fiber reinforced epoxy resin rod of high strength (FRP rod). Glass fibers and resin shall be optimized in the FRP rod. Glass fibers shall be Boron free electrically corrosion resistant (ECR) glass fiber or Boron free E-Glass and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP rod shall be manufactured through Pultrusion process. The FRP rod shall be void free.

ii) HOUSING:

The FRP rod shall be covered by a seamless sheath of a silicone elastomeric compound or silicone alloy compound of a thickness of 3mm minimum. It shall be one-piece housing using Injection Molding Principle to cover the core. The elastomer housing shall be designed to provide the necessary creepage distance and protection against environmental influences. Housing shall conform to the requirements of IEC 61109/92-93 with latest amendments

iii) WEATHERSHEDS

The composite polymer weather sheds made of a silicone elastomeric compound or silicone alloy compound shall be firmly bonded to the sheath, vulcanized to the sheath or molded as part of the sheath and shall be free from imperfections It should protect the FRP rod against environmental influences, external pollution and humidity. The weather sheds should have silicon content of minimum 30% by weight. The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The interface, if any, between sheds and sheath (housing) shall be free from voids.

iv) METAL END FITTINGS:

End fitting transmit the mechanical load to the core. They shall be made of spheroidal graphite cast iron, malleable cast iron or forged steel or aluminum alloy. They shall be connected to the rod by means of a controlled compression technique. Metal end fittings shall be suitable for tongue & clevis hard wares of respective specified mechanical load and shall be hot dip galvanized after, all fittings have been completed. The material used in fittings shall be corrosion resistant. As the main duty of the end fittings is the transfer of mechanical loads to the core the fittings should be properly attached to the core by a coaxial or hexagonal compression process & should not damage the individual fibers or crack the core. The gap between fitting and sheath shall be sealed by a flexible silicone elastomeric compound or silicone alloy compound sealant. System of attachment of end fitting to the rod shall provide superior sealing performance between housing, i.e. seamless sheath and metal connection. The sealing must be moisture proof. The dimensions of end fittings of insulators shall be in accordance with the standard dimensions stated in IEC: 60120/ IS: 2486 - Part-II /1989.

7) WORKMANSHIP

7.1 All the materials shall be of latest design and conform to the best engineering practices adopted in the high voltage field. Manufacturers shall offer only such insulators as are guaranteed by them to be satisfactory and suitable for continued good service in power transmission lines.

7.2 The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners.

- 7.3 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.
- 7.4 The core shall be sound and free of cracks and voids that may adversely affect the insulators.
- 7.5 Weather sheds shall be uniform in quality. They shall be clean, sound, smooth and shall be free from defects and excessive flashing at parting lines.
- 7.6 End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively sealed to prevent moisture ingress; effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth with out projecting points or irregularities, which may cause corona.

All load bearing surfaces shall be sooth and uniform so as to distribute the loading stresses uniformly.

- 7.7 All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/sq.m. or 87 microm thickness and shall be in accordance with the requirement of IS:4759. the zinc used for galvanizing shall be of purity 99.5% as per IS:4699. 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 four successive dips each lasting for one (1) minute duration under the standard preece test. The galvanizing shall be carried out only after any machining.

8) TESTS AND STANDARDS

Insulators offered shall be manufactured with the same configuration & raw materials as used in the insulators for which design & type test reports are submitted. The manufacturer shall submit a certificate for the same. The design & type test reports submitted shall not be more than five years old.

8.1 DESIGN TESTS :

For polymeric insulators it is essential to carry out design test as per clause 4.1 of IEC 61109 / 92-93 with latest amendments. The design tests are intended to verify the suitability of the design, materials and method of manufacture (technology). When a composite insulator is submitted to the design tests, the result shall be considered valid for the whole class of insulators, which are represented by the one tested and having the following characteristics:

- Same materials for the core, and sheds and same manufacturing method;
- Same material of the fittings, the same design, the same method of attachment;
- Same or greater layer thickness of the shed material over the core (including a sheath where used);
- Same or smaller ratio of the highest system voltage to insulation length;
- Same or smaller ratio of all mechanical loads to the smallest core diameter between fittings
- Same or greater diameter of the core.

The tested composite insulators shall be identified by a drawing giving all the dimensions with the manufacturing tolerances.

Manufacturer should submit test reports for Design Tests as per IEC – 61109 (clause – 5). Additionally following tests shall be carried out or reports for the tests shall be submitted after award of contract:

UV test: the test shall be carried out in line with clause 7.2 of ANSI C29.13.

8.2 TYPE TESTS :

The type tests are intended to verify the main characteristics of a composite insulator. The type tests

shall be applied to composite insulators, the class of which has passed the design tests.

8.2.1 Following Type test shall be conducted on a suitable number of individual insulator units, components, materials or complete strings:

Sl. No	Description of type test	Test procedure / standard
1	Dry lightning impulse withstand voltage test	As per IEC 61109(Clause 6.1)
2	Wet power frequency test	As per IEC 61109(Clause 6.2)
3	Mechanical load-time test	As per IEC 61109(Clause 6.4)
4	Radio interference test	As per IEC 61109(Clause 6.5) revised
5	Recovery of Hydrophobicity test	Annexure – B This test may be repeated every 3yrs by the manufacturer
6	Chemical composition test for silicon content	Annexure – B Or any other test method acceptable to the Employer
7	Brittle fracture resistance test	Annexure – B

The Manufacturer shall submit type test reports as per IEC 61109. Additional type tests required if any shall be carried out by the manufacturer, after award of contract for which no additional charges shall be payable. In case, the tests have already been carried out, the manufacturer shall submit reports for the same.

8.3 ACCEPTANCE TESTS :

The test samples after having withstood the routine test shall be subject to the following acceptance tests in order indicated below:

(a)	Verification of dimensions	: Clause 7.2 IEC: 61109,
(b)	Verification of the locking system (if applicable)	: Clause 7.3 IEC: 61109,
(c)	Verification of tightness of the interface Between end fittings & Insulator housing	: Clause 7.4 IEC: 61109 amendment 1of 1995
(d)	Verification of the specified mechanical load	: Clause 7.4 IEC: 61109, amendment 1of 1995
(e)	Galvanizing test	: IS:2633/IS:6745

8.4 ROUTINE TESTS:

Sr.No.	Description	Standard
1	Identification of marking	As per IEC: 61109 Clause 8.1
2	Visual Inspection	As per IEC: 61109 Clause 8.2
3	Mechanical routine test	As per IEC: 61109 Clause 8.3

Every polymeric insulator shall withstand mechanical routine test at ambient temperature tensile load at RTL corresponding to at least 50 % of the SML for at least 10 sec.

8.5 TESTS DURING MANUFACTURE:

Following tests shall also be carried out on all components as applicable

- (a) Chemical analysis of zinc used for galvanizing
- (b) Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings.
- (c) Chemical analysis, hardness tests and magnetic particle inspection for forgings.

8.6 SAMPLE BATCH FOR TYPE TESTING :

The Manufacturer shall offer material for sample selection for type testing only after getting Quality Assurance Plan approved by Employer. The sample for type testing will be manufactured strictly in accordance with the approved Quality Assurance Plan.

9) QUALITY ASSURANCE PLAN :

9.1 The Manufacturer shall submit following information:

- i) Test certificates of the raw materials and bought out accessories.
- ii) Statement giving list of important raw material, their grades along with names of sub-Manufacturers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of Manufacturer's representative.
- iii) List of manufacturing facilities available.
- iv) Level of automation achieved and lists of areas where manual processing exists.
- v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- vi) List of testing equipments available with the Manufacturer for final testing of equipment along with valid calibration reports.
- vii) The manufacturer shall submit Manufacturing Quality Assurance Plan (QAP) for approval & the same shall be followed during manufacture and testing.

9.2 The Manufacturer shall submit the routine test certificates of bought out raw materials/accessories and central excise passes for raw material at the time of inspection.

9.3 The Employer's representative shall at all times be entitled to have access to the works and all places of manufacture, where insulator, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Manufacturer's and sub-Manufacturer's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

9.4 The material for final inspection shall be offered by the Manufacturer only under packed condition. The Employer shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for inspection shall be homogeneous and shall contain insulators manufactured in 3-4 consecutive weeks.

9.5 The Manufacturer shall keep the Employer informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.

9.6 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested unless the Employer in writing waives off the inspection. In the later case also the material shall be dispatched only after satisfactory testing specified herein has been completed.

9.7 The acceptance of any quantity of material shall in no way relieve the Manufacturer of his responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection, if such material are later found to be defective

10) TEST CERTIFICATE :

The manufacturerer shall furnish detailed type test reports of the offered composite Insulators as per clause 8.2 of the Technical Specifications at the NABL approved laboratories to prove that the composite Insulators offered meet the requirements of the specification. These Type Tests should have been carried out within five years prior to the date of opening of this manufacturer

The Employer reserves right to demand repetition of some or all the Type Test in presence of Employer's representative. For this purpose, the manufacturerer shall quote unit rates for carrying out each Type Test. However, such unit rates will not be considered for evaluation of the offer. In case the unit fails in the Type Tests, the complete supply shall be rejected.

11) TESTING FACILITIES :

The manufactirer must clearly indicate what testing facilities are available in the works of the manufacturer and whether facilities are adequate to carry out all Routine & acceptance Tests. These facilities should be available to Employer's Engineers if deputed or carry out or witness the tests in the manufacturer works. The insulators shall be tested in accordance with the procedure detailed in IEC 61109 / 92-93 with latest amendments.

12) DRAWINGS :

(i) The Manufacturer shall furnish full description and illustration of the material offered.

(ii) The Manufacturer shall furnish the outline drawing (3 copies) of each insulator unit including a cross sectional view of the long rod insulator unit. The drawing shall include but not be limited to the following information:

- Long rod diameter with manufacturing tolerances
- Minimum Creepage distance with positive tolerance
- Protected creepage distance
- Eccentricity of the long rod unit
 - Axial run out
 - Radial run out
- Unit mechanical and electrical characteristics
- Size and weight of ball and socket/tongue & clevis
- Weight of composite long rod units
- Materials
- Identification mark
- Manufacturer's catalogue number

(iii) After placement of award the Manufacturer shall submit fully dimensioned insulator crate drawing for different type of insulators for approval of the Employer.

13) RETEST AND REJECTION:

13.1 Sample Procedure for testing of insulators shall be as per clause 7.1 to 7.6 of IEC 61109 for Acceptance

& Routine Tests.

For the sampling tests, two samples are used, E1 and E2. The sizes of these samples are indicated in the table below.

Lot Size (N)	Sample Size	
	E1	E2
N < 300	Subject to agreement	
300 < N < 2000	4	3
2000 < N < 5000	8	4
5000 < N < 10000	12	6

If more than 10000 insulators are concerned, they shall be divided into an optimum number of lots comprising between 2000 and 10000 insulators. The results of the tests shall be evaluated separately for each lot.

The insulators shall be selected by the Employer's representative from the lot at random.

The samples shall be subjected to the applicable sampling tests.

The sampling tests are:

- Verification of dimensions - (E1 + E2)
- Verification of the locking system - (E2)
- Verification of tightness of the interface between end fittings & Insulator housing - (E2)
- Verification of the specified mechanical load SML - (E1)
- Galvanizing test - (E2)

In the event of a failure of the sample to satisfy a test, the retesting procedure shall be as follows :

If only one insulator or metal part fails to comply with the sampling tests, a new sample equal to twice the quantity originally submitted to the tests shall be subjected to retesting. The retesting shall comprise the test in which failure occurs. If two or more insulator or metal parts fail to comply with any of the sampling tests or if any failure occurs during the retesting, the complete lot is considered as not complying with this standard and shall be withdrawn by the manufacturer.

Provided the cause of the failure can be clearly identified, the manufacturer may sort the lot to eliminate all the insulators with these defects. The sorted lot then be resubmitted for testing. The number then selected shall be three times the first chosen quantity for tests. If any insulators fail during this retesting, the complete lot is considered as not complying with this standard and shall be withdrawn by the manufacturer.

13.2 Verification of dimensions (E1 + E2)

The dimensions given in the drawings shall be verified. The tolerances given in the drawing are valid. If no tolerances are given in the drawings the values mentioned in this specification shall hold good.

13.3 Verification of the locking system (E2)

This test applies only to the insulators equipped with socket coupling as specified by IEC 120 and is performed according to IEC 383.

13.4 Verification of tightness of the interface between end fittings & Insulator housing (E2)

One insulator selected randomly from the sample E2, shall be subjected to crack indication by dye penetration, in accordance with ISO 3452, on the housing in the zone embracing the complete length of the interface between the housing and metal fitting and including an additional area, sufficiently extended beyond the end of the metal part.

The indication shall be performed in the following way.

- (i) the surface shall be properly pre-cleaned with the cleaner ;
- (ii) the penetrant, which shall act during 20 minutes, shall be applied on the cleaned surface;
- (iii) within 5 minutes after the application of the penetrant, the insulator shall be subjected, at the ambient temperature, to a tensile load of 70 % of the SML, applied between the metal fittings; the tensile load shall be increased rapidly but smoothly from zero up to 70 % of the SML, and then maintained at this value for 1 minute;
- (iv) the surface shall be cleaned with the excess penetrant removed, and dried;
- (v) the developer shall be applied if necessary;
- (vi) the surface shall be inspected.

Some housing materials may be penetrated by the penetrant. In such cases evidence shall be provided to validate the interpretation of the results.

After the 1 min. test at 70 % of the SML, if any cracks occur, the housing and, if necessary, the metal fittings and the core shall be cut, perpendicularly to the crack in the middle of the widest of the indicated cracks, into two halves. The surface of the two halves shall then be investigated for the depth of the cracks.

13.5 Verification of the specified mechanical load SML

The insulators of the sample E1 shall be subjected at ambient temperature to a tensile load, applied between the couplings. The tensile load shall be increased rapidly but smoothly from zero to approximately 75 % of the SML, and then be gradually increased to the SML in a time between 30 sec. to 90 sec.

If 100 % of the SML is reached in less than 90 s, the load (100 % of the SML) shall be maintained for the remainder of the 90 s. (This test is considered to be equivalent to a 1min withstand test at the SML.)
 The insulators have passed the test at 13.4 & 13.5 above if:

No failure (breakage or complete pull out of the core, or fracture of the metal fitting) occurs either during the 1 min. 70 % withstand test (a) or during the 1 min. 100 % withstand test (b).

No cracks are indicated after the dye penetration method described in 13.4 above.

The investigation of the halves described in 13.4 above shows clearly that the cracks do not reach the core.

13.6 Galvanizing test

This test shall be performed according to IS: 2633/IS: 6745 on galvanized parts.

14) MARKINGS :

14.1 Each insulator shall be legibly and indelibly marked with the following details as per IEC- 61109:

- a) Name or trademark of the manufacturer.
- b) Voltage & Type
- c) Month and year of manufacturing.
- d) Min. failing load/guaranteed mechanical strength in kilo Newton followed by the word 'KN' to facilitate easy identification.
- e) DDUGJY 'Employer Name'. Marking

14.2 One 10 mm thick ring or 20 mm thick spot of suitable quality of paint shall be marked on the end fitting of each composite long rod of particular strength for easy identification. The paint shall not have any deteriorating effect on the insulator performance.

Following codes shall be used as identification mark:

For 45 KN long rod units : Blue
For 70 KN long rod units : Red

15) PACKING :

- 15.1 All insulators shall be packed in strong corrugated box of min. 7 ply duly palletted or wooden crates. The gross weight of the crates along with the material shall not normally exceed 100 Kg to avoid hackling problem. The crates shall be suitable for outdoor storage under wet climate during rainy season.
- 15.2 The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.
- 15.3 Suitable cushioning, protective padding, or Dunn age or spacers shall be provided to prevent damage or deformation during transit and handling.
- 15.4 All packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty packing and faulty or illegible markings. Each wooden case /crate /corrugated box shall have all the markings stenciled on it in indelible ink.
- 15.5 The Manufacturer shall provide instructions regarding handling and storage precautions to be taken at site.

16) GUARANTEE

The Manufacturer of insulators shall guarantee overall satisfactory performance of the insulators. The manufacturerer shall furnish in the form attached (Schedule 'A') all the guaranteed technical particulars.

SCHEDULE – A1

GUARANTEED TECHNICAL PARTICULARS.

COMPOSITE INSULATOR UNIT

11KV(45KN) / 11KV(70KN).

(to be filled separately for each type mentioned above)

Sr.No	Parameter Name	Parameter type	
1.	Type of insulator	Text	
2.	Standard according to which the insulators manufactured and tested	Text	
3.	Name of material used in manufacture of the insulator with class/grade	Text	
3.1	Material of core (FRP rod) i) E-glass or ECR-glass ii) Boron content		
3.2	Material of housing & weather sheds (Silicon content by weight)	Text	
3.3	Material of end fittings	Text	
3.4	Sealing compound for end fitting	Text	
4.0	Colour	Text	
5.	Electrical characteristics		
5.1.	Nominal system voltage	KV (rms)	Numeric
5.2	Highest system voltage	KV (rms)	Numeric
5.3	Dry Power frequency withstand voltage	KV (rms)	Numeric
5.4	Wet Power frequency withstand voltage	KV (rms)	Numeric
5.5	Dry flashover voltage	KV (rms)	Numeric
5.6	Wet flash over voltage	KV (rms)	Numeric
5.7	Dry lighting impulse withstand voltage a) Positive b) Negative	KV (peak) KV (peak)	Numeric
5.8	Dry lighting impulse flashover voltage a) Positive b) Negative	KV (peak) KV (peak)	Numeric
5.9	RIV at 1 MHz when energized at 10 kV/ 30 kV (rms) under dry condition	Micro volts	Numeric
6.0	Creepage distance (Min.) (320mm)	(mm)	Numeric
6.1	Center to center distance between tongue & clevis (300mm)	(mm)	Numeric
6.2	Shed diameter (100mm)	(mm)	Numeric
7.0	Mechanical characteristics: Minimum failing load	KN	Numeric
8.0	Dimensions of insulator		
8.1	Weight	Kg	Numeric

Sr.No	Parameter Name	Parameter type
8.2	Dia. of FRP rod: mm	Numeric
8.3	Length of FRP rod mm	Numeric
8.4	Dia. of weather sheds (100mm) mm	Numeric
8.5	Thickness of housing mm	Numeric
8.6	Dry arc distance mm	Numeric
8.7	Dimensioned drawings of insulator (including weight with tolerances in weight) enclosed.	Boolean
9.0.	Method of fixing of sheds to housing (Specify): Single mould or Modular construction (Injection molding / compression molding)	Text
10.0	No of weather sheds	Text
11.0	Type of sheds	
11.1	Aerodynamic	Text
11.2	With underribs	Text
12.	Packing details	
12.1	Type of packing	Text
12.2	No. of insulators in each pack	Text
12.3	Gross weight of package	Text
13.0	Design Test Report, Type Test Report of insulator enclosed.	Boolean
14.0	Any other particulars which the Manufacturer may like to give	File

SCHEDULE – A2

GUARANTEED TECHNICAL PARTICULARS.

COMPOSITE INSULATOR UNIT

22KV (70KN)

Sr.No	Parameter Name	Parameter type
1.	Type of insulator	Text
2.	Standard according to which the insulators manufactured and tested	Text
3.	Name of material used in manufacture of the insulator with class/grade	
3.1	Material of core (FRP rod) i) E-glass or ECR-glass ii) Boron content	Text
3.2	Material of housing & weather sheds (silicon content by weight)	Text
3.3	Material of end fittings	Text
3.4	Sealing compound for end fitting	Text
4.0	Colour	Text
5.	Electrical characteristics	
5.1.	Nominal system voltage	KV (rms) Numeric
5.2	Highest system voltage	KV (rms) Numeric
5.3	Dry Power frequency withstand voltage	KV (rms) Numeric
5.4	Wet Power frequency withstand voltage	KV (rms) Numeric
5.5	Dry flashover voltage	KV (rms) Numeric
5.6	Wet flash over voltage	KV (rms) Numeric
5.7	Dry lighting impulse withstand voltage a) Positive b) Negative	KV (peak) KV (peak) Numeric
5.8	Dry lighting impulse flashover voltage a) Positive b) Negative	KV (peak) KV (peak) Numeric
5.9	RIV at 1 MHz when energized at 10 kV/ 30 kV (rms) under dry condition	Micro volts Numeric
6.0	Creepage distance (Min.)	mm Numeric
6.1	Center to center distance between tongue & clevis (mm)	Numeric
6.2	Shed diameter	(mm) Numeric
7.0	Mechanical characteristics:	KN Numeric
	Minimum failing load	
8.0	Dimensions of insulator	
8.1	Weight	Kg Numeric

Sr.No	Parameter Name	Parameter type
8.2	Dia. of FRP rod: mm	Numeric
8.3	Length of FRP rod mm	Numeric
8.4	Dia. of weather sheds mm	Numeric
8.5	Thickness of housing mm	Numeric
8.6	Dry arc distance mm	Numeric
8.7	Dimensioned drawings of insulator (including weight with tolerances in weight) enclosed.	Boolean
9.0.	Method of fixing of sheds to housing (Specify): Single mould or Modular construction (Injection molding / compression molding)	Text
10.0	No of weather sheds	Text
11.0	Type of sheds	
11.1	Aerodynamic	Text
11.2	With underribs	Text
12.	Packing details	
12.1	Type of packing	Text
12.2	No. of insulators in each pack	Text
12.3	Gross weight of package	Text
13.0	Design Test Report, Type Test Report of insulator enclosed.	Boolean
14.0	Any other particulars which the Manufacturer may like to give	File

SCHEDULE – A3

GUARANTEED TECHNICAL PARTICULARS.

COMPOSITE INSULATOR UNIT

33KV (70KN)

Sr.No	Parameter Name	Parameter type
1.	Type of insulator	Text
2.	Standard according to which the insulators manufactured and tested	Text
3.	Name of material used in manufacture of the insulator with class/grade	
3.1	Material of core (FRP rod) i) E-glass or ECR-glass ii) Boron content	Text
3.2	Material of housing & weather sheds (silicon content by weight)	Text
3.3	Material of end fittings	Text
3.4	Sealing compound for end fitting	Text
4.0	Colour	Text
5.	Electrical characteristics	
5.1.	Nominal system voltage KV (rms)	Numeric
5.2	Highest system voltage KV (rms)	Numeric
5.3	Dry Power frequency withstand voltage KV (rms)	Numeric
5.4	Wet Power frequency withstand voltage KV (rms)	Numeric
5.5	Dry flashover voltage KV (rms)	Numeric
5.6	Wet flash over voltage KV (rms)	Numeric
5.7	Dry lighting impulse withstand voltage a) Positive KV (peak) b) Negative KV (peak)	Numeric
5.8	Dry lighting impulse flashover voltage a) Positive KV (peak) b) Negative KV (peak)	Numeric
5.9	RIV at 1 MHz when energized at 10 kV/ 30 kV (rms) under dry condition Micro volts	Numeric
6.0	Creepage distance (Min.) mm	Numeric
6.1	Center to center distance between tongue & clevis (mm)	Numeric
6.2	Shed diameter (mm)	Numeric
7.0	Mechanical characteristics: Minimum failing load KN	Numeric
8.0	Dimensions of insulator	
8.1	Weight Kg	Numeric

Sr.No	Parameter Name	Parameter type
8.2	Dia. of FRP rod: mm	Numeric
8.3	Length of FRP rod mm	Numeric
8.4	Dia. of weather sheds mm	Numeric
8.5	Thickness of housing mm	Numeric
8.6	Dry arc distance mm	Numeric
8.7	Dimensioned drawings of insulator (including weight with tolerances in weight) enclosed.	Boolean
9.0.	Method of fixing of sheds to housing (Specify): Single mould or Modular construction (Injection molding / compression molding)	Text
10.0	No of weather sheds	Text
11.0	Type of sheds	
11.1	Aerodynamic	Text
11.2	With underribs	Text
12.	Packing details	
12.1	Type of packing	Text
12.2	No. of insulators in each pack	Text
12.3	Gross weight of package	Text
13.0	Design Test Report, Type Test Report of insulator enclosed.	Boolean
14.0	Any other particulars which the Manufacturer may like to give	File

ANNEXURE 'A'

STANDARDS TO BE ADOPTED FOR COMPOSITE INSULATORS

Sr.	Indian Standard	Title	International Standard
1	-	Definition, test methods and acceptance criteria for composite insulators for A.C. overhead lines above 1000V	IEC: 61109
2	IS: 731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000V	IEC: 60383
3	IS: 2071	Methods of High Voltage Testing	IEC: 60060-1
4	IS: 2486	Specification for Insulator fittings for Overhead power Lines with a nominal voltage greater than 1000V General Requirements and Tests Dimensional Requirements Locking Devices	IEC: 60120 IEC: 60372
5.	-	Thermal Mechanical Performance test and mechanical performance test on string insulator units	IEC: 60575
6.	IS: 13134	Guide for the selection of insulators in respect of polluted condition	IEC: 60815
7.	-	Characteristics of string insulator units of the long rod type	IEC: 60433
8.	-	Hydrophobicity Classification Guide	STRI guide 1.92/1
9.	-	Radio interference characteristics of overhead power lines and high-voltage equipment.	CISPR: 18-2 Part 2
10.	IS: 8263	Methods of RI Test of HV insulators	IEC: 60437
11.		Standard for Insulators- Composite-Distribution Dead-end Type	ANSI C29.13-2000
12.	IS: 4759	Hot dip zinc coatings on structural steel & other allied products	ISO: 1459 ISO: 1461
13.	IS: 2629	Recommended Practice for Hot, Dip Galvanization for iron and steel	ISO: 1461 (E)
14.	IS: 6745	Determination of Weight of Zinc Coating on Zinc coated iron and steel articles	ISO: 1460
15.	IS: 3203	Methods of testing of local thickness of electroplated coatings	ISO: 2173
16.	IS: 2633	Testing of Uniformity of Coating of zinc coated articles	
17.	-	Standard specification for glass fiber strands	ASTM D 578-05
18.	-	Standard test method for compositional analysis by Thermogravimetry	ASTM E 1131-03
19.	IS:4699	Specification for refined secondary Zinc	

Annexure-B

Tests on Insulator units

1 RIV Test (Dry)

The insulator string along with complete hardware fittings shall have a radio interference voltage level below 100 micro volts at one MHz when subjected to 50 Hz AC voltage of 10kV & 30 kV for 11 kV & 33 kV class insulators respectively under dry condition. The test procedure shall be in accordance with IS:8263 /IEC:437/CISPR 18-2.

2 Brittle Fracture Resistance Test

Brittle fracture test shall be carried out on naked rod along with end fitting by applying "1N HNO₃ acid" (63 g conc. HNO₃ added to 937 g water) to the rod. The rod should be held 80% of SML for the duration of the test. The rod should not fail within the 96-hour test duration. Test arrangement should ensure continuous wetting of the rod with Nitric acid.

3 Recovery of Hydrophobicity & Corona test

The test shall be carried out on 4mm thick samples of 5cm X 7cm.

- i. The surface of selected samples shall be cleaned with isopropyl alcohol. Allow the surface to dry and spray with water. Record the Hydrophobicity classification in line with STRI guide for Hydrophobicity classification. Dry the sample surface.
- ii. The sample shall be subjected to mechanical stress by bending the sample over a ground electrode. Corona is continuously generated by applying 12 kV to a needle like electrode placed 1mm above the sample surface. The test shall be done for 100 hrs.
- iii. Immediately after the corona treatment, spray the surface with water and record the HC classification. Dry the surface and repeat the corona treatment as at clause 2 above. Note HC classification. Repeat the cycle for 1000 hrs. or until an HC of 6 or 7 is obtained. Dry the sample surface.
- iv. Allow the sample to recover and repeat hydrophobicity measurement at several time intervals. Silicone rubber should recover to HC 1 – HC 2 within 24 to 48 hours, depending on the material and the intensity of the corona treatment.

4 Chemical composition test for Silicon content

The content of silicon in the composite polymer shall be evaluated by EDX (Energy Dispersion X- ray) Analysis or Thermo-gravimetric analysis. The test may be carried out at CPRI or any other NABL accredited laboratory.

25 Guy Strain Insulators

1. SCOPE

This Specification covers porcelain guy strain insulators for use in rural electrification system.

2. APPLICABLE STANDARDS

Unless otherwise modified in this specification, the insulators shall comply with IS: 5300-1969 or the latest version thereof.

3. GENERAL REQUIREMENTS

3.1 The porcelain insulator shall be sound, free from defects, thoroughly vitrified and smoothly glazed.

3.2 The design of the insulator shall be such that the stresses due to expansion and contraction in any part of the insulator shall not lead to its deterioration.

3.3 The glaze, unless otherwise specified, shall be brown in colour. The glaze shall cover the entire porcelain surface parts except those areas that serve as supports during firing.

4. TYPE OF INSULATORS

4.1 The standard guy strain insulators shall be of designations 'A' and 'C' as per IS:5300.

4.2 The recommended type of guy strain insulators for use on guy wires of overhead lines of different voltage levels are as follows :

Power Line Voltage	Designation of Insulators
415/240V	A
11000V	C
33000V	C (2 Insulators to be used in series)

5. DIMENSIONS

The dimensions of guy strain insulators shall be in accordance with Figs. 1 and 2.

6. BASIC INSULATION LEVELS

The test voltage of the insulators shall be as under :

Designation of Insulator	Dry one minute power Frequency withstand voltageKV (rms)	Wet one minute power Frequency withstand voltage KV (rms)
A	18	8
C	27	13

7. MECHANICAL STRENGTH

The insulators shall be suitable for the minimum failing loads specified as under:

Designation of Insulator	Minimum failing load (KN)
A	44
	88

8. TESTS

The insulators shall comply with the following routine, type and acceptance tests as per IS:5300.

8.1 Routine Test

Visual examination

8.2 Type Tests

- a) Visual examination
- b) Verification of dimensions
- c) Temperature cycle test
- d) Dry one-minute power-frequency voltage withstand test
- e) Wet one-minute power frequency voltage withstand test
- f) Mechanical strength test
- g) Porosity test

8.3 Acceptance Tests: (to be conducted in the following order)

- a) Verification of dimensions
- b) Temperature cycle test
- c) Mechanical strength test
- d) Porosity test

9. MARKING

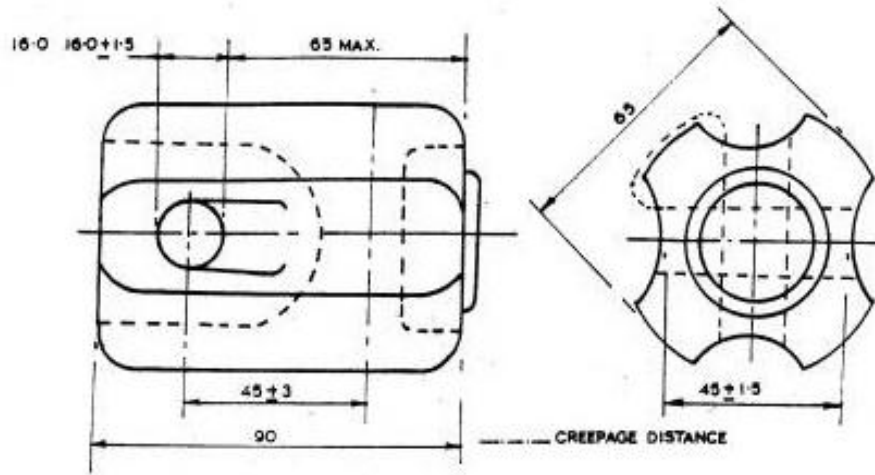
9.1 Each insulator shall be legibly and indelibly marked to show the following :

- a) Name or trade mark of the manufacturer
- b) Year of manufacture
- c) ISI certification mark, if any.

9.2 Marking on porcelain shall be applied before firing.

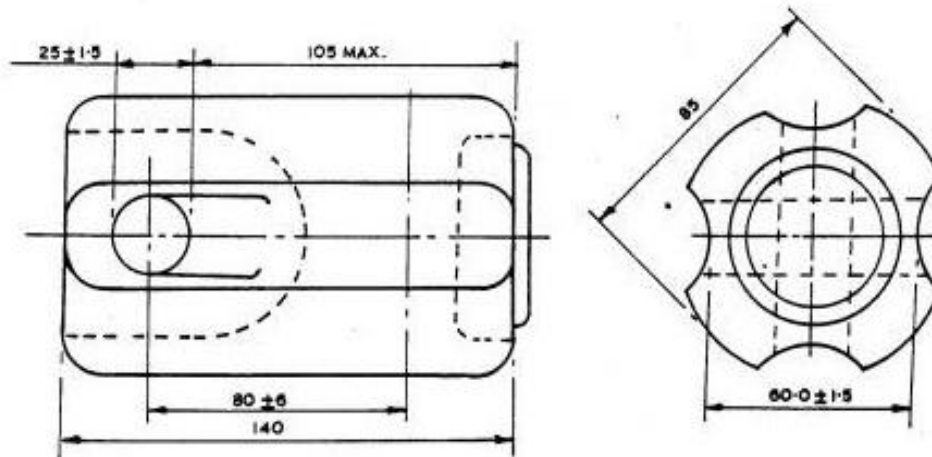
10. PACKING

All insulators shall be packed in wooden crates suitable for easy but rough handling and acceptable for rail transport. Wooden separators shall be fixed between the insulators to keep individual insulators in position without movement within the crate.



चित्र-१. तान रस्सी विकृतिसह विद्युतरोधक - संज्ञा ए.

FIG. 1. GUY STRAIN INSULATOR (DESIGNATION - A)



चित्र-२ तान रस्सी विकृतिसह विद्युतरोधक - संज्ञा सी.

FIG. 2. GUY STRAIN INSULATOR (DESIGNATION - C)

26 Helically Formed Fittings for 11 kV and LT Lines

1. SCOPE

This Standard specifies the requirements and tests for helically formed fittings for use on 11 KV and LT overhead lines.

The following types of fittings are covered:-

- a) Conductor dead end fittings
- b) Distribution ties, side ties and double ties
- c) Conductor splices
- d) Guy grip dead-ends
- e) Tap connectors
- f) Service grip dead-ends
- g) Lashing rods

2. GENERAL REQUIREMENTS

2.1 Aluminium alloy, aluminium-clad steel and galvanised steel wires having required mechanical strength, corrosion resistance and formability, depending on the type of application shall be employed in the manufacture of the fittings. The material of the formed fittings shall be compatible with the conductors with which it is used.

2.2 In case of formed wires, no joints shall be permitted except those in the base rod or wire before final drawing.

2.3 Each formed set shall be marked with indelible and distinct colour to indicate starting/cross-over point of application to facilitate its application on the conductor.

2.4 The ends of the individual wires of the formed fittings shall be suitably debarred to provide a smooth finish so as to avoid any damage to the conductor due to sharp edges.

2.5 Suitable grit shall be applied to the gripping section of the formed fitting (except lashing rods) in order to enhance its gripping strength.

3. PROPERTIES OF WIRES

3.1 Materials of the wires used in the manufacture of the fittings covered by this specification shall have the mechanical and electrical properties as specified in Tables 1,2 and 3. Materials used for chloroprene pad shall have the properties specified in Table 4.

Table 1

Aluminium Alloy Wires

Test	Requirements
1. Visual	a) No scratches
	b) No peeling off

	c) No speed crack
	d) No cut mark
2. Dimensions after forming	a) Diameter Tolerance (+) .000 mm (-) .025 mm
	b) Flattening (+) .000 mm (-) .076 mm
3. Tensile strength of formed wires	35 Kg/mm ²
4. Elongation of finished wire	Min. 2% in a gauge length of 50 mm
5. Conductivity of finished wire	Min. 39% as per IACS
6. <u>Wrap test</u> Wire diameter mm	Min. number of twists on a mandrel of its own dia without fracture at a rate of 15 turn per minute
Upto 3.07	18
From 3.08 to 3.45	16
From 3.46 to 3.71	14
From 3.72 to 4.24	12
From 4.25 and above	10

Table 2
Aluminium Clad Steel Wires

S.No.	Test	Requirements
1.	Visual	Free from splints, scale, inequalities, flaws and other irregularities :
2.	Dimentional	Roundness to (±) 0.013mm
3.	Tensile strength	As per table 2a below
4.	Weight of coating	As per table 2b below
5.	Wrap test (on a mandrel 2 times the dia of the sample and at the rate of 15 turns/minute)	After close helix, the sample should not fracture

6.	Adherence of coating (in a close helix not exceeding 15 turns/minute) around a cylindrical mandrel having a diameter prescribed in table 2c.	No cracking or flaking to such an extent that the aluminium coating can be removed by rabbing with the bare fingers
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Table 2a

Wire diameter (mm)	Ultimate tensile strength minimum) MPa	Ultimate elongation (Min.) percent in 254 mm
1.270 to 2.283 including	1280	3.0
2.286 to 3.045 including	1240	3.5
3.048 to 3.515 including	1210	4.0
3.518 to 3.782 including	1170	4.0
3.785 to 4.826 including	1140	4.0

Table 2b

Wire diameter (mm)	Min. weight of aluminium coating on uncoated wire surface (gms/m ²)
1.270 to 1.521 including	70
1.524 to 1.902 including	76
1.905 to 2.283 including	79
2.286 to 2.639 including	85
2.642 to 3.045 including	92
3.048 to 3.553 including	98

3.556 to 4.569 including	104
4.572 to 4.826 including	116

Table 2c

Wire diameter	Min. ratio of mandrel diameter to wire diameter
1.270 to 2.283 including	3
2.286 to 3.553 including	4
3.556 to 4.826 including	5

Table 3
Zinc coated steel wire

	Test	Requirements
1.	Visual	Free from splints, scale, inequalities and other irregularities :
2.	Dimentional	Roundness to (\pm) 0.013mm
3.	Tensile strength of finished wire	As per table 3a below
4.	Weight of zinc coating	As per table 3b below
5.	Wrap test (on a mandrel 2 times the dia of the sample and at the rate of 15 turns/minute)	After close helix of minimum 8 turns, the sample should not fracture.
6.	Adherence of coating (in a close helix not exceeding 15 turns/minute) around a cylindrical mandrel having a diameter prescribed in table 3c.	No cracking or flacking to such an extent that zinc coating can be removed by rabbing with the bare fingers

Table 3 a

Wire diameter mm	Ultimate tensile strength (Minimum) MPa	Elongation in 200 mm gauge length minimum (%) mm
1.270 to 2.283 including	1450	3.0
2.286 to 3.045 including	1410	3.5
3.048 to 3.053 including	1410	4.0
3.556 to 4.022 including	1380	4.0

Table 3b

Wire diameter (mm)	Minimum weight of zinc coating on uncoated wire surface (gms/m ²)
1.270 to 1.521 including	183
1.524 to 1.902 including	198
1.905 to 2.283 including	214
2.286 to 2.639 including	229
2.642 to 3.045 including	244
3.048 to 3.553 including	259
3.556 to 4.69 including	274
4.572 to 4.822 including	305

Table 3c

Wire diameter (mm)	Ratio of mandrel diameter to wire diameter
1.270 to 2.283 including	3
2.286 to 3.553 including	4
3.556 to 4.822 including	5

Table 4
 Properties for Chloroprene pad
 Chloroprene cushion shall have following properties :

1a)	Tensile Strength	Minimum 100Kg/cm ²
b)	Tensile strenght (after ageing)	Loss of maximum 25% of the test value obtained in 1(a)
2a)	Elongation	250% minimum
b)	Elongation (after ageing)	Loss of maximum 25% of the test value obtained in 2(a)
3a)	Shore hardness 'A'	65 (±)5
b)	Shore hardness (after ageing)	(±)15% of test values obtained in 3(a)

Note : Ageing should be carried out for 70 hours at 100°C.

4. REQUIREMENTS OF FORMED FITTINGS FOR VARIOUS APPLICATIONS

4.1 Conductor Dead-end fittings

4.1.1 Formed conductor dead-end fitting for 11 KV lines consists of the following parts for use with disc insulators of clevis and tongue type:

a) Cross arms strap for attaching the fittings to the pole on one side and the disc insulator on the other. These fittings shall conform to the REC Specifications of 11 KV Porcelain Insulators and Fitting.

b) Aluminium alloy die cast thimble clevis for attaching the fitting to the tongue of disc insulator on one end and for accomodating loop of the helically formed fitting at the other end in its smooth internal contour. The thimble clevis is attached to the insulator through a steel cotter pin used with a non-ferrous split pin of brass or stainless steel. The thimble clevis shall have clevis dimensions as per IS : 2486 (Part II) - 1989 and shall have the minimum failing load strength of 3000 kg.

c) Helically formed fitting acting as the dead-end grip.

4.1.2 The die-cast aluminium alloy thimble clevis shall be manufactured with alloy A6 Designation of IS : 617 - 1975.

4.1.3 Nuts and bolts used shall be of galvanised steel conforming to IS : 1364 - 1967 and cotter pins conforming to IS : 2004 -1978. Spring washers used shall be electro-galvanised.

4.1.4 The fitting for LT lines shall comprise of the helically formed fitting to suit the LT shackle insulator as per REC Specification of Porcelain Insulators and Insulator Fittings For 415/240V Overhead Power Lines

4.1.5 The fittings shall be made to suit the following conductor sizes for 11 KV/LT Lines conforming to REC Specification 1/1971(R-1993) and each fitting shall have a clear identification mark on PVC/metallic/plastic tag, indicating size of the conductor and voltage. The following colour code shall be used for the tag as also for the starting/cross-over marks for quick identification:

20 mm ² ACSR(Squirrel)	Blue
30 mm ² ACSR(Weasel)	Red
50 mm ² ACSR (Rabbit)	Yellow
50 mm ² ACSR (Rabbit)	Brown
50 mm ² AAC (Ant)	Grey

4.2 Distribution ties side ties and double ties

- 4.2.1 Helically formed ties are used to hold the conductor to pin insulators or shackle insulators.]
- 4.2.2 Chloroprene pad shall be provided with the formed ties for use on 11 KV lines to avoid abrasion of the conductor
- 4.2.3 The conductor sizes and voltage class shall be clearly marked on each fitting and the fittings shall also be identified by color code as per clause 4.1.5.
- 4.2.4 To ensure proper fitting of 11 KV pin insulator ties, the purchaser shall furnish full-dimensions of the insulator top particularly the crown diameter, neck diameter etc. See REC specification 11KV porcelain insulators and fittings.

4.3 Conductor Splices

4.3.1 Conductor splices for ACSR conductors shall consist of (i) galvanised steel formed splice for steel core (ii) aluminium alloy formed filler rod (iii) aluminium alloy formed splice for the aluminium strands of the conductor. For AAC conductor, splice is formed with aluminium alloy only.

4.3.2 Repair Splice: Repair splices are non-tension splices and are used where some of the outer strands of the conductor are damaged.

4.4 Guy Grip Dead-End

4.4.1 Guy grip dead ends have one leg shorter than the other and are suitable for gripping the guy wire. These grips are applied on one side into the thimble eye of the stay rod and on the other side to the guy wire. These can also be used directly with guy insulators.

4.4.2 The fittings shall be made of two sizes to suit stay wires of 7/3.15mm(7/10SWG) and 7/2.5 mm(7/12SWG) having UTS values 3625 kg and 2300 kg respectively.

4.4.3 The fittings shall be clearly identified on a PVC/mettalic/plastic tag for the size of stay wire with which these are to be used and, in addition, the following colour codes for the tag as well as the corss-over marks shall be adopted for proper identification:

Guy grip for 7/3.15 mm stay wire - Green

Guy grip for 7/2.5 mm stay wire - Black

4.4.4 The guy grip shall be supplied complete with thimble to suit the fitting. Thimble shall be made of hot-dipped galvanized steel.

Note: The guy grips to be used with guy insulators shall take into account the standard sizes of insulators as per REC specification and the type and size of the guy insulator shall be clearly specified by the purchaser.

4.5 Tap Connectors: Tap connectors consist of helically formed aluminium alloy wires for non-tension tapping of conductors and cables from the main line. The sizes of conductors/cables for which these tap connectors are to be used have to be clearly specified by the purchaser.

4.6 Service Grip Dead End: Service grip dead-ends are used with metallic knob to hold one or more service bearer wires.

4.7 Lashing Rods: Lashing rods are helically formed wires to secure the bearer wire to the service cable. The number of lashing rods will depend on the length of service.

5. DIMENSIONAL REQUIREMENTS OF THE FINISHED FORMED FITTINGS

5.1 The lay of the helix shall be right hand.

5.2 The diameter and number of formed rods used per set of fittings to be used on various sizes of conductors shall be as per the approved drawings.

5.3 Tolerances of formed fittings: The various requirements of the helically formed fitting shall be within the following tolerances:

	Item	Tolerances
	Pitch length	+ 0.6 mm (-)0.12 mm
	Internal diameter	+ 1% (-) 3%
	Length of individual rod	(±) 1%
	Difference in length	(±) 1% between the longest and the shortest rod in an individual set

6. TESTS

6.1 Type Tests: The following tests shall constitute the type tests on the finished fittings:

	Applicable to
Visual examination	All fittings
Verification of dimension	All fittings

Tensile strength test	All fittings
Electrical resistance test	All aluminium alloy fittings
Wrapping test	All fittings
Slip strength test	Conductor dead-end, guy grip and splices
Resilience test	Conductor dead-end, guy grip and conductor splices
Unbalanced holding Strength Test	Ties only
Fatigue test	Conductor dead-end, ties and splices
Galvanising test	Hardwares and fittings using GI wire
Pull-off strength test	Ties only
Electrical & Mechanical Test	Tap Connectors

Acceptance Test: The following shall constitute the acceptance test:

1. Visual examination
2. Verification of dimension
3. Tensile Strength test
4. Electrical resistance test
5. Wrapping test
6. Slip Strength test
7. Resilience test
8. Unbalanced load
9. Galvanisation test
10. Pull-off strength
11. Electrical & Mechanical tests on tap connectors
12. The tests for other requirements as per Tables 1,2,3 & 4 on the individual wires used in making the helically formed fittings and chloroprene pad (where used).

6.2 Routine Tests: The following shall constitute the routine tests:

- a) Visual examination
- b) Verification of dimensions

7. TEST PROCEDURE

7.1 Visual Examination: All fittings and individual wires shall be checked visually for good workmanship, smooth finish and other requirements indicated in Table 1, 2 and 3.

7.2 Verification of dimensions: The dimensions shall be checked as specified in the tables 1, 2, 3 and clause 5.

- 7.3 Tensile Strength Test:
- 7.3.1 Individual wire of the helically formed wires shall be straightened by light hammering and tested for tensile strength and elongation in accordance within the IS:398(Part II)-1976. The tensile strength and the elongation of the formed wires shall not be less than the values specified in tables 1, 2 and 3.
- 7.3.2 For thimbles and hardwares other than formed fittings:
 The dead-end clevis thimble and straps shall be tested for tensile strength in accordance with the requirements of mechanical failing load as per IS:2486(Part I)-1993.
- 7.4 Electrical Resistance Test: This test shall be done on straightened aluminium alloy formed wires only. The conductivity of the wires should not be less than 39% IACS.
- 7.5 Wrapping Test: The individual wires of the formed fittings shall be tested as specified in tables 1, 2 and 3. The wires should not break or show fracture when tested as above.
- 7.6 Slip Strength Test: For the conductor dead-end and guy grip dead-end, the test shall be made in accordance with IS:2486(Part I)-1993 and the value of slip/breaking strength shall not be less than 85% of the breaking strength of the conductor for conductor dead-end fitting and 100% for guy wires dead end fittings. In case of tension splices, the test shall be carried out as per IS:2121. No slippage or damage to the fitting shall occur at a value less than 100% of breaking load of the conductor. This test should be repeated after the resilience test.
- 7.7 Resilience Test: A set of helically formed fitting is wrapped and un-wrapped on a piece of conductor 3 times successively. The helical fitting should not lose its resilience even after three applications and should be able to pass the slip strength test requirements mentioned in 7.6 thereafter.
- 7.8 Unbalanced Holding test: Unbalanced holding strength is the ability of the formed ties to maintain a constant and uniform grip on the conductor when intermittent and repeated unbalanced loads impose a tension imbalance in the span. These imbalances occur due to wind induced motion, impacts, ice conditions and more so when the conductor is broken.

The test is intended to simulate the broken wire condition. A span of minimum 20 meters tensioned for 40% of UTS of the conductor shall be erected in the laboratory and a pin insulator alongwith the insulator tie under test shall be applied in the middle of span. The conductor used for this purpose shall be of the specific size with which the insulator tie is to be used. The test set up shall be such that it should be possible to apply a pull on one of the two dead ends of the conductor. For the purpose of this test, a steel replica of the insulator will be used. During the test, tension on one side of the pin insulator shall be suddenly released and effect observed. No slippage or damage to the fitting shall occur. After releasing tension from the other end, the fitting should retain the original form. This test will not only check the holding strength of the fitting but will also prove the resilience of the fitting in the event of broken wire.

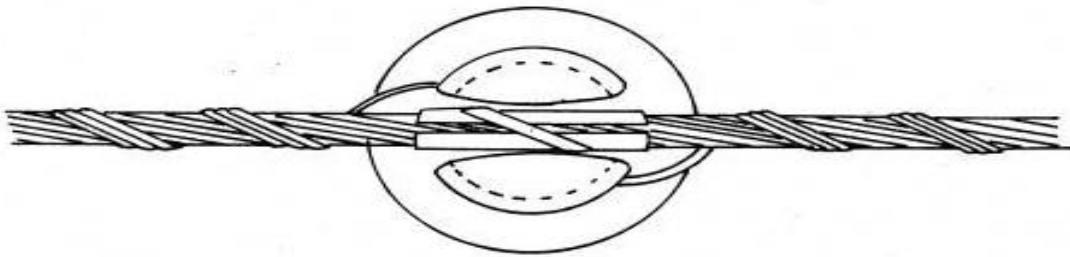
The test shall be repeated. After releasing the conductor tension on one side, pulling force shall be slowly applied on the other dead-end to pull the conductor till slippage/damage occurs. This force shall not be less than 320 kg.

- 7.9 Fatigue Test: The fittings should be subjected to fatigue test alongwith the conductor by imparting 10 million cycles of peak to peak amplitude at a frequency above 30 cycles for minimum span length of 20 meters, at 40% of UTS of conductor. The amplitude of the vibrations at the antinodal points should be atleast 50% of the diameter of the conductor. The test should be carried out for 10 million cycles as continuously as possible after which the conductor fitting and insulator should be examined. There should be no damage to the conductor or the insulator where the fitting is attached. The fitting should also be able to withstand the test without any damage.
- 7.10 Galvanising Test: Galvanising test should be carried out in accordance with IS:4826-1979 for uniformity and IS:6745-1972 for weight of zinc coating and the fittings will meet the requirements of Table 3.
- 7.11 Pull-Off Strength Test: This test is intended to simulate the conductor pull-off conditions created by various factors including elevation difference of the supporting structures on the two sides of the tie. A span of minimum 20 metres tensioned for 40% of UTS of the conductor shall be erected in the laboratory with a conductor of the specified size with which the fitting is intended to be used. A steel replica of pin insulator alongwith the insulator tie under test shall be applied in the middle of span so that a suitable pull-off force can be applied on the pin by means of a machine. The pull-off strength of the tie shall not be less than 200 Kg. for all the three sizes of ACSR.
- 7.12 Electrical & Mechanical Test on Tap Connectors: The tap Connector shall conform to all the electrical and mechanical properties as per IS:5561.
8. PACKING AND MARKING
- 8.1 All helically formed items covered under this specification shall be carefully handled to prevent distortion and damage. These items shall be packed and stored in suitable cartons.
- 8.2 Different colour codes shall be adopted for different conductor sizes and catalogue number and range of outside diameter of the conductor shall be indicated on the packing.
- 8.3 Clevis thimbles and other hardwares for conductor dead-ends shall be packed in wooden crates with all necessary markings.
- 8.4 The packings of the fittings should carry the following informations.
- a) Purchaser's name
 - b) Manufacturer's name and trade mark
 - c) Size of conductor, line voltage (when required) and numbers
 - d) Batch number, date, month and year of manufacture
 - e) Any other marking agreed to between manufacturer and user.

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 CONSTRUCTION STANDARD
 C-3



DISTRIBUTION TIE



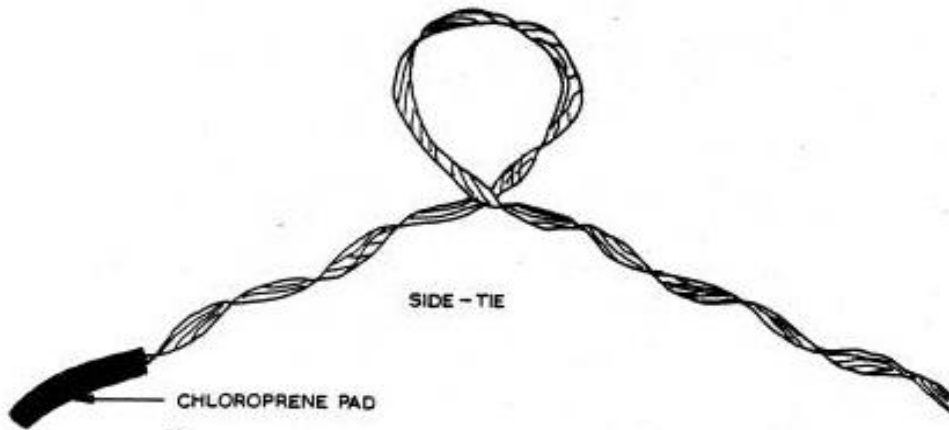
DISTRIBUTION TIE IN POSITION ON 11KV PIN INSULATOR

NOTE

FOR DETAILS OF HELICALLY FORMED FITTING REFER REC SPECIFICATION NO. 25/1983

११ के. वी. पिन इन्सुलेटर पर कन्डक्टर स्थापित करना - स्ट्रेट-रन (सर्पिल फॉर्मिंग फिटिंग का प्रयोग करना) HOLDING OF CONDUCTOR ON 11KV PIN INSULATOR - STRAIGHT RUN (USING HELICALLY FORMED FITTING)	
SCALE - N.T.S	JULY, 1984.

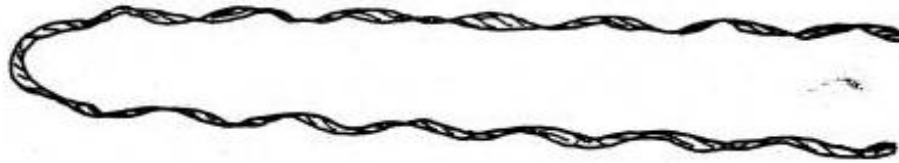
REC
CONSTRUCTION STANDARD
C-4



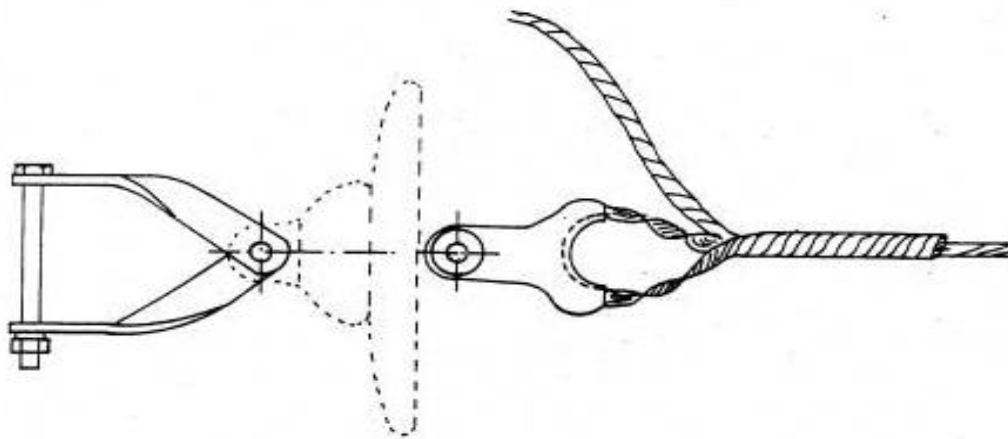
NOTE :- FOR DETAILS OF HELICALLY FORMED FITTINGS
REFER REC SPECIFICATION NO. 25/1983.

११ के. वी. पिन इन्सुलेटर पर कन्डक्टर स्थापित करना - सही लोकेशन (सोपल प्रकार के हेलिकल फिटिंग का प्रयोग करना)	
HOLDING OF CONDUCTOR ON 11KV PIN INSULATOR - ANGLE LOCATION (USING HELICALLY FORMED FITTING)	
SCALE:-N.T.S	JULY, 1984

REC
 CONSTRUCTION STANDARD
 C-5



CONDUCTOR DEAD-END FITTING



11 KV CONDUCTOR DEAD-END FITTING IN POSITION

11 KV STRAIN INSULATOR HARDWARE CONSIST OF:

1. HELICALLY FORMED DEAD-END FITTING
2. CLEVES THIMBLE AND
3. CROSS-ARM STRAP WITH BOLT.

NOTE:-

FOR DETAILS OF HELICALLY FORMED FITTING REFER
 REC SPECIFICATION NO. 25/1983

११ के. वी. कन्डक्टर अन्तिम छोर का विन्यास
 (सर्पिल आकार के फॉर्मड फिटिंग का प्रयोग
 करना)

11KV CONDUCTOR DEAD-END ARRANGEMENT
 (USING HELICALLY FORMED FITTINGS)

SCALE :- N.T.S

JULY, 1984

REC
CONSTRUCTION STANDARD
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USE OF LASHING RODS TO SECURE THE OVERHEAD BEARER WIRE AND
THE PVC SERVICE CABLE



FIGURE - 1

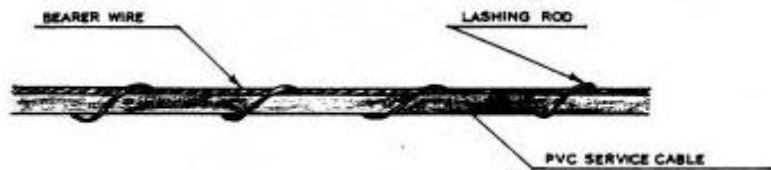


FIGURE-2

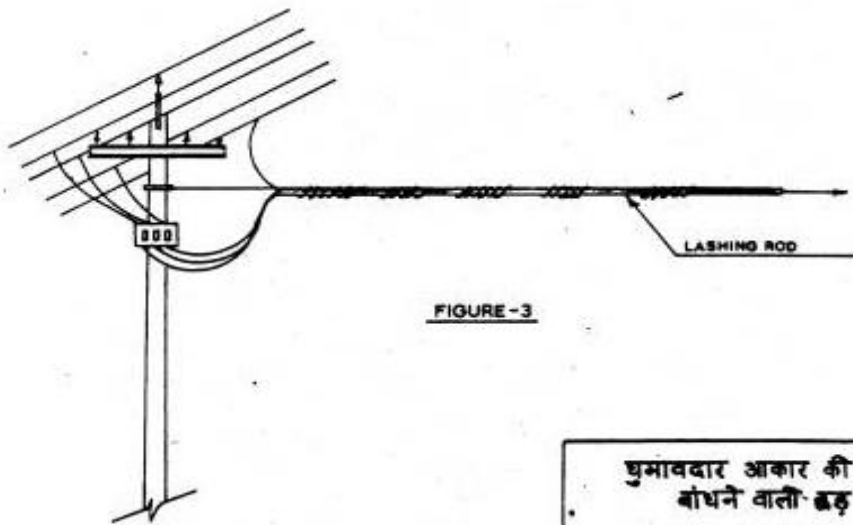


FIGURE - 3

FIG-1 SHOWS THE LASHING ROD.
FIG.2&3 SHOW THE LASHING RODS IN POSITION.

घुमावदार आकार की फिटिंग
बांधने वाली छड़
HELICALLY FORMED FITTINGS
LASHING RODS
SCALE :- N.T.S | JULY - 1984

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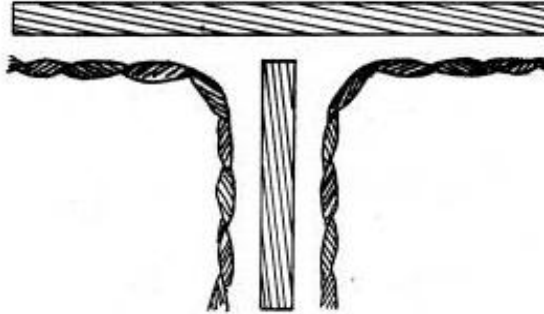


FIGURE - 1

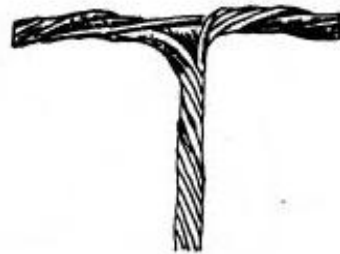


FIGURE - 2

NOTE:-

T-CONNECTORS CAN BE USED TO TAP SERVICE CONNECTIONS FROM THE LINE OR FOR TAPPING A BRANCH LINE FROM THE MAIN LINE.

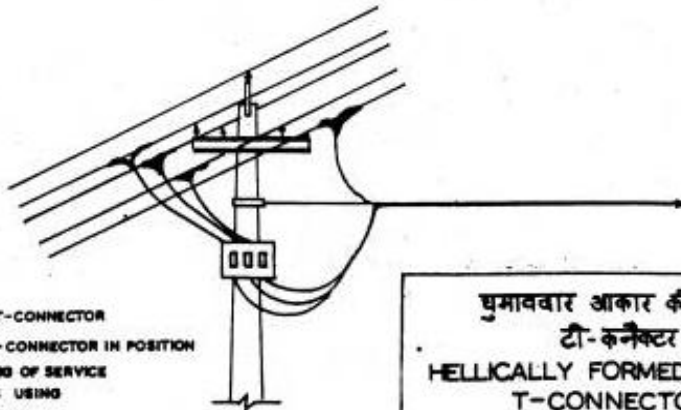


FIG.1 SHOWS THE T-CONNECTOR
 FIG.2 SHOWS THE T-CONNECTOR IN POSITION
 FIG.3 SHOWS TAPPING OF SERVICE CONNECTIONS USING T-CONNECTORS.

FIGURE - 3

घुमावदार आकार की फिटिंग
 टी-कनेक्टर
 HELICALLY FORMED FITTINGS
 T-CONNECTOR

SCALE:- N.T.S

JULY - 1984

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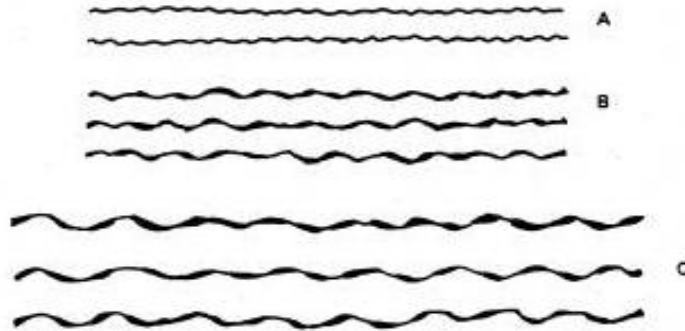


FIGURE-1

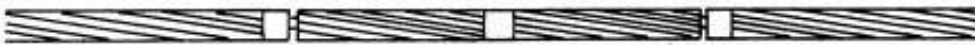


FIGURE-2

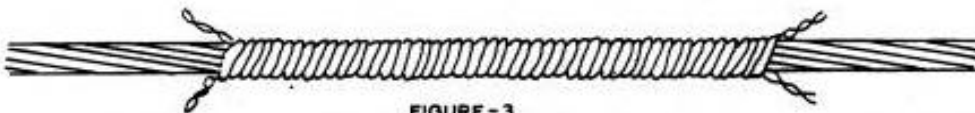


FIGURE-3

- A SHOWS THE CORE SPLICE
- B SHOWS THE FILLER RODS.
- C SHOWS THE OUTER SPLICE
- FIG.1. SHOWS THE CORE SPLICE IN POSITION
- FIG.2. SHOWS THE CORE SPLICE AND FILLER RODS IN POSITION
- FIG.3. SHOWS THE COMPLETE JOINT AND THE OUTER SPLICE IN POSITION.

घुमावदार आकार की फिटिंग
 र. सी. रम. आर. के लिए स्पलाईस
 HELLICALLY FORMED FITTINGS
 SPLICE FOR ACSR JOINT

SCALE :- N.T.S

27 Insulation Piercing Connectors, Anchor (Dead End) & Suspension Accessories & Other Accessories for Aerial Bunched Cables for Working Voltage upto and including 1100 Volts

1.0 SCOPE

This specification covers the design, manufacture, assembly, testing and supply of Accessories for anchoring, suspending & making connections to Aerial Bunched Cables rated 1100 volts and insulated with cross-linked polyethylene.

2.0 STANDARD

The design, performance and test requirements shall confirm to this specification and the following standards. However in case of any conflict, the requirements of this specification shall prevail.

- NFC 33-020 Insulation Piercing Connectors
- NFC 33-209 LV Aerial Bunched Cables
- NFC 20-540 Environment Testing for Outdoor
- NFC 33-004 Electrical Ageing Test
- NFC 33-040 Suspension Equipments
- NFC 33-041 Anchoring Devices
- IS 14255 LV Aerial Bunched Cables

The Devices shall also be compatible with the cables of sizes & dimensions as defined in the Cable Specifications for the cables with which they are intended to be used.

3.0 CLIMATIC CONDITIONS

For the purpose of designing the climatic conditions as specified in annexure-1 shall be considered.

4.0 CABLE DATA

The standard sizes and characteristics of the phase and street lighting conductors, messenger wires shall be as specified in IS: 14255-1995.

The Accessories of LT XLPE Insulated Aerial Bunched Cables (ABC) with ~~insulated~~bare messenger cum neutral are specified below:

- a) The ABC accessories should be of proven design with minimum 2 years record of satisfactory operation with a major utility. Order copies and Performance Certificates should be enclosed with the offer.
- b) Since ABC accessories are to be used with ~~insulated~~ bare neutral-cum-messenger, their design should incorporate specific features to prevent damage to the insulation which meeting the required electrical, mechanical & thermal requirements.
- c) All mechanical, electrical & thermal ratings should meet or exceed 90% of the corresponding ratings of the cable, or the values specified herein, whichever are more stringent.
- d) The accessories should provide "Double Insulation" so that a single point failure of insulation will not result in the system tripping.

5.0 THE ABC ACCESSORIES

The ABC Accessories shall consist of the following:

a)	Insulation Piercing Connectors (IPC)	:	For making tap-off/branch connectors/service connector to an ABC line.
b)	Anchoring Assembly (AA)	:	For fitting onto a pole for anchoring the end of a length of ABC, or for a major change in direction.
c)	Suspension Assembly (SA)	:	For supporting a length of ABC at an intermediate pole in a length, with small angle of deviation.
d)	Service clamp (sc)	:	For anchor Insulated service lines (armoured or unarmour)
e)	Transformer Connections	:	For connection to the transformer bushing.
f)	Junction Sleeves	:	For Phases, neutral messengers & Street lighting conductor.
g)	ABC Service Main Distribution Box	:	For Distribution of multiple no. of Service Connections from Main AB cable.

5.1 Insulation Piercing Connectors (IPC)

5.1.1 Insulation Piercing Connectors (IPC) are used for making Tee/Tap-off/Service connectors to an ABC/Bare Overhead Line.

5.1.2 Insulation Piercing Connectors are designed to make a connection between the uncut main conductor and a branch cable conductor without having to strip either cable to expose the conductor instead the tightening action of the IPC will first pierce the Insulation, then make good electrical contact between the main end and branch conductor while simultaneously insulating and sealing the connection.

5.1.3. Constructional Features of IPC

5.1.3.1 The housing shall be made entirely of mechanical and weather resistant plastic insulation material and no metallic part outside the housing is acceptable except for the tightening bolt.

5.1.3.2 Any metallic part that is exposed must not be capable of carrying a potential during or after connector installation.

5.1.3.3 Screws or nuts assigned for fitting with IPC (Insulating Piercing connector), must be fitted with torque limiting shear heads to prevent over tightening or under tightening (min & max torque values to be specified by Manufacturer).

5.1.3.4 The IPC must perform piercing and connection on Main and Branch cable simultaneously.

5.1.3.5 The IPCs shall be water proof and the water tightness shall be ensured by appropriate elastomer materials and not by grease, gel or paste alone.

5.1.3.6 Design of IPC should be such as to not cause damage to insulation of adjacent conductors due to vibration and relative movement during service.

5.1.3.7 The connector shall have a rigid removable end cap which can be slide fitted onto the main connector body on either right or left by the installer (depending on site requirement) for sealing the cut end of the branch cable. Once the connector is fitted, it should not be possible to remove the cap without removing the connector.

5.1.3.8 All the metallic parts of the connector should be corrosion resistant and there should not be any appreciable change in contact resistance & temperature after overloads & load cycling.

- The contact plates should be made of tinned copper/aluminium alloy.
- Connector teeth should be factory greased & sealed to retard water or moisture ingress & corrosion.
- The Insulation material should be made of weather & UV resistant reinforced polymer.
- The outer metallic part should have potential free tightening bolts to allow safe installation on live lines.

5.1.4 Mechanical Tightening and Electrical Continuity

5.1.4.1 Connectors shall be tightened upto 70% of the minimum torque indicated by the Manufacturer. At this torque electrical contact should have occurred between conductors to be joined. Then connectors shall be tightened up to the breakdown of the shear heads and lastly, upto 1.5 times the maximum torque indicated by the manufacturer.

For the connector fitted with two screws on the same core, after the breakdown of the shear heads tightening may be carried out manually and alternatively using a torque meter. The test conditions shall be as close as possible to those defined for the use of the test machine as per NF-C standard.

5.1.4.2 At 1.5 times the maximum torque indicated by the manufacturer, there shall be no breakdown of any part of the connector or the core conductor.

5.1.4.3 Maximum rated torque shall not exceed 20 N.m for conductor <95 sq.mm and 30 for >95 but <150 sq.mm.

5.1.4.4 Tightening screws shall have hex. Heads of 10 mm, 13 mm or 17 mm only.

5.1.5 Effect of Tightening on Main Core of IPC

5.1.5.1 The connector shall be fitted approx. at the centre of the main core, which is secure between two anchoring points 0.5 mtr. To 1.5 mtr.apart. At the time of fitting the connectors, the main core shall be under longitudinal tension at 20% of the load indicated in Table-1:

Table-1	
Nominal Cross – section (sq.mm.)	Tensile Strength (Newton)
16	1200
25	1800
35	2500
50	3500

70	5000
150	10000

5.1.5.2 Tensile strain shall be increased to the full value indicated in the Table 1 and held minute. There should be no breakdown of the core conductor.

5.1.6 Effect of Tightening on Branch Core of IPC

5.1.6.1 Test specimen shall be made up as in clause 5.1.5.1 except that this shall be do the smallest cross sections of main and branch conductors within its range.

5.1.6.2 An increasing tensile load shall be applied to the Branch Conductor along the axis of the recess for the Branch cable. Load shall increase at 100 – 500 N/minute until it reaches the value specified in the Table 2 and maintained for 1 minute.

Nominal Cross – section (sq.mm.)	Tensile Strength (Newton)
16 (Alu)	290
25	450
35 & above	500

5.1.6.3 No slippage or breaking of conductor shall occur.

5.1.7 Dielectric & Water Tightness Test of IPC

5.1.7.1 The connector is tightened up to the minimum torque indicated by the manufacturer.

5.1.7.2 Connectors are mounted on

- Minimum cross section of main core.
- Maximum cross section of main core.

5.1.7.3 In each case Branch is of minimum cross section.

5.1.7.4 Protection caps for the branch cable are to be used in accordance with the requirements of clause 5.1.3.7. An additional water tight cap of any design may be used to seal one end of the main cable if it is immersed under water. No additional gel or any protection is to be provided while installing connector.

5.1.7.5 The entire assembly shall be immersed at a depth of approx. 30cms. For 30 minutes with the free ends of main and branch cable out of the water.

5.1.7.6 An AC voltage of 6 kV shall be applied between the water bath and each of the cores in turn for 1 minute. There shall be no flashover or electrical tripping with a trip setting of 10 mA + 0.5mA.

5.1.8 Electrical & Ageing Test of IPC

5.1.8.1 Two test configurations are used according to Table 3 with the connections tightened to the minimum torque specified by their manufacturers and resistance recorded.

Table - 3		
Configuration	Main core cross section	Branch core cross section Tensile Strength (K.N)
1st Configuration	Maximum	Maximum
2nd Configuration	Maximum	Maximum

- 5.1.8.2 The configurations are subjected to 200 heat cycles by injecting suitable current into them. In each cycle the temperature of the conductor shall be raised from ambient to 120 + 5°C as, measured by a thermocouple.
- 5.1.8.3 The duration of each heating cycle is chosen to maintain a sufficiently steady temperature of 120 + 5°C for 15 minutes. The duration of each cooling cycle is chosen to bring the conductor temperature to within 2°C of ambient.
- 5.1.8.4 Nominal heating current is indicated in the Table-4. It shall be permissible to accelerate the temperature rise by using a current up to 1.5 times the nominal current and to accelerate the cooling period by use of a fan or air blower.

Table-4	
Nominal Cross – section (sq.mm.)	Nominal Heating Current (A)
16	102
25	139
35	175
50	225
70	283
95	350
120	412
150	480
185	545
240	670

- 5.1.8.5 The over current test of Clause 5.1.9 shall be done after 50 cycles if the connector is a safety connector designed to ground a phase connector while the line is being worked on.
- 5.1.8.6 At the end of the 200 cycles the resistance shall again be measured. It shall not differ from the initial value by more than 12%.
- 5.1.9 Over Current Test of IPC
 - 5.1.9.1 Over current test is required to establish the performance of Safety Connectors that are intended to provide a safe path to ground for the phases while the line is de-energised for working. It establishes the performance of the connector under short term over load conditions.
 - 5.1.9.2 After the first 50 cycles of clause 5.1.8, the connectors are subjected to 4 over currents of 1 sec duration each.
 - 5.1.9.3 The conductor temperature at the start of the over current test should be not more than 35°C.

5.1.9.4 Current density during over current shall be 100 A/sq.mm for Aluminium and 95 A/sq.mm for Aluminium – Alloy Conductor.

5.1.9.5 Variation in time of over current is permissible between 0.85 sec & 1.15 sec., provided it maintains the relationship $I^2 t = K$

$$t = K / I^2 \text{ where,}$$

I = rms value of over current in Amps.
t = time in seconds
K = Constant

5.1.9.6 After the over current test the electrical ageing test of clause 5.1.8 shall be resumed.

5.1.10 Type Test of IPC

5.1.10.1 Type Test Reports should be submitted from an Independent Laboratory of Repute or the Works Laboratory in case of a foreign manufacturer covering the following (on any convenient size of fitting of same design made from the same materials).

5.1.10.2 The installation of the connectors shall be done by the laboratory following instructions provided by the manufacturer.

5.1.10.3 The Test report shall record the embossing and marking on the connector.

5.1.10.4 The following shall constitute Type Tests for IPC :

- Electrical Ageing Test
- Dielectric and Water Tightness Test.
- Mechanical Tightening Test
- Effect of Tightening on main Core
- Effect of Tightening on Branch core
- Over-current Test (if applicable)

The following shall be Type Test for Suspension Assembly (SA)

- Mechanical Test
- Voltage Test
- Climatic Aging Test
- Corrosion Test
- Endurance Test under Thermal & Mechanical Stresses

The following shall be Type Tests for Anchoring Assemblies (AA)

- Mechanical Test
- Voltage Test
- Dynamic Test
- Climatic Aging Test
- Corrosion Test
- Endurance Test under Thermal & Mechanical Stresses

5.2 Anchoring Clamp for Insulated Messenger:

The clamps should be designed to Anchor LT-AB cable with insulated messenger. The clamp should consist of an Aluminium alloy corrosion resistant castled body, bail of stainless steel and self adjusting plastic wedges which shall anchor/hold the neutral messenger without damaging the insulation.

- No losable part in the process of clamping arrangement
- The clamp should conform to the standard NFC 33041 and 33042 or equivalent I.S. if any.
- The clamp body should be made of corrosion resistant Alluminium alloy, bail should be of stainless steel and wedges should be weather and UV resistant polymer.
- Ultimate tensile strength of the clamp should not be less than 15 km for 50/70sq.mm insulated messenger wire / 10 KN for 25/35 sq.mm insulated messenger wire.
- Slip load of the clamp should not be less than 3 KN for 50/70 sq.mm. messenger wire / 2 KN for 25/35 sq.mm. messenger wire.

5.2.1 Anchoring assemblies are used to firmly attach the messenger of ABC to a support and transmit the mechanical tension.

- at the end of a run or to the supporting structures
- at a major change in direction.

5.2.2 Each Anchoring Assembly shall include.

- One number tension bracket.
- One number wedge type tension clamp
- Flexible Rope for fixing tension clamp to bracket.

5.2.3 Anchoring assemblies shall be supplied in sets to ensure compatibility of the materials against corrosion or wear of moving parts.

5.2.1 Tension Bracket of AA

5.2.4.1 The tension bracket shall be made out of a single piece of Aluminium alloy suitable for attachment to a pole either by

- a) 16mm galvanized steel bolt (s) or
- b) two stainless Steel straps of 20 x 0.7 mm.

5.2.4.2 The tension bracket should be designed to ensure the Flexible rope cannot slip out at any angle.

5.2.4.3 The tension bracket should be rated and tested for the loads specified in Table-5. The load shall be applied at an angle of 45° from the normal to the surface of mounting of the bracket.

Table - 5			
Conductor Size (Sq.mm.)	Rating	Load for deformation <10mm (Newtons)	Load for deformation <30mm & no-break (Newtons)
25-35	1500 Kg.	12,000	15,000
50-95	2000Kg	15,600	19,500

5.2.5 Flexible Rope of AA

5.2.5.1 The Anchoring assembly shall be supplied with a stainless steel flexible Rope to connect the Tension Clamp to the Tension Bracket.

5.2.5.2 The rope should have sufficient flexibility to ease the torsional movement of the ABC System.

5.2.5.3 The Rope should be pre-fitted with compression type end fittings to secure the tension clamp.

- 5.2.5.4 A wear resistant moveable saddle should be un-loosably fitted on the Rope to prevent abrasion at the point of fitting into the tension bracket.
- 5.2.5.5 The Rope should have sufficient mechanical strength to withstand the mechanical test for the complete assembly tests in this specification.
- 5.2.6 Wedge Type Tension Clamp of AA
- 5.2.6.1 Wedge type clamps shall be used for clamping the messenger without damaging the insulation.
- 5.2.6.2 The clamp shall be capable of clamping an uncut messenger so that it can continue without break to the connecting point or next span.
- 5.2.6.3 The clamp shall be fully insulating type of mechanical and weather resisting thermoplastic.
- 5.2.6.4 No bolts or loose parts are allowed as part of the Clamping system.
- 5.2.6.5 No tools shall be needed for fitting the messenger into the clamp.
- 5.2.6.6 The clamp shall be self tightening and capable of holding without slippage the load specified in the Table-6.

Table - 6				
Conductor Size		Rating (Kg.)	T start (1 minute) (Newtons)	T final (1 minute) (Newtons)
Sq. mm.	Dia. (mm)			
25-35	8-11	1000 Kg.	8,000	10,000
50-54	8-11	1500 Kg.	12,000	15,000
70-95	13.5-16	2000 Kg.	12,000	15,000

- 5.2.6.7 After fitting the insulated messenger in the clamp, load T start will be held for 1 minute & then load increased to T final at rate between 5000 – 7,500 N/mtr. In each case there shall be no breakdown of any part of clamp and slippage of messenger in relation to the clamp.
- 5.2.7 Voltage Test on Clamp of AA
- 5.2.7.1 Voltage test is carried out on anchor clamps to ensure no damage is caused to the insulated messenger.
- 5.2.7.2 A conductive rod of dia. corresponding to the average dia. that can be accommodated in the clamp is fitted into the clamp, protruding by approx. 50mm at each end of the tightening piece.
- 5.2.7.3 The rod and clamp is subjected to tensile load as stated in Table 7 below when fixed to a support in its normal manner.

Table - 7			
Conductor Size		Normal rating (kg)	Load Applied (N)
Sq. mm.	Dia. (mm)		
25-35	8-11	1000	2000
50-54	8-11	1500	4000
70-95	13.5-16	2000	4000

- 5.2.7.4 A power frequency voltage of 6 kV is applied for 1 minute between the rod and conductive part of the clamp, or fixation point in absence of conductive part.

5.2.7.5 No breakdown or flashover shall occur. There shall be no tripping due to leakage with a setting of 10 + 0.5 mA.

5.2.8 Endurance under Mechanical & Thermal Stress of AA

5.2.8.1 This test is done on clamp rated 1500 Kg. or 2000 Kg. using insulated messenger 50 to 70 sq. mm.

5.2.8.2 A neutral messenger is fitted between two anchor clamps, with clamp spacing approx. 5 mtr. & 1 mtr. Of messenger protruding from the end. Marks are made to enable measurement of slippage.

5.2.8.3 The sample is subjected to 500 cycles of 90 minutes each as described below:

5.2.8.3.1 Messenger temperature is raised by passing an AC current to 60 +30 C within 15 minutes. This temperature is maintained for at least 30 minutes to give a total heating period of 45 mts.per cycle.

5.2.8.3.2 Messenger is allowed to cool naturally to ambient for further 45 minutes to complete 90mts. Cycle time.

5.2.8.3.3 Mechanical load is applied during the cycle as per table 8 below. Load F1 is applied throughout the cycle, except for a short period of 5 sec. to 60 sec. when it is gradually increased from F1 to F2 at any time during the last 15 minutes of the 90 minute cycle.

Table - 8				
Conductor Size		Rating (Kg.)	F1 (Newtons)	F2 (Newtons)
Sq. mm.	Dia. (mm)			
25-35	8-11	1000 Kg.	2,200	5,000
50-54	8-11	1500 Kg.	4,000	7,500
70-95	13.5-16	2000 Kg.	4,500	10,000

5.2.8.3.4 There should be no slippage greater than 4 mm after 2 cycles or greater than 8 mm after 500 cycles.

5.2.8.3.5 Voltage test is done at the end of the 500 cycles by immersing the test specimen of neutral messenger and clamps in water of resistivity not less than 200 Ohm mtr. For 30 minutes.

5.2.8.3.6 A voltage of 10 kV ac is applied for 1 minute between messenger and water bath using a trip setting of 10 + 0.5 am. There should be no breakdown or tripping.

5.3 Suspension clamp for insulated neutral messenger:

The clamp should be designed to hang L.T – AB cable with insulated neutral messengers. The neutral messengers should be fixed by an adjustable grip device. A movable link should allow longitudinal and transversal movement of the clamp body.

- No losable part in the process of clamping arrangement.
- The clamp should conform to the standard NFC 33040 or equivalent I.S, if any.
- The clamp and the link made of Polymer should provide an additional insulation between the cable and the pole.
- The clamps and movable links should be made of weather and UV resistant glass fibre reinforced polymer.
- Clamps should be fixed with pole by eye hook / bracket. Bracket should be made of corrosion resistant aluminium alloy.
- Ultimate tensile strength of the clamp should not be less than 15 KN for 50/70 sq.mm. Insulated messenger wire 4.3 KN for 25/35 sq.mm. Insulated messenger wire.
- Maximum allowable load of the clamp should not be less than 20 KN for 50/70 sq.mm. insulated messenger wire/15 KN for 25/30 sq.mm insulated messenger wire.

5.3.1 Suspension Assembly is used for supporting an ABC by installation on the messenger at an intermediate point of support such as a pole. It can accommodate small angles of deviation upto 30°.

5.3.2 Each Suspension Assembly shall consist of:

- One number Suspension Bracket.
- One number moveable (articulated) connecting link.
- One number Suspension Clamp.

5.3.3 Suspension Assemblies shall be supplied in sets to ensure compatibility of the materials against corrosion or wear of rotating/moving parts.

5.3.4 Suspension Bracket of SA

5.3.4.1 The Suspension Bracket shall be made from single piece aluminium alloy suitable for attachment to a pole by either.

- a) 16 mm galvanized steel bolt or
- b) Two stainless steel straps.

5.3.4.2 The Suspension Bracket shall be provided with an upper bulge to prevent the clamp from turning over on the Bracket for more than 45° from the horizontal or to within less than 60 mm from the pole / fixing structure.

5.3.4.3 The Suspension Bracket should be so designed to ensure that the articulated link cannot slip out of it.

5.3.4.4 Suspension Brackets shall be designed to withstand a load applied at the anchoring point of the movable link as per Table – 9 below without deformation of more than 10mm or breakdown at 330° below horizontal (there should be no longitudinal component of load parallel to the plane of fixing).

Table - 9			
Conductor Size		Normal rating (kg)	Load (N)
Sq. mm.	Dia. (mm)		
25-35	8-11	1500Kg.	12500
70-95	13-17	2000Kg.	14000

5.3.5 Movable (Articulated) Link of SA

5.3.5.1 Movable Links are used between the Suspension Bracket and Suspension Clamp to allow a degree of movement and flexibility between the two.

5.3.5.2 Moveable Links should be made fully of insulating type of mechanical and weather resistant thermoplastic. A metallic wear resistant ring should however be fitted at point of contact between the Suspension Bracket and the movable link.

5.3.5.3 The Movable link should be unloosably fitted to the Bracket and the Clamp.

5.3.6 Suspension Clamp of SA

5.3.6.1 Suspension Clamps are used for locking the messenger of the ABC bundle without damaging the insulation or allowing the messenger to become dismounted from the fitting.

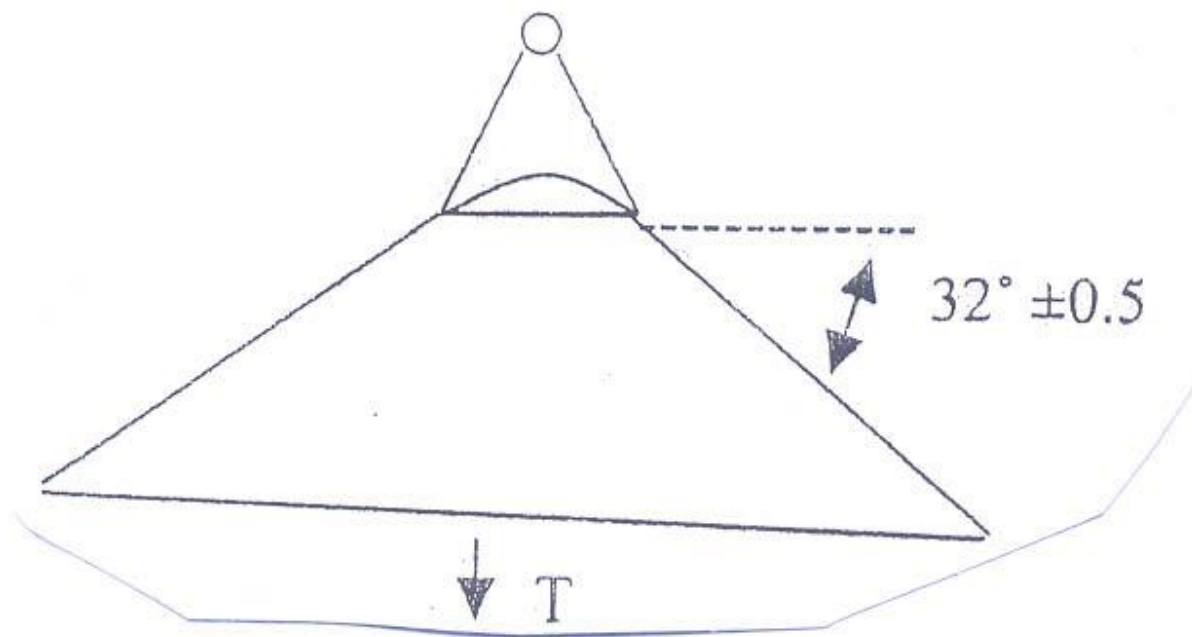
5.3.6.2 The Suspension Clamp shall accommodate messenger wires from 25 to 95 sq.m.

5.3.6.3 The Suspension Clamp shall be made fully of insulating type of mechanically strong and weather resistant plastic.

- 5.3.6.4 Bolts should not be used for clamping / locking the messenger in the Clamp.
- 5.3.6.5 There shall be no losable parts in the Suspension clamp.
- 5.3.6.6 The Suspension Clamp should be unloosably fitted to the rest of the Suspension Assembly.
- 5.3.7 Mechanical Test on Clamp of SA
- 5.3.7.1 The Sub Assembly shall be subjected to a vertical load applied as per drawing in accordance with Table-10. There shall be no breakdown or permanent deformation at load T initial for 1 minute or when the load is increased to T final and released.

Table - 10				
Conductor Size		Rating (Kg.)	T start (1 minute) (Newtons)	T final (1 minute) (Newtons)
Sq. mm.	Dia. (mm)			
25-54	8-15	1500 Kg.	9,600	12,000
70-95	13-17	2000 Kg.	12,800	16,000

Fig. : A



- 5.3.7.2 A sample messenger shall be fitted into a fixed suspension clamp and subjected to a gradually applied longitudinal load of 300 N. There shall be no permanent slip page.

- 5.3.8 Voltage Test of SA
 A copper foil is wrapped at the clamping point around the maximum size of messenger allowed in that clamp. An ac voltage of 6 KV is applied between the copper foil and nearest conductive point of the clamp or into its absence to the point of fixation. The voltage should be withstood for 1 minute without breakdown or flashover.
- 5.3.9 Test Under Mechanical & Thermal Stress
- 5.3.9.1 The test specimen is made up of approx. 10mts. Of messenger wire strung between two anchor clamps with a Suspension Clamp fixed in the middle. Masses of 40 Kg. are suspended at a distance of 1-2mtr. On either side of the Suspension Clamp with a fixing mechanism of mass 2 + 1 Kg.
- 5.3.9.2 The specimen is subjected to 500 cycles of 90 minutes each. Each cycle consists of the following:
- a) For first 75 minutes a constant longitudinal tension of 4000 N is applied to the messenger for rating of 1500 Kg. and of 4500 N rating of 2000 Kg. while 64cycles right and left oscillation are produced on the clamp 32°on either side of the vertical.
 - b) During the first 45 minutes an intermittent current of 4-5 A/sq.mm is applied to maintain the conductor temp at 60 + 3° C.
 - c) During the next 45 minutes of the cycle the conductor is allowed to cool down naturally to the ambient.
 - d) At the 75th minute, after having completed 64 oscillations, the oscillations are stopped and the longitudinal tension is increased to 7500 N for 1500 kg. Rating and 10000 N for 2000 Kg. Rating.
- 3.9.3 No messenger slippage should occur within the Suspension Clamp during the 500cycles.
- 5.3.9.4 At the end of the 500 cycles, the messenger is immersed in water for 30 minutes. It is then tested to withstand 10 kV ac for 1 minute with a trip setting of 10 + 0.5 mA. There should be no breakdown or flashover.
- 5.4 Acceptance Tests
- 5.4.1 The following shall constitute Acceptance Tests for Insulation Piercing Connectors(IPC) :
- Visual *
 - Dimensional (as per SCD and overall dimensions submitted with Tender Offer)*
 - ~~Electrical Ageing Test ***~~
 - Dielectric and Water Tightness Test. **
 - Mechanical Tightening Test **
 - Effect of Tightening on Main Core **
 - Effect of Tightening on Branch Core **

The above tests are to be carried out as per sampling plan below. ~~However electrical ageing test on IPC (market***) is to be done on only one connector of each type and size.~~

In case of random failure/defect, double the sample lot is to be drawn and there should be no failure/defect exceeding half the permissible defects (rounded down) shown in the chart.

Lot Size	For tests Marked*		For tests Marked**	
	Sample Size	Max. permissible Defects	Sample Size	Max. permissible Defects
Upto 100	2	nil	2	nil
101 to 1000	6	nil	4	nil
>1001	0.01% subject to min. 6 pieces	0.1% of pieces checked	4	nil

5.4.2 The following shall constitute acceptance tests for Anchor Assemblies:

- Visual *
- Dimensional (as per SCD and overall dimensions submitted with Tender Offer)*
- Mechanical Test on Bracket**
- Mechanical Test on Clamp **
- Voltage Test *

5.4.3 The following shall constitute acceptance tests for Suspension Assemblies:

- Visual *
- Dimensional (as per SCD and overall dimensions submitted with Tender Offer)*
- Mechanical Test on Bracket**
- Mechanical Test on Clamp **
- Voltage Test *

The above tests (for AA & SA) are to be carried out as per sampling plan below. In case of random failure/defect, double the sample lot is to be drawn and there should be no failure/defect exceeding half the permissible defects (rounded down) shown in the chart.

Lot Size	For tests Marked*		For tests Marked**	
	Sample Size	Max. permissible Defects	Sample Size	Max. permissible Defects
Upto 100	2	nil	1	nil
101 - 500	5	1	2	nil
501 - 2500	10	2	2	nil
2501 & above	10 + 0.2 %	2 + 10% pf addl. Sample quantity	4	1

6.0 SERVICE CLAMP

The clamps should be designed to anchor insulated service lines (armoured or unarmoured) with 2/4 conductors.

- The clamps should be made of weather and UV resistant polymer.
- No losable part in the process of clamping arrangement
- The clamp should conform to the standard NFC 33042 or equivalent I.S., if any. No losable
- Breaking Load of the clamp should not be less than 3 KN.

7.0 TRANSFORMER CONNECTION

- The connection to the transformer should be made with Pre-Insulated lugs for phase and street lighting conductors and with an Aluminum Lug for neutral Messenger. If the Bus-bars-bars are of copper, the Lugs should be preferably Bi-metallic type.
- The Barrel of the lug normally insulated with an Anti-UV black Thermoplastic tube sealed with a flexible ring. Die reference, size and strip length are to be indicated on the plastic.
- Sizes covered 16-70 & upto 150 m2 Aluminium XLPE insulated cable.
- Reference standard NFC 33021 or equivalent I.S. if any.

8.0 JUNCTION SLEEVES

- The sleeves should be Pre-Insulated for phases, neutral messengers and street lighting conductors.
- Sleeve should be made of Aluminum, insulated with an Anti-UV black thermoplastic tube hermetically sealed two ends with 2 flexible rings.
- Die reference, size and strip length are indicated on the sleeve itself.
- Sizes needed : 16-70 & upto 150 mm2 for Aluminum XLPE insulated cable.
- Reference standard : NFC 33021 or equivalent I.S. if any.
- Design as per furnished drawing.

9.0 EYE HOOKS

- Eye looks should be designed as to hold suspension clamps and Dead end clamps and to be installed with the pole clamp.
- Eye-hooks should be made of forged Galvanized steel.
- The clamps corrosion resistance should conform the standards I.S. 2629 & I.S.2633.
- Bolts and nuts should be made of hot dip Galvanized steel according to VDE 0210 and VDE 0212.
- Ultimate Tensile strength (UTs) of the clamp should 20 KN.
- Design as per furnished drawing.

10.0 SERVICE MAIN DISTRIBUTION BOXES

10.1 Scope

This Distribution Box should be Weather & Moisture Proof with Spring loaded/Bolt& Nut type Bus Bar system & should be able to carry a current according to specified capacity. It can have 1/3-phase input & provision of 4 to 6 nos. of 3-phase or 1-phase outputs. The box should have the provision for special key for locking & Proper arrangement of sealing. The boxes should be assembled on the pole using Metal Tapes & Buckles or Bolts. No. of Boxes per pole may vary with supporting arrangement for more no. of service connections. The Spring used should be of stainless steel having required capacity to provide suitable pressure in the connector.

10.2 Construction

Distribution Boxes should be designed with Bus Bars with spring action contact, or screw-bolt technique. For spring action contact only insertion of the conductor into the specified groove of the Busbar is sufficient for proper connection whereas for Nut Bolt type proper washers & other accessories are to be provided for connections. It should be used for multiple connections (3-phase or 1-phase) in low voltage Distribution Network. The boxes should be suitable for 1/3-phase (4 crores) inputs & provision for 4 to 6 nos. of 3-phase or 1-phase outputs. Bus bars should be with a continuous pair of contact bars with colour code to facilitate the identification of the correct energy phase.

The box should be able to incorporate the input or output cable dia. Of maximum 16mm. (Equivalent to 120Sq.mm.).

The Boxes should consist of special type Lock & key system as well as provision for sealing for complete protection of the service connection contacts.

10.3 Current Ratings

The maximum current rating should be 140A/200A/250A & concerned authority should have the liberty to choose among the above ratings as per their requirement.

10.4 Voltage Ratings:

The maximum voltage withstand capacity should be 600V.

10.5 Working Temp

Safe working temperature should be around 80 C for Outer Box & 100OC for metallic Bus bars.

10.6 Materials

Material used in the manufacturing process of the components of this product should be specified in the respective product drawings & can be summarized as follows :

- Outer Box (Base & Cap) : With UV protection & Flame retardant characteristics(HB, as per UL 94- Tests for Flammability of Plastic materials) & preferably made up of ASA (Achylnitrile Styrene Acrylate).
- Cable Grommets : Ethylene-Propylene Rubber :
- Safety Key : PA 6.6 (Nylon).
- Safety Screw : Stainless Steel or Plating Finished steel.
- Insulation protection as per IP 44.
- Bus bars or Terminal Blocks : PA 6.6 (Nylon), Stainless Steel & Copper.
- Button & Cable Holder : PA 6.6 (Nylon) with 50% Glass Fibre.
- Busbar Insulation : Polymide.

10.7 Locking System

The boxes should consist of Special type Lock & Key arrangement as well as provision for sealing for complete protection of the service connection contacts.

11.0 G.A. DRAWINGS ETC.

11.1 A drawing / picture clearly showing principal parts & dimensions for all products should be submitted along with the offer.

11.2 The principal outer dimensions of each item, l x b x w in mm and weight in gms should be submitted along with the offer.

11.3 The Employer may call for samples for verification & evaluation purposes.

- 12.0 GENERAL CONDITIONS OF MANUFACTURE
- 13.0 GTP

The Guaranteed Technical Particulars should be filled up in the given format of GTP.

- 14.0 TESTING STANDARD – Given in Annexure 2 & 3.

- Note :
- 1) Any specific meteorological data other than those listed above applicable for a particular equipment/item will be available in the technical specification for that equipment/item.
 - 2) When values specified above contradicts with respective equipment TS, the later will prevail for that equipment.
 - 3) The atmosphere in the area is laden with industrial and town gases and smoke with dust in suspension during the dry months and subject to tough colder months.
 - 4) Heavy lightning is usual in the area during the months from May to November.

ANNEXURE-1

GENERAL CONDITIONS FOR MANUFACTURE

The products shall be in accordance recognized standards used in L.T. ABC or equivalent I.S., if any.

Marking	:	Each product shall be clearly identified with manufacturer name or trade mark, reference and capacity of the item and batch no.
Packaging	:	Manufacturer shall mention the packaging of each item. Installation instruction should be included in packaging.
Type test	:	Each supplier should provide type test reports with the offer, carried out in accordance with one of the reference standards in NABL Accredited Laboratory.
Routine test	:	Supplier shall provide a control plan, which will be implemented on each item. Routine test reports should be submitted by the manufacturer with inspection call.
Quality	:	All suppliers should preferably be ISO-9000 certified.

Anchoring and suspension clamps should be installable on existing poles using appropriate devices (hooks, pigtails, brackets etc.).

All crimped connectors should be installed with mechanical or hydraulic hand crimping tools.

ANNEXURE – 2

TESTING STANDARDS :

The Insulating Piercing Connector should conform to following std. :

Tests	Tests Standard / Test Procedure
Corrosion Qualification Test	<p>As per NF C 33-020 (Jun '98), or equivalent I.S., if any.</p> <p>Exposure in Saline Environment : The exposure should be carried out as per NF en 60068-2-11 (Aug. '99) std. requirement. The concentration of Saline solution must be of 5% \pm 1% in mass, & the temperature of the test chamber must be maintained at 35°C \pm 2°C.</p> <p>Exposure in Sulphur environment saturated of humidity – The exposure should be carried out as per NF T 30-055 (Mar. '74) std. requirement. SO₂ concentration in the chamber should be 0.067% in volume. The temperature of the test chamber should be increased to 40°C \pm 3°C.</p> <p>The total test should include four identical periods of 14 days, in which 7 days of exposure in Saline environment & in other 7 days – 8 hrs. cycles in SO₂ environment & 16 hrs. in laboratory environment.</p>
Electrical Ageing Test	<p>As per NF C 33-020 & NF C 33-004 (Jun '98) or equivalent I.S., if any.</p> <p>Total no. of cycles 200, Heating time -60 mins., Cooling time -45 mins., Pause time – 2 mins.</p>
Dielectric Investigation Test in water	<p>As per NF C 33-020 (Jun '98) or equivalent I.S., if any. 15°C & 30°C & relative humidity between 25% & 75%. The tightening of the connectors should be at minimal value of the torque indicated by the manufacturer. The sample should be placed in tank full of water on 30 cm height, after an immersion length of 30 mins. The set is subjected to a dielectric test under a voltage of 6 KV at industrial frequency during 1 min. No flashover / breakdown should occur at 6 KV during 1 min.</p>
Tests	Tests Standard / Test Procedure
Mechanical Tests	<p>As per NF C 33-020 (Jun '98) or equivalent I.S., if any.</p> <p>For checking electrical continuity, shear heads & mechanical behaviour of the connector's suitable tests as per the above specification have to conduct.</p>

Capacity needed :

For ABC 16 to 95 mm²

Model 1 for customer service

Main 16 to 95 mm²

Tap 2.5 to 10 mm² (For Street lighting/service connection)

Design as per furnished drawing

Model 2 for customer service

Main 16 to 95 mm²

Tap 04 to 35 mm² (for distribution box charging)

Design as per furnished drawing

Model 3 for customer service

Main 25 to 95 mm²

Tap 25 to 95 mm² (For ABC to ABC Tee Joint)

Design as per furnished drawing.

ANNEXURE – 3

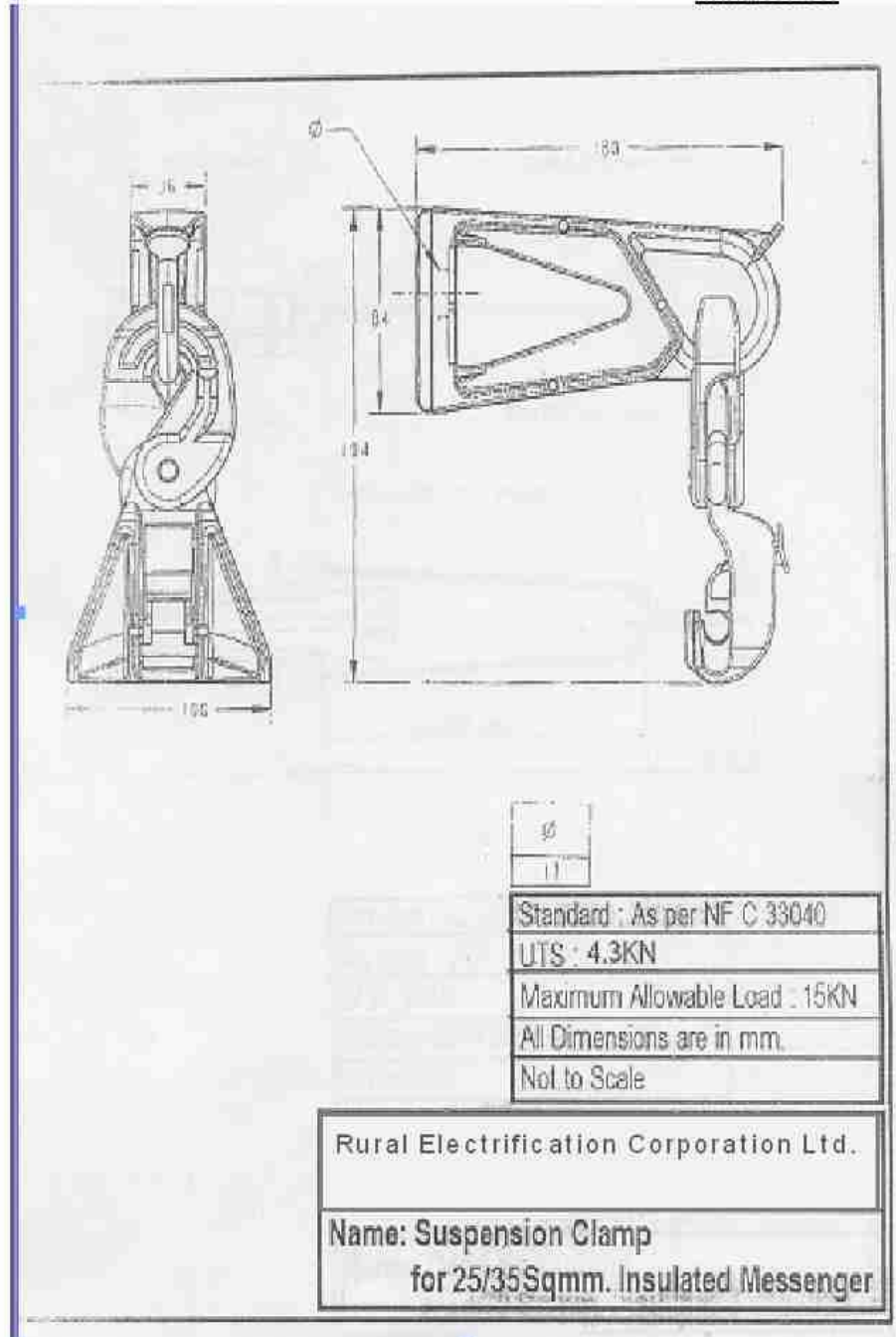
TESTING STANDARDS

Impact Resistance should be according to UL 746C. Insulation Protection should be as per IP 44. The Outer Plastic box should conform to following std. –

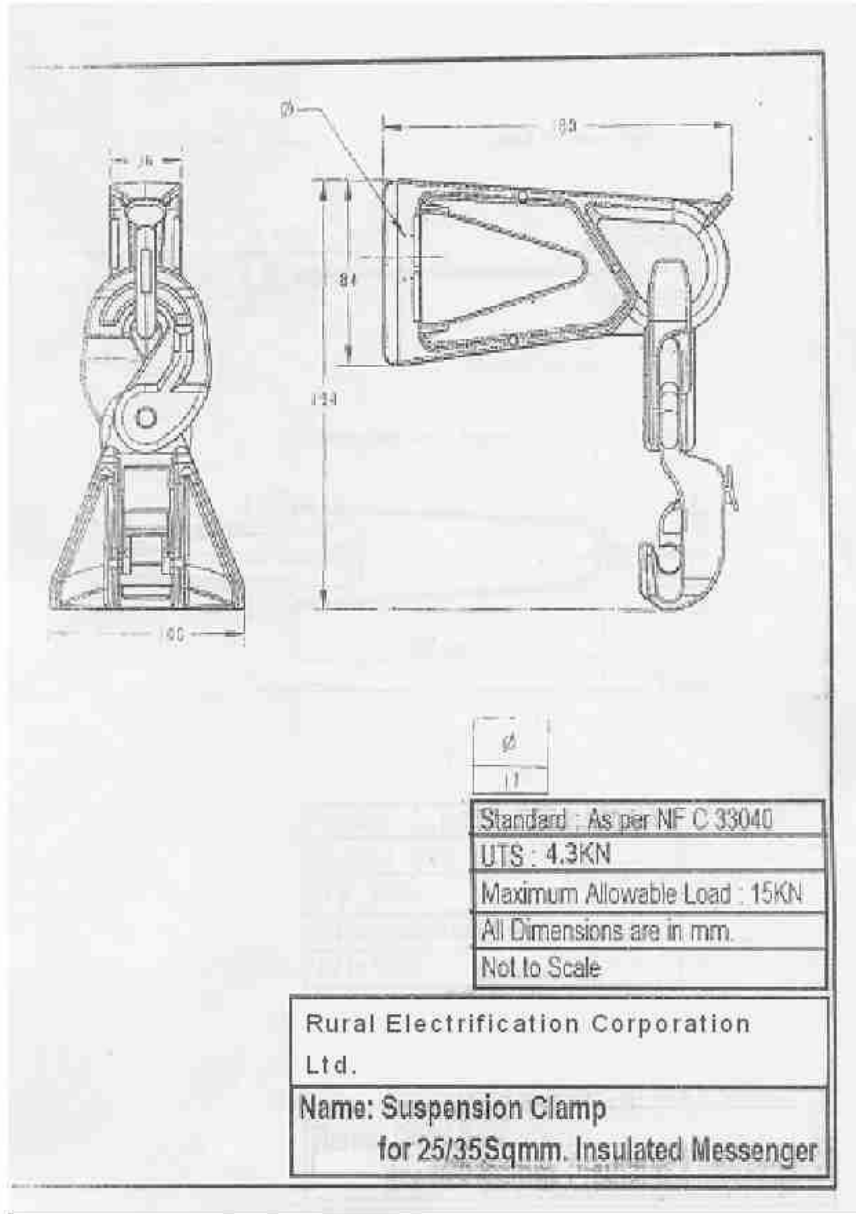
Test / Standard	Requirements	Test Procedures
Degree of Protection IEC 60529	IP 44 – Protected against the penetration of solid objects exceeding 1.0mm in diameter and against penetration of water jets that may affect the product operation.	First Digit : A 1.0mm diameter test wire should not penetrate in any apparent opening (force = 1 N \pm 10%) Second Digit : A spray nozzle is used to spread a water jet in all possible directions.
Impact Resistance UL 746-C	After the test the product should not show any evidence of : - Live electrical parts accessible to the test probe, as described in this test specification. - Any results, which may affect the mechanical performance of the product. - Any results, which may increase the probability of electrical shocks.	The impact should be generated by dropping a steel ball – with a diameter of 50.8 mm and a mass of 0.535 kg – from a specified height sufficient to produce an impact energy of 6.8 J (0.69 13 kg.m.)
UV Resistance UL 746-C	The sample physical properties average value after an accelerated aging with UV radiation – should not be lower than 70% of its initial value, without aging, that is, a variation of + 30% is allowed.	According to ASTM G26, Exposure Method 1, Xenon Arc Lamp Type B or ASTM G 155, Exposure Cycle I, with continuous exposure to light and intermittent exposure to water jets, with programmed cycles of 120 minutes, consisting of a 102 minutes light-only exposure

Test / Standard	Requirements	Test Procedures
		and a 18 minutes exposure to light and water jets.
Withstanding Voltage UL 746-C	Product should withstand the specified voltage	A 5 kV voltage should be applied to the samples after the 40 hours conditioning cycle at $23 \pm 2^{\circ}\text{C}$ and $50 \pm 5\%$ relative humidity plus 96 hours at $35 \pm 2^{\circ}\text{C}$ and $90 \pm 5\%$ relative humidity.
Flammability UL 94	After the UV radiation accelerated aging, the material should maintain the same original flammability level (HB).	The test can be applied to test samples molded with the same material used for the base and the cap of the box or taking a piece of these components.
Flexural Strength ASTM D790 UL 746-C	After UV radiation accelerated aging, the average value for this test should not be lower than 70% of the original value, that is, a maximum variation of 30% is allowed.	A group of test samples without aging should be tested and the average values calculated. Another group should be aged under UV radiation then it should be tested and the new average should be calculated and compared to the initial average value.
Tensile Strength ASTM D638 UL 746-C	After aging with UV Radiation, the average value should not be lower than 70% of the initial values, that is, a maximum variation of 30% is allowed.	One of the test bodies must be tested without being submitted to accelerated aging and is computed over mean values. Another group is submitted to the radiation induced aging and then tested and the new mean value is computed and compared to the first computed mean value.

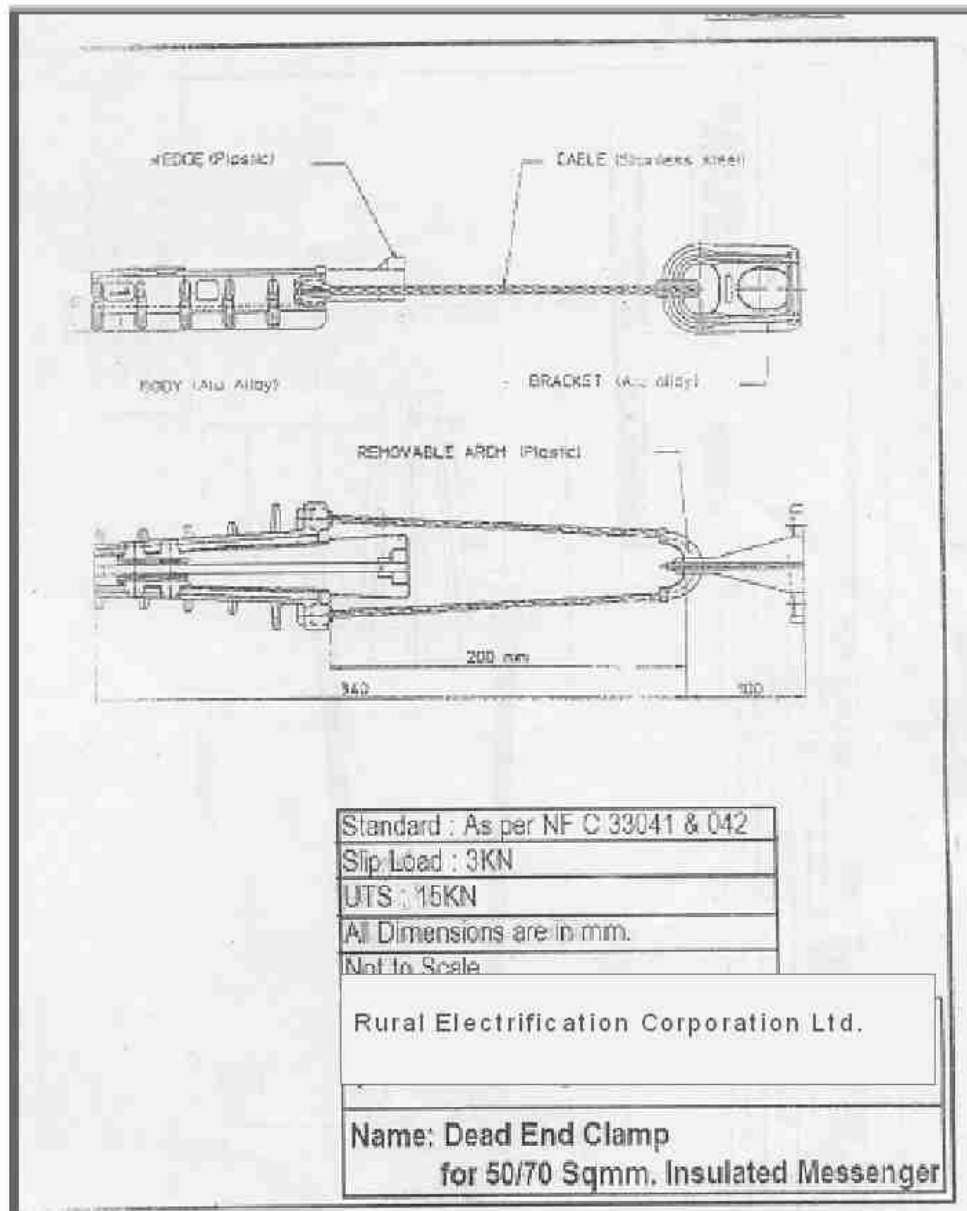
ANNEXURE-A



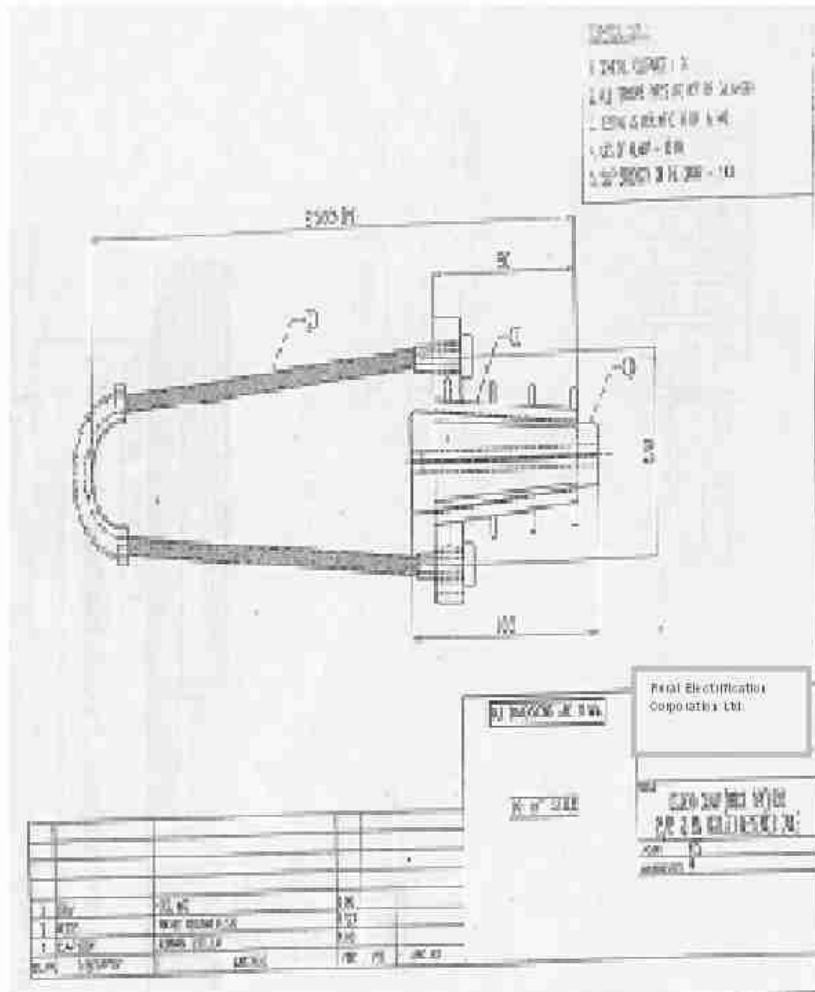
ANNEXURE-B



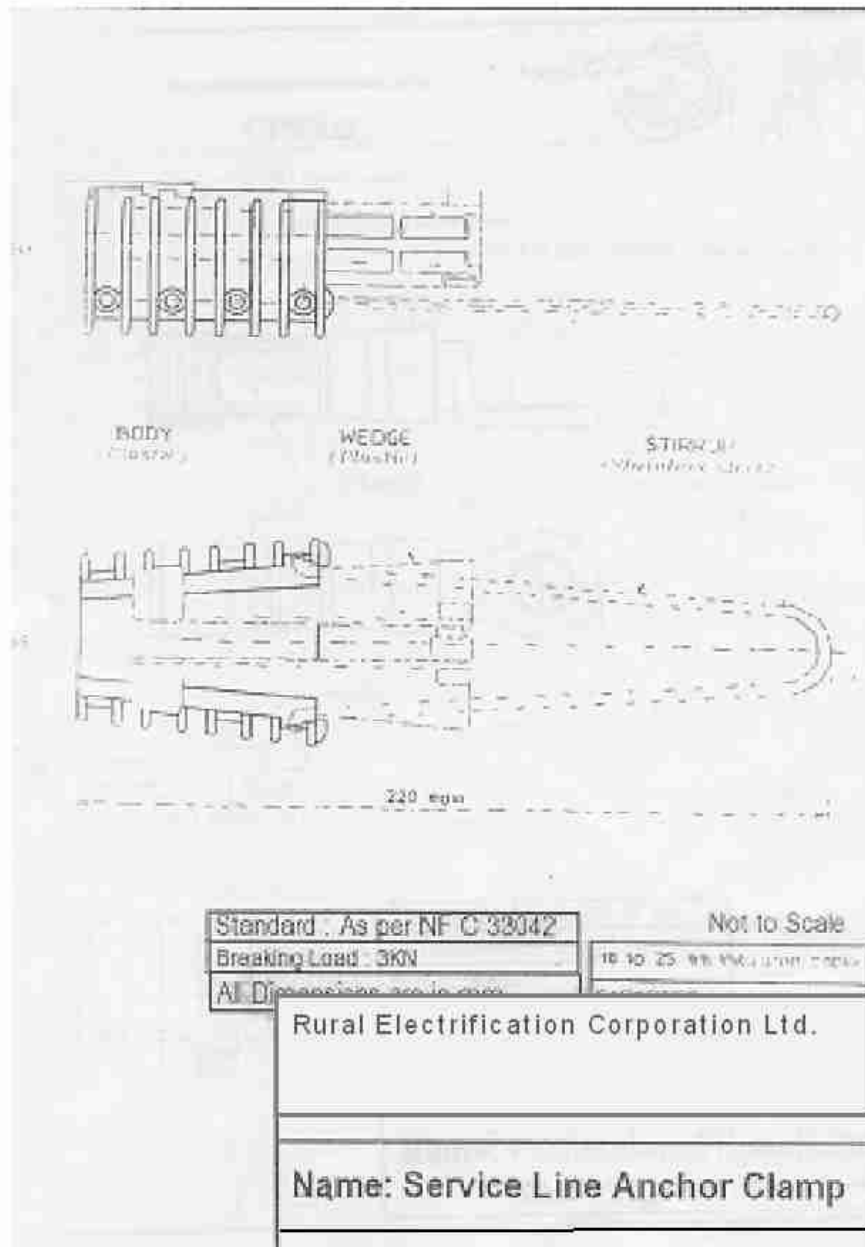
ANNEXURE-C



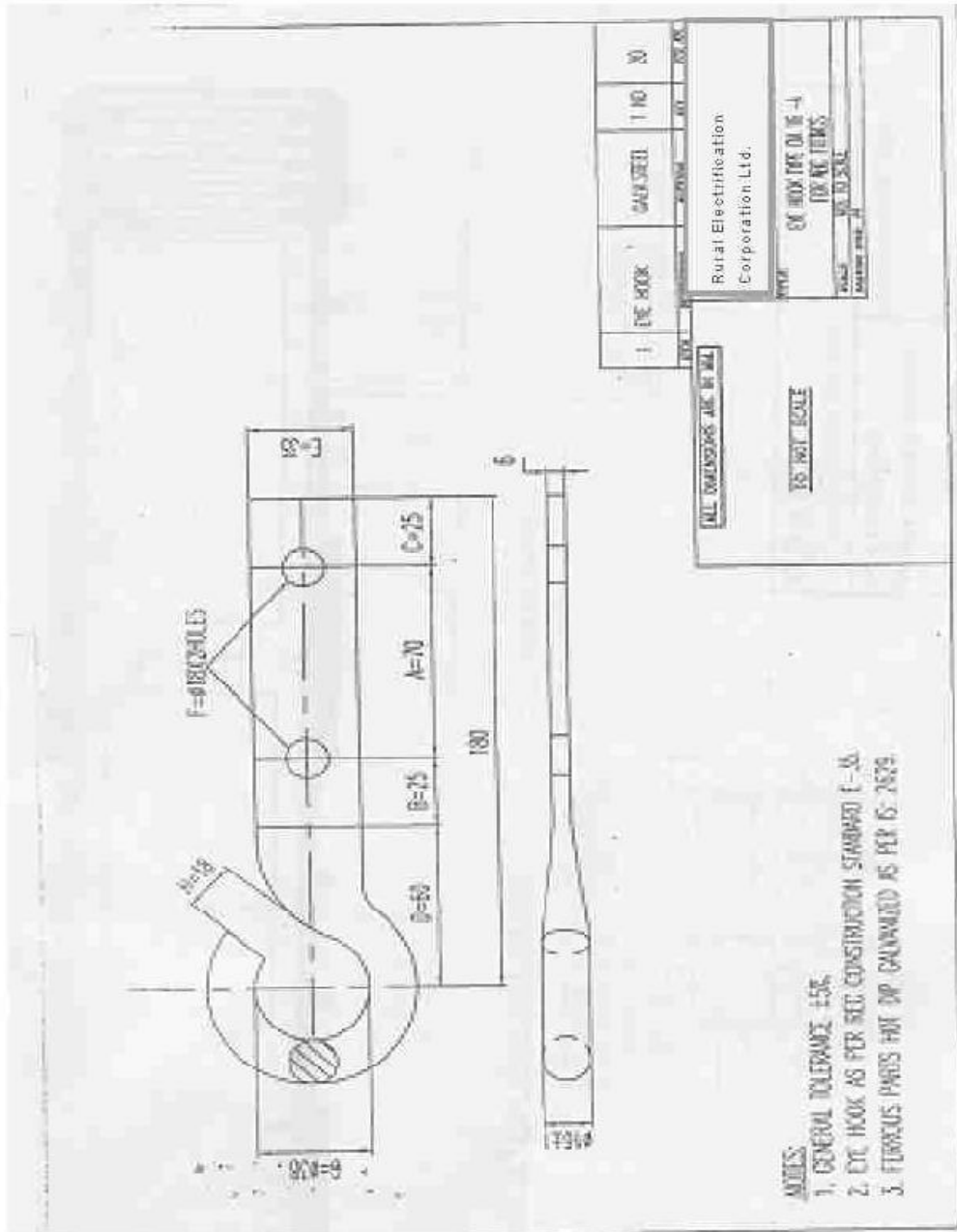
ANNEXURE-D



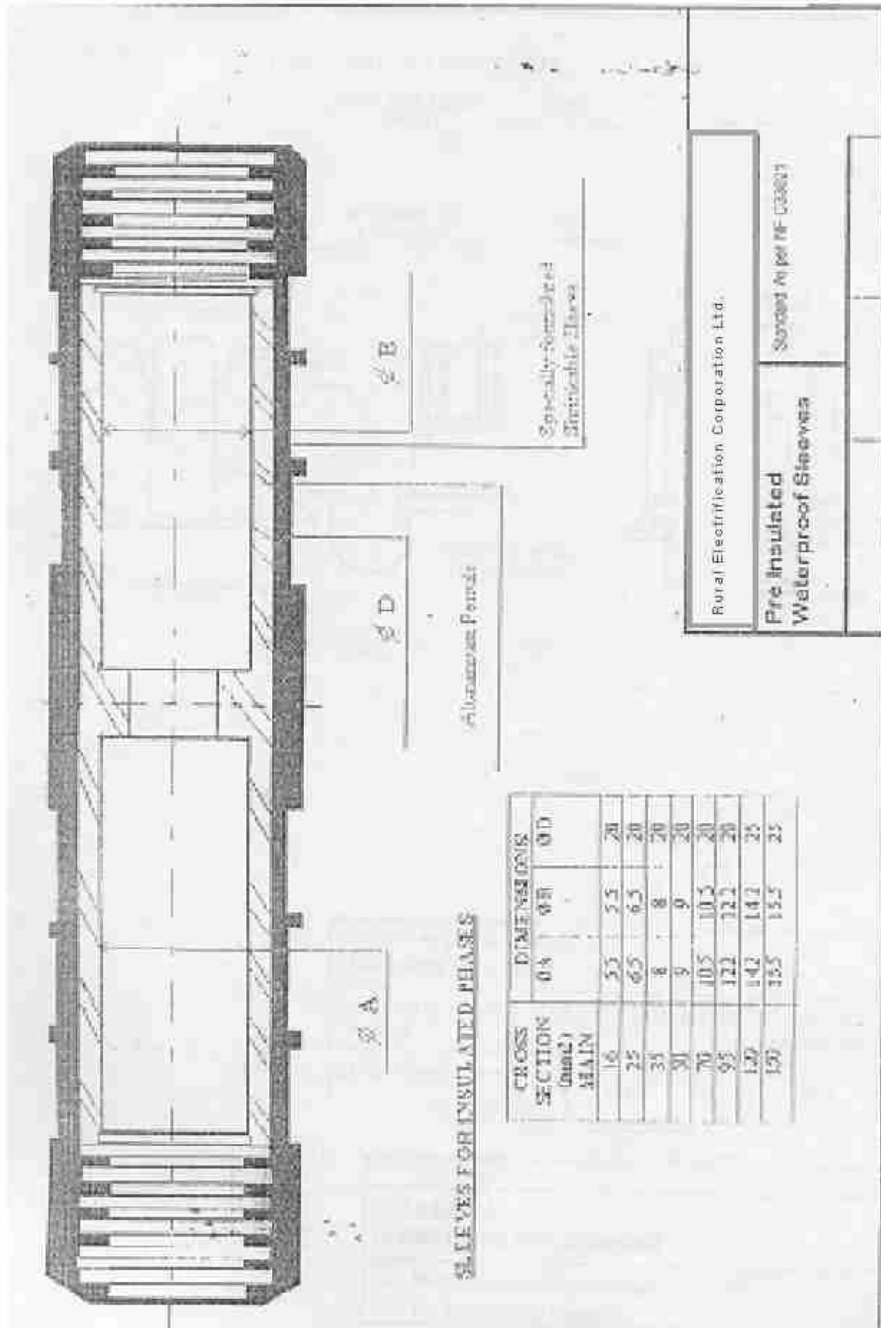
ANNEXURE-E



ANNEXURE-G



ANNEXURE-H

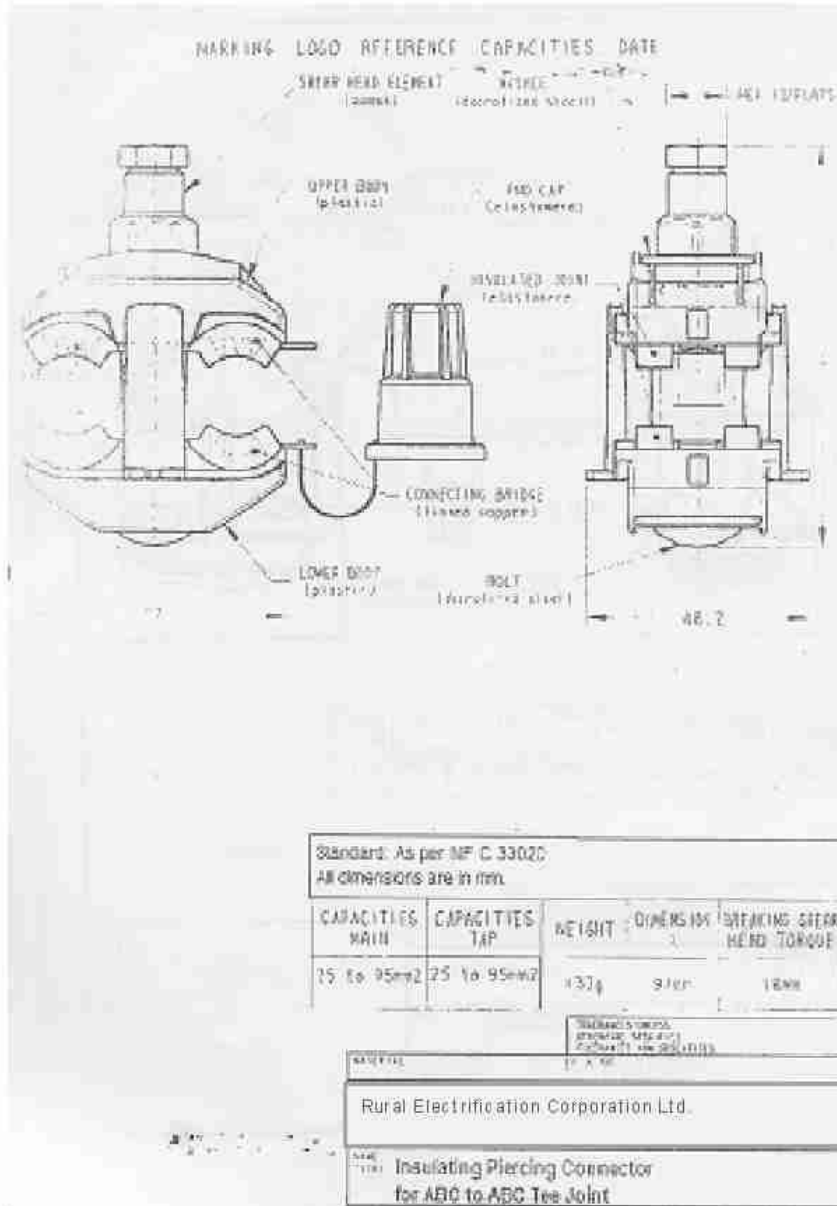


Rural Electrification Corporation Ltd.

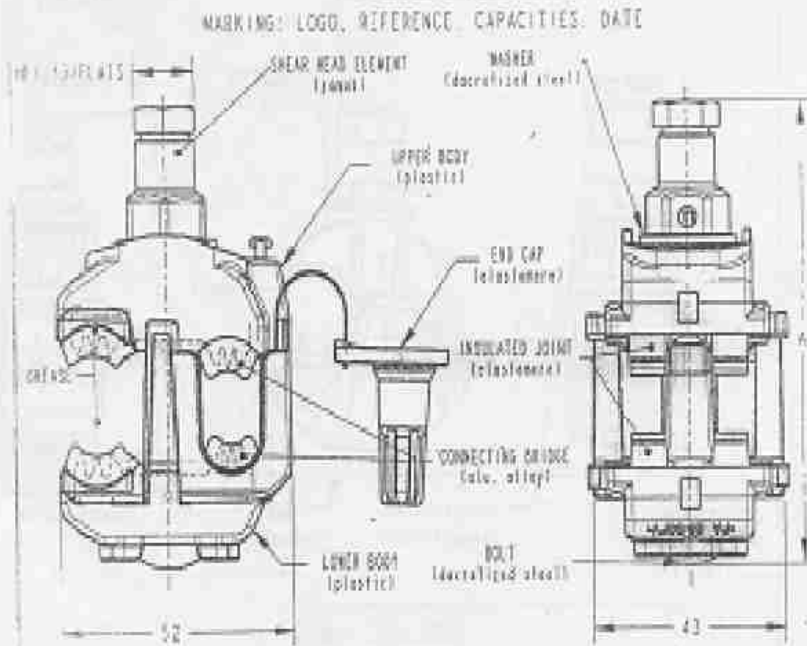
**Pre Insulated
Waterproof Sleeves**

Standard as per IS: 6362/1

ANNEXURE-I



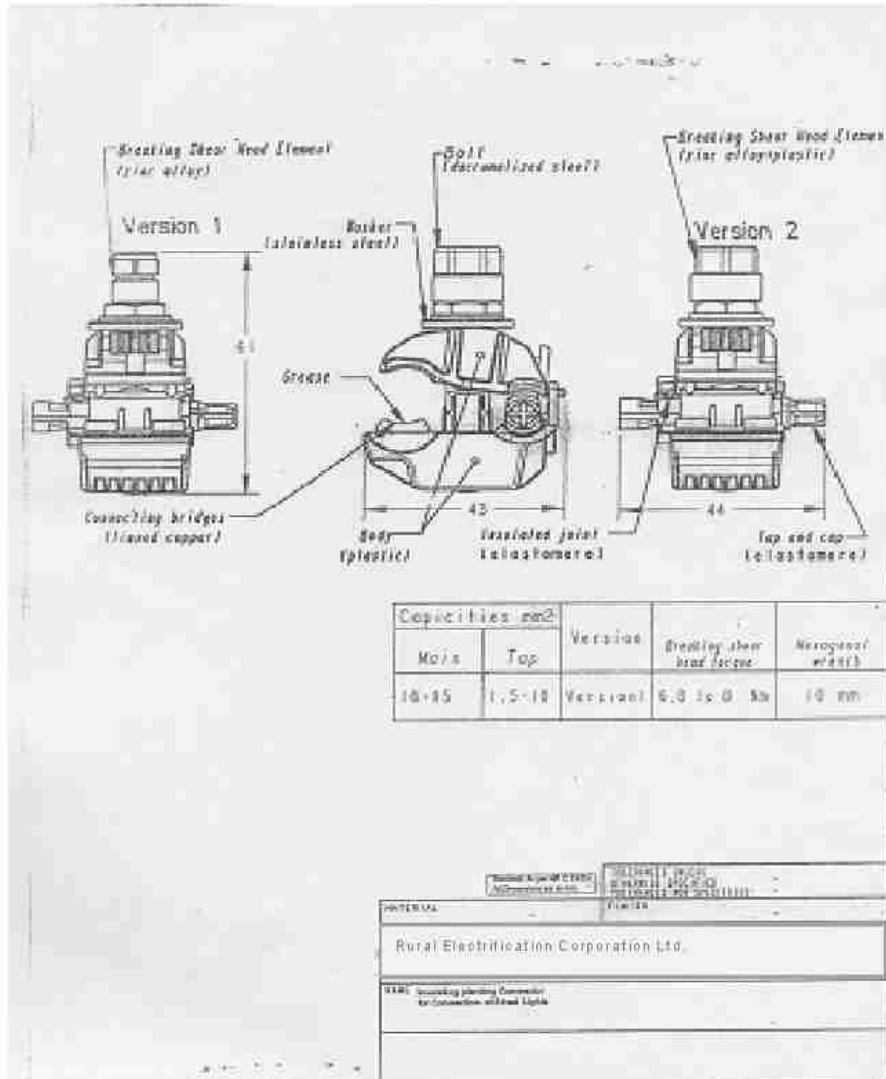
ANNEXURE-J



CAPACITIES: MAIN	CAPACITIES: TAP	WEIGHT	DIMENSION A	BREAKING SHEAR HEAD TORQUE
16 to 85mm ²	4 to 35mm ² (50mm ²)	113.5g	86mm	114N

DESIGNED BY: ...
CHECKED BY: ...
DATE: ...
MATERIAL: ...
Rural Electrification Corporation Ltd.
MS: Insulating Plastic Connector for Distribution Box Charging

ANNEXURE-K



28 11 kV and 33 kV Isolators

1) SCOPE

This specification provides for design, manufacture, testing at manufactures works, delivery of outdoor station type 11KV and 33KV (Local) manual operating mechanism isolating without/ with earthing blades and complete in all respect with bi-metallic connectors. Operating mechanism, fixing details etc. shall be as described herein.

2) PARTICULARS OF THE SYSTEM

The isolators to be provided under this specification are intended to be used on 3 phase A.C. 50 cycles, effectively grounded system. The nominal system voltages are 11 kV & 33 kV respectively.

3) STANDARD

The Isolator shall comply in all respects with IS: 9921 or IEC Publication No.: 129. Equipment meeting any other authoritative standard which ensures an equal or better quality than the standard mentioned above will also be accepted.

4) TYPE & RATING

Isolators shall have three posts per phase, triple pole single throw, gang operated out-door type silver plated contacts with horizontal operating blade and isolators posts arranged vertically. The isolators will be double break type. Rotating blade feature with pressure relieving contacts is necessary i.e. the isolator shall be described in detail along-with the offer. However, the design of turn & twist arrangement shall be subject to owner's approval. (Banging type feature is not acceptable). All isolators shall operate through 90 degree from their fully closed position to fully open position, so that the break is distinct and clearly visible from the ground level.

The equipment offered by the tenderer shall be designed for a normal current rating of 400 A for 11 KV & 630 A for 33 KV suitable for continuous service at the system voltage specified herein. The isolators are not required to operate under load but they must be called upon to handle magnetization currents of the power transformers and capacitive currents of bushings, bus-bars connections, very short lengths of cables and current of voltage transformers.

The rated insulation strength of the equipment shall not be lower than the levels specified in IS 9921 JEC publication No. 129, which are reproduced below

Standard declared voltage kv/rms	Rated voltage of the Isolator	Standard withstand positive kV (peak)	Impulse Voltage polarity	One minute power frequency withstand voltage KV (RMS)	
				Across the isolating distance	To earth and between poles
11 KV	12	85	75	45	35
33 KV	36	195	170	100	75

The 11 KV and 33 KV isolators are required with post insulators but with mounting structures. The isolators should be suitable for mounting on the Boards standard structures. The isolators shall be supplied with base channels along with fixing nuts, bolts and washers for mounting on the structured.

5) TEMPRATURE RISE

The maximum temperature attained by any part of the equipment when in service at site under continues full load conditions and exposed to the direct rays of Sun shall not exceed 45 degree centigrade above ambient temperature.

6) ISOLATOR INSULATION

Isolation to ground, insulation between open contacts and the insulation between phases of the completely assembled isolating switches shall be capable of withstanding the dielectric test voltage specified above.

7) MAIN CONTACTS

All isolators shall have heavy duty self aligning and high pressure line type fixed contacts of modern design and made of hard drawn electrolytic copper. The fixed contact should be of reverse loop type. The various parts shall be accordingly finished to ensure inter- changeability of similar components.

The fingers of fixed contacts shall be preferably in two pieces and each shall form the reverse loops to hold fixed contacts. The fixed contacts would be placed in 'c' clamp. The thickness of 'C' clamp shall be adequate. This channel shall be placed on a channel of adequate thickness. This channel shall be welded on an insulator mounting plate of 8mm thickness. The spring of fixed contact shall have housing to hold in place. This spring shall be made of stainless steel with adequate thickness. The pad for connection of terminal connector shall be of aluminum with thickness not less than 12 mm.

The switch blades forming the moving contacts shall be made from tubular section of hard drawn electrolytic copper having outer dia not less then 38 mm and thickness 3 mm. These contacts shall be liberally dimensioned so as to withstand safely the highest short circuit and over voltage that may be encountered during service. The surfaces of the contacts shall be rendered smooth and silver plated. The thickness of silver plating shall not be less than 15 microns for 11 KV and 25 microns for 33 KV. In nut shell, the male and female contact assemblies shall be of robust construction and design of these assemblies shall ensure the same.

1. Electro-dynamic withstands ability during short circuit without any risk of repulsion of contacts.
2. The current density in the copper parts shall not be less than 2 Amp/sq.mm and aluminium parts shall be less than 1 Amp/sq.mm.
3. Thermal withstand ability during short circuit.
4. Constant contact pressure even when the live parts of the insulator stacks are subjected to tensile stresses due to linear expansion of connected bus bar of flexible conductors either because of temperature verification or strong winds.
5. Wiping action during closing and opening.
6. Self alignment assuring closing of the switch without minute adjustment.

The earthing switch should be provided with three sets of suitable type of fixed contacts below the fixed contacts assemblies of the main switch on the incoming supply side and the sets of moving contacts having ganged operation. These contacts shall be fabricated out of electrolytic copper for 33 KV isolators with earth switch and designed to withstand current on the line.

Arcing contacts / Horn: Arcing contacts are not required.

Auxiliary switches : Auxiliary switches are not required.

8) CONNECTORS

The connectors for 11KV isolator shall be made of Aluminium alloy LM-9 or LM-25 and shall be suitable for Squirrel, Weasel and Rabbit ACSR Conductors for 11KV and Raccoon/Dog conductors for 33 KV with horizontal and vertical takeoff arrangement. The details in regard to dimensions, the number of bolts to be provided, material and manufacture shall be furnished by the bidder for owner approval before manufacturing. The groove provided in the connection should be able to accommodate conductor size mentioned above smoothly.

The clamps to be offered should be manufactured by gravity die-casting method only and not by sand casting process. It is necessary that suitable clamps are offered along with the isolator and also it is obligatory to give complete technical particular of clamps along with the drawing, as per details given above and also as per following detail.

1. The terminal connector shall be manufactured and tested as per IS: 5561.
2. All castings shall be free from blow holes, surface blisters, cracks and cavities.
3. All the sharp edges shall be blurred and rounded off.
4. No part of the clamp shall be less than 12 mm thick.
5. All current carrying parts shall be designed and manufactured to have minimum contact resistance.
6. Connectors shall be designed to be corona free in accordance with the requirement of IS: 5561.
7. All nuts and bolts shall be made of stainless steel only. Bimetallic sleeve/liner shall be 2 mm thick

Wherever necessary, bi-metallic strip of standard quality and adequate dimension shall be used.

9) POST INSULATOR

11KV / 33KV insulators shall be of reputed make subject to owner approval. The post insulators for the above 11 KV isolators shall comprise of three numbers 11 KV insulators per stack and 9 such stack shall be supplied with each isolator. Similarly, for 33 KV isolators, two numbers 33 KV insulators per stack and 9 stacks shall be supplied with each isolator. The insulator stack shall conform to the latest applicable Indian or IEC standard and in particulars to the IS; 2544 specification for porcelain post insulators. The porcelain used for manufactures of insulators shall be homogeneous, free from flaws or imperfections that might affect the mechanical or dielectric quality, and they shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be uniform brown colour, free from glisters, burns and other similar defects. Insulators of the same rating and type shall be interchangeable.

The porcelain and metal parts should be assembled in such a manner that any thermal expansion differential between the metal and the porcelain parts throughout the range of temperature variation shall not loosen the parts or create undue internal stresses which may affect the electrical or mechanical strength and rigidity. Each cap and base shall be of high-grade cast steel or malleable steel casting and they shall be machine faced and smoothly galvanised. The cap and base of the insulators shall be interchangeable with each other.

The tenders shall in variably enclose with the offer, the type test certificate and other relevant technical guaranteed particulars of insulators offered by them. Please note that isolators without type test certificates will not be accepted.

Each 11KV / 33KV Post Insulators used in the isolators should have technical particulars as detailed below:-

	11KV	33KV
1. Nominal system voltage KV (rms)	11	33
2. Highest system voltage KV (rms)	12	36
3. Dry P.F. One minute with stand KV (rms)	35	75
4. Wet PF one minute withstand KV (rms)	35	75
5. P.F. Puncture withstand test voltage KV	1.3 time the actual dry flash over voltage of the unit	
6. Impulse voltage withstand test KV (peak)	75	170
7. Visible discharge test KV voltage	9	27
8. Creepage distance mm (min)	320	580
9. Tensile strength in KN	10KN	16KN
10. Short time current rating for 3 Secs	25KA	25KA

For 33 KV Isolators: In place of 33 KV Post Insulator the composition of 2 units of 22KV Post Insulators per stack complying the following parameters are acceptable:-

(a) Norminal system voltage	:	33 KV
(b) Highest system voltage	:	36 KV
(c) Impulse voltage withstand	:	170 KV
(d) Power frequency wet withstand voltage	:	75 KV
(e) Height of stack	:	500 mm
(f) Creepage distance (Minimum)	:	840 mm
(g) Tensile Strength	:	30KN
(h) Bending strength	:	4.5KN

Operating Mechanism for 11KV / 33KV Isolators:-

All Isolators and earthing switches shall have separate dependent manual operation. The Isolator should be provided with padlocking arrangements for locking in both end position to avoid unintentional operation. For this purpose Godrej make 5 lever brass padlocks having high neck with three keys shall be provided. The isolating distances should be visible for isolators.

The Isolators and Isolators with earth switch inclusive of their operating mechanism should be such that they cannot come out of their open or close position by gravity wind pressure, vibrations reasonable shocks or accidental touching of connecting rods of the operating mechanism. Isolators should be capable of resisting in closed position, the dynamic and thermal effects of maximum possible short circuit current at the installation point. They shall be so constructed that they do not open under the influence of the short circuit current. The operating mechanism should be of robust construction and easy to operate by a single person and conveniently located for local operation in the switchyard. Provision for earthing of operating handle by means of 8 SWG GS wire must be made.

10) PIPES

Tandem pipes operating handle shall be class B ISI marked type having atleast 24mm internal diameter for 11KV/33KV isolator. The operating pipe shall also be class B ISI marked with internal diameter of atleast 32 mm and 38 mm for 11 KV and 33KV isolators respectively.

The pipe shall be terminated in to suitable universal type joints between the insulator bottom bearing and operating mechanism.

11) BASE CHANNEL

The Isolator shall be mounted on base fabricated from steel channel section of adequate size not less than 75x40x6 mm for 11KV and 100x50x6 mm for 33KV.

To withstand total weight of isolator and insulator and also all the forces that may encounter by the isolator during services, suitable holes shall be provided on this base channel to facilitates it's mounting on our standard structures. The steel channel in each phase shall be mounted in vertical position and over it two mounting plates atleast 8mm thick with suitable nuts and bolts shall be provided for minor adjustment at site.

12) CLEARANCES

We have adopted the following minimum clearance for isolators in our system .The bidder should therefore keep the same in view while submitting their offers: -

Description	Center distance between Poles (Center to Center) i.e. Phase to Phase clearance	Distance between center lines of outer posts on same pole
11 KV Isolator	75 Cm	60 Cm
33 KV Isolator	120 Cm	96 Cm

29 11kV and 33 kV Air Break Switches

1) SCOPE

This specification provides for manufacture, testing at works and supply of 11KV & 33KV AB switches. The 11KV and 33 KV AB switches shall conform to IS: 9920 (Part-I to IV)

2) AB SWITCHES

The 11KV & 33KV Air Break Switches are required with two poles in each phase. The AB Switches shall be supplied complete with phase coupling shaft, operating rod and operating handle. It shall be manually gang operated and vertically break and horizontal mounting type.

The equipment offered by the bidder shall be designed for a normal current rating of 200 Amps and for continuous service at the system voltage specified as under:

- | | | | |
|--------------------|---|-------------|---|
| i) 11 KV AB Switch | : | 11KV + 10% | continuous 50 C/s solidly grounded earthed neutral system |
| ii) 33KV AB Switch | : | 33 kV + 10% | -do- |

The length of break in the air shall not be less than 400 mm for 11KV AB Switches and 500 mm for 33 KV AB Switches.

The 11KV & 33KV AB Switches are required with post insulators. The AB switches should be suitable for mounting on the structure. The mounting structure will be arranged by the bidder. However, the AB Switches shall be supplied with base channel for mounting on the structure which will be provided by the owner. The phase to phase spacing shall be 750mm in case of 11KV AB Switches & 1200mm in case of 33KV AB Switches.

3) POST INSULATORS

The complete set of three phase AB Switches shall have stacks of post insulators.

11KV AB Switches: 3 No. 11KV Post Insulator per stack

33KV AB Switches: 3 No. 33KV Post Insulator per stack

The post insulators should conform to the latest applicable Indian standards IS: 2544 Specification for Porcelain Post insulator of compact solid core or long rod insulators are also acceptable. Creepage distance should be adequate for highly polluted outdoor atmosphere in open atmosphere. The porcelain used for manufacture of AB Switches should be homogeneous free from flaws or imperfections that might affect the mechanical dielectric quality. They shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be of uniform brown in colour, free from blisters, burns and other similar defects. Insulators of the same rating and type shall be interchangeable.

The porcelain and metal parts shall be assembled in such a manner that any thermal expansion differential between the metal and porcelain parts through the range of temperature variation shall not loose the parts or create undue internal stresses which may affect the electrical or mechanical strength. Cap and base of the insulators shall be interchangeable with each other. The cap and base shall be properly cemented with insulators to give perfect grip. Excess cementing must be avoided.

Each 11KV & 33KV Post Insulators should have technical particulars as detailed below:

		11 kV	33 kV
i	Nominal system voltage kV (rms)	11	33
ii	Highest system voltage kV (rms.)	12	36
iii	Dry Power Frequency one kV minute withstand voltage (rms) in KV	35	75
iv	Wet Power frequency one minute withstand voltage (rms) in KV	35	75
v	Power Frequency puncture kV (rms) voltage	1.3 times the actual dry flashover voltage	
vi	Impulse withstand voltage kV (Peak)	75	170
vii	Visible discharge voltage kV (rms)	9	27
viii	Creepage distance in mm (minimum)	320	580

The rated insulation level of the AB Switches shall not be lower than the values specified below:-

Sl. No	Standard declared voltage KV/RMS	Rated Voltage of the AB Switches	Standard impulse with stand voltage (positive & negative polarity kV (Peak)		One Minute power frequency withstand voltage kV (rms)	
			Across the Isolating distance	To earth & between poles	Across the Isolating distance	To earth & between poles
i	11KV	12KV	85KV	75KV	32KV	28KV
ii	33KV	36KV	195KV	170KV	80KV	70KV

4) TEMPERATURE RISE

The maximum temperature attained by any part of the equipment when in service at site under continuous full load conditions and exposed to the direct rays of Sun shall not exceed 45 degree above ambient.

5) MAIN CONTACTS

AB Switches shall have heavy duty self-aligning type contacts made of hard drawn electrolytic copper/brass. The various parts should be accordingly finished to ensure interchangeability of similar components. The moving contacts of the switch shall be made from hard drawn electrolytic copper brass. This contact shall have dimensions as per drawing attached so as to withstand safely the highest short-circuit currents and over voltage that may be encountered during service. The surface of the contact shall be rounded smooth and silver-plated. In nut shell the male and female contact assemblies shall ensure.

1. Electro-dynamic withstands ability during short circuits without any risk of repulsion of contacts.
2. Thermal withstands ability during short circuits.
3. Constant contact pressure even when the lower parts of the insulator stacks are subjected to tensile stresses due to linear expansion of connected bus bar of flexible conductors either because of temperature variations or strong winds.
4. Wiping action during closing and opening.
5. Fault alignment assuring closing of the switch without minute adjustments.

6) CONNECTORS

The connectors shall be made of hard drawn electrolytic copper or brass suitable for Raccoon/Dog ACSR conductor for both 11KV & 33KV AB Switches. The connector should be 4 -bolt type.

7) OPERATING MECHANISM

All AB Switches shall have separate independent manual operation. They should be provided with ON/OFF indicators and padlocking arrangements for locking in both the end positions to avoid unintentional operation. The isolating distances should also be visible for the AB Switches.

The AB Switch will be supplied with following accessories:

Sl	Item	Size of 11KV AB Switch	Size of 33KV AB Switch
i	Operating Rod (GI dia) ISI mark	Length 5.50 meter dia: 25MM	Length 5.50 mtrs dia: 40MM
ii	Phase coupling square rod (GI) ISI mark	Length 1800 mm Size 25x25 mm	Length 2700 mm Size 40 x 40 mm
iii	Hot dip galvanized Operating handle (GI)	1 No.	1 No.

The AB Switches shall be capable to resist any chance of opening out when in closed position. The operating Mechanism should be of robust constructions, easy to operate by single person and to be located conveniently for local operation in the switchyard. The GI pipe shall conform to ('B' class or Medium class Blue strip) ISS: 1239-68 and ISI marked by embossing. The vertical down rod should be provided with

adequate joint in the mid section to avoid bending or buckling. Additional leverage should be provided to maintain mechanical force with minimum efforts.

All iron parts should be hot dip galvanized as per IS 4759-1979 and zinc coating shall not be less than 610 gm/sq. meter. All brass parts should be silver plated and all nuts and bolts should be hot dip galvanized.

8) ARCING HORNS

It shall be simple and replaceable type. They should be capable of interrupting line-charging current. They shall be of first make and after break type.

9) BUSH

The design and construction of bush shall embody all the features required to withstand climatic conditions specified so as to ensure dependable and effective operations specified even after long periods of inaction of these Air Break Switches. They shall be made from highly polished Bronze metal with adequate provision for periodic lubrication through nipples and vent.

10) DESIGN, MATERIALS AND WORKMANSHIP

All materials used in the construction of the equipment shall be of the appropriate class, well finished and of approved design and material. All similar parts should be accurately finished and interchangeable.

Special attention shall be paid to tropical treatment to all the equipment, as it will be subjected during service to extremely severe exposure to atmospheric moisture and to long period of high ambient temperature. All current carrying parts shall be of non-ferrous metal or alloys and shall be designed to limit sharp points/edges and similar sharp faces.

The firm should have the following type test certificate. The type test should be from CPRI or equivalent lab:-

1. Test to prove capability of rated peak short circuit current and the rated short time current. The rated short time current should correspond to minimum of 10K Amp and the peak short circuit current should correspond to minimum of 25K Amps.
2. Lightning impulse voltage test with positive & negative polarity.
3. Power Frequency voltage dry test and wet test
4. Temperature rise test
5. Mill volt drop tests

The above tests should be performed on the AB Switches, manufactured as per owner approved drawing with the specification. Along with the type test certificate, the certified copy of the drawing (from the testing lab) should also be kept for inspection of our officer. Also the test certificates should not be older than 5 years from the date of opening of tender.

Dimension of 11 & 33KV AB Switches in (Max.)Tolerance 5%.

Sl.	Particulars	11KV AB Switch	33KV AB Switch
i	MS Channel	450x75x40	675x100x50
ii	Creepage distance of Post Insulator	320mm (Min)	580mm (Min)
iii	Highest of Port shell	254 mm	368 mm
iv	Fixed contact assembly		
	i) Base	165x36x8	165x36x8
	ii) Contact	70x30x6	70x30x6
	iii) GI cover	110x44	140x44
	v) Spring	6 Nos.	6 Nos.

11) Moving Contact Assembly

i	Base Assembly	135x25x8	170x40x8
ii	Moving	180x25x9	290x25x14
iii	Bush	Bronze Metal	Bronze Metal
iv	Thickness of Grooves	7	11

12) Connectors

i	Connector	60x50x8 (Moving & fix both)	60x50x8 (Moving & fix both)
---	-----------	-----------------------------	-----------------------------

The bidder should provide AB Switches with terminal connectors, set of insulators, mechanical inter works and arcing horns sets. The base channel for the mounting of AB Switches shall also be included in the scope of AB Switches. The operating mechanisms together with down pipe operating handle etc. are also included in the scope of supply.

30 11 kV Drop Out Fuse Cut Outs

1. SCOPE

This specification covers outdoor, open, drop-out expulsion type Fuse Cutouts suitable for installation in 50 Hz, 11 KV distribution system.

2. APPLICATION

The distribution fuse cutouts are intended for use in distribution transformers and have no inherent load break capacity.

3. APPLICABLE STANDARD

Unless otherwise modified in this specification, the cutout shall conform to IS:9385 (Part-I to III) as amended from time to time.

4. RATED VOLTAGE

The rated voltage shall be 12 KV.

5. RATED CURRENT

The rated current shall be 100 A.

6. RATED LIGHTNING IMPULSE WITHSTAND VOLTAGE VALUES FOR THE FUSE BASE

The rated lightning impulse withstand voltages both for positive and negative polarities shall be as given below:

- | | |
|---|--------------|
| a) To earth and between poles | 75 KV (Peak) |
| b) Across the isolating distance of fuse base | 85 KV (Peak) |

7. RATED ONE MINUTE POWER FREQUENCY WITHSTAND VOLTAGE (DRY & WET) VALUES FOR THE FUSE BASE

- | | |
|----------------------------------|-------------|
| a) To earth and between poles | 28 KV (rms) |
| b) Across the isolating distance | 32 KV (rms) |

8. TEMPERATURE RISE LIMIT (In Air)

- | | |
|--|------|
| a) Copper contacts silver faced | 65°C |
| b) Terminals | 50°C |
| c) Metal parts acting as springs. The temp. shall not reach such a value that elasticity of metal is changed | |

9. RATED BREAKING CAPACITY

The rated breaking capacity shall be 8 KA (Asymmetrical).

10. GENERAL REQUIREMENTS/CONSTRUCTIONAL DETAILS

- 10.1 The cutouts shall be of single vent type (downward) having a front connected fuse carrier suitable for angle mounting.
- 10.2 All ferrous parts shall be hot dip galvanised in accordance with the latest version of IS:2633. Nuts and bolts shall conform to IS:1364. Spring washers shall be electro-galvanised.
- 10.3 Typical constructional details of the fuse cutout are shown in Fig. 1

11. FUSE BASE TOP ASSEMBLY

- 11.1 The top current carrying parts shall be made of a highly conductive copper alloy and the contact portion shall be silver plated for corrosion resistance and efficient current flow. The contact shall have a socket cavity for latching and holding firmly the fuse carrier until the fault interruption is completed within the fuse.
- 11.2 The top contact shall be actuated by a strong steel spring which keeps it under sufficient pressure to maintain a firm contact with the fuse carrier during all operating conditions. The spring shall also provide flexibility and absorbs most of the stresses when the fuse carrier is pushed into the closing position.
- 11.3 The current carrying parts of the assembly shall be protected from water and dust formation by a stainless steel top cover.
- 11.4 The top contact assembly shall have a robust galvanised steel hook to align and guide the fuse carrier into the socket latch even when the fuse carrier is closed at an off-centre angle.
- 11.5 The top assembly shall have an aluminum alloy terminal connector (refer clause 19).
- 11.6 The top assembly shall be robust enough to absorb bulk of the forces during the fuse carrier closing and opening operations and shall not over-stress the spring contact. It shall also prohibit accidental opening of the fuse carrier due to vibrations or impact.

12. FUSE BASE BOTTOM ASSEMBLY

- 12.1 The conducting parts shall be made of high strength highly conductive copper alloy and the contact portion shall be silver plated for corrosion resistance and shall provide a low resistance current path from the bottom fuse carrier contacts to the bottom terminal connector.
- 12.2 The bottom assembly shall have hinge contacts made from highly conductive, anti-corrosive copper alloy and shall accommodate and make a firm contact with the fuse carrier bottom assembly. The fuse carrier shall be placed easily in or lifted from the hinges without any maneuvering. In addition, the bottom assembly shall perform the following functions :-
- i) When opened manually or after fault interruption the fuse carrier shall swing through 180° to the vertical and its further travel shall be prevented by the fuse base bottom assembly.
 - ii) The fuse carrier shall be prevented from slipping out of the self locking hinges during all operating conditions and only when the fuse carrier has reached its fully open position can it be removed from the hinge support.
- 12.3 The assembly shall have an aluminium alloy terminal connector (refer clause 19).

13. FUSE CARRIER TOP ASSEMBLY

13.1 The fuse carrier top contact shall have a solid replaceable cap made from highly conductive, anti-corrosive copper alloy and the contact portion shall be silver plated to provide a low resistance current path from the Fuse Base Top Contact to the Fuse Link. It shall make a firm contact with the button head of the fuse link and shall provide a protective enclosure to the fuse link to check spreading of arc during fault interruptions.

13.2 The fuse carrier shall be provided with a cast bronze opening eye (pull ring) suitable for operation with a hook stick from the ground level to pull-out or close-in the fuse carrier by manual operation.

14. FUSE CARRIER BOTTOM ASSEMBLY

14.1 The fuse carrier bottom assembly shall be made of bronze castings with silver plating at the contact points to efficiently transfer current to fuse base. It shall make smooth contact with the fuse base bottom assembly during closing operation.

14.2 The bottom assembly shall have a lifting eye for the hook stick for removing or replacing the fuse carrier.

14.3 The bottom assembly shall have a suitable ejector which shall perform the following functions :

i) It shall keep the fuse link in the centre of fuse tube and keep it tensioned under all operating conditions.

ii) It shall be capable of absorbing the shock when the fuse carrier is pushed into the closed position and shall not allow the fuse link to be damaged. This is specially important when the fuse link is of low-ampere rating.

iii) The ejector at the instant of interruption shall retain the fuse carrier in the closed position long enough to ensure that the arc is extinguished within the fuse tube thereby excluding the possibility of arcing and subsequent damage at the contact surfaces.

iv) The ejector shall help the fuse link separation after fault interruption, allowing the fuse carrier to drop out and clearing the pigtail of the blown fuse link through the bore of fuse tube.

15. FUSE BASE (PORCELAIN)

The fuse base shall be a bird-proof, single unit porcelain insulator with a creepage distance (to earth) not less than 320mm. The top and bottom assemblies as also the middle clamping hardware shall be either embedded in the porcelain insulator with sulphur cement or suitably clamped in position. For embedded components, the pull out strength should be such as to result in breaking of the porcelain before pull out occurs in a test. For porcelain insulators, the beam strength shall not be less than 1000 Kg.

16. FUSE TUBE

The fuse tube shall be made of fibre glass coated with ultraviolet inhibitor on the outer surface and having arc quenching bone fibre liner inside. The tube shall have high bursting strength to sustain high pressure of the gases during fault interruption. The inside diameter of the fuse tube shall be 17.5mm. The

solid cap of the fuse carrier shall clamp the button head of the fuse link, closing the top end of the fuse tube and allowing only the downward venting during fault interruption.

17. TYPE TESTS

The cutout shall be subjected to the following type tests :

i) Dielectric tests (rated impulse withstands and rated one minute power frequency with stand test voltages)

ii) Temperature rise test

The above tests shall be carried out in accordance with IS:9385 Part I & II.

For Porcelain Fuse Base only.

iii) Pull out test for embedded components of the fuse base

iv) Beam strength of porcelain base

18. MOUNTING ARRANGEMENT

18.1 The cutouts shall be provided with a suitable arrangement for mounting these on 75x40mm or 100x50mm channel cross arm in such a way that the centre line of the fuse base is at an angle of 15° to 20° from the vertical and shall provide the necessary clearances from the support. Mounting arrangement shall be made of high strength galvanised steel flat and shall be robust enough to sustain the various stresses encountered during all operating conditions of the cutout. For more details see enclosed figure 2.

18.2 Strength of the component marked 1 (see figure) shall be determined by clamping the member with the shorter leg at the top to a rigid support by M-10 carriage bolts. A downward force shall be applied along the axis of M-14 carriage bolt parallel to the longer leg and in the direction of longer leg of the member under test. A load of 50 Kg. shall be applied and then removed to take up any slack in the mounting arrangement before the measurement of position is taken, the permanent set measured at the axis of the M-14 carriage bolt shall not exceed 1.6mm when a load of 425 Kg. is applied and removed.

18.3 The strength of the M-14 bolt shall in no case be less than 1900 Kg. and the strength of M-10 bolts not less than 3500 Kg.

19. TERMINAL CONNECTIONS

The cut-out shall be provided with two aluminium alloy (alloy designation 2280 (A-11) as per IS:617-1975) terminal connectors at top and bottom of fuse base assemblies to receive aluminium conductors of diameters between 6.3mm to 10.05mm. These terminals shall be easily accessible irrespective of the cut-out location with respect to the pole. The terminals shall meet the test requirements of REC Construction Standard.

20. INSPECTION

All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and the purchaser at the time to purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities without charge, to satisfy him that the material is being furnished in accordance with this specification.

The purchaser has the right to have the tests carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

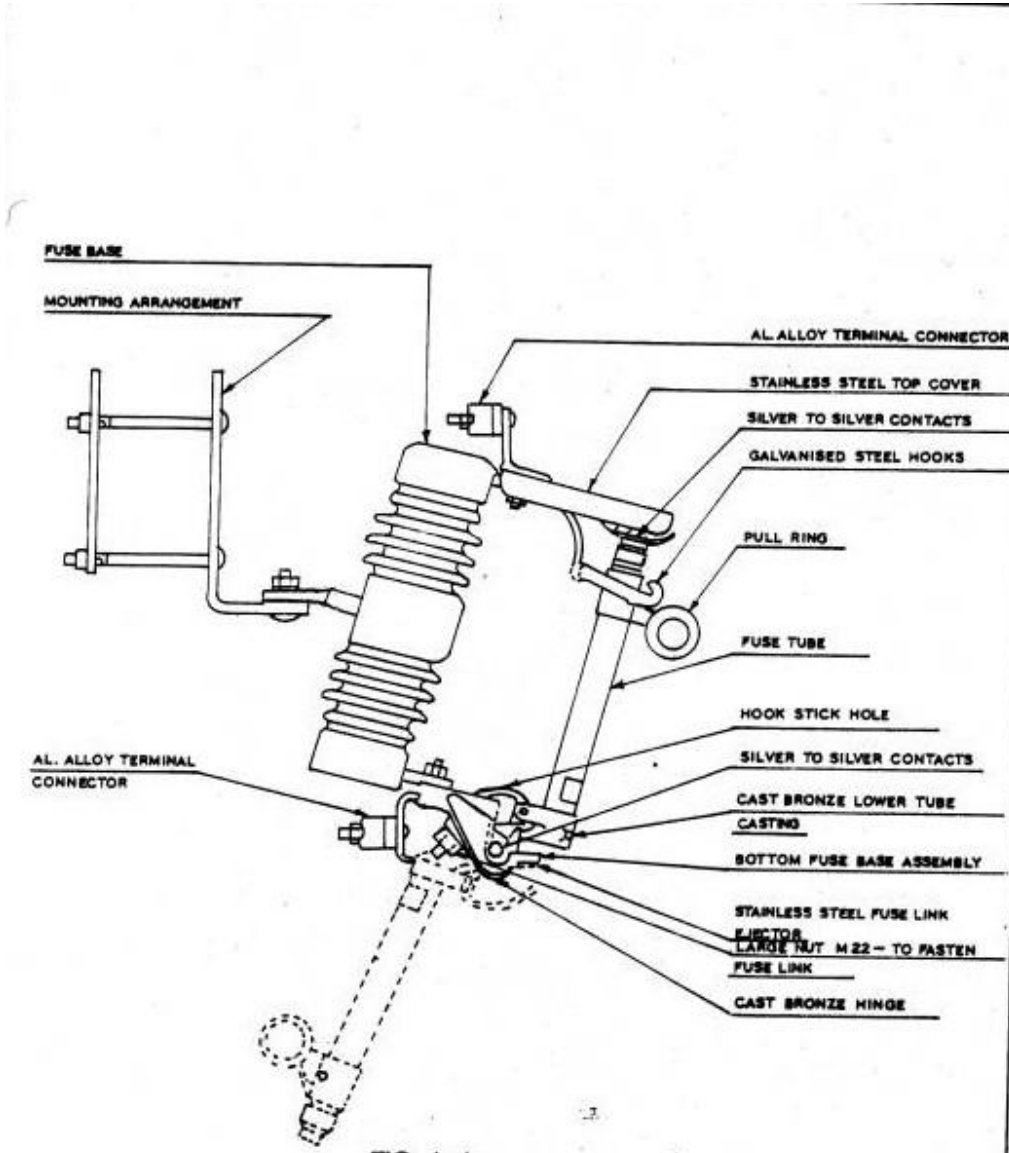


FIG. :- 1

११ के० वी० फ्यूज कट-आउट का प्रारूपिक निर्माण विवरण
 TYPICAL CONSTRUCTIONAL DETAILS OF 11KV
 FUSE CUT-OUT

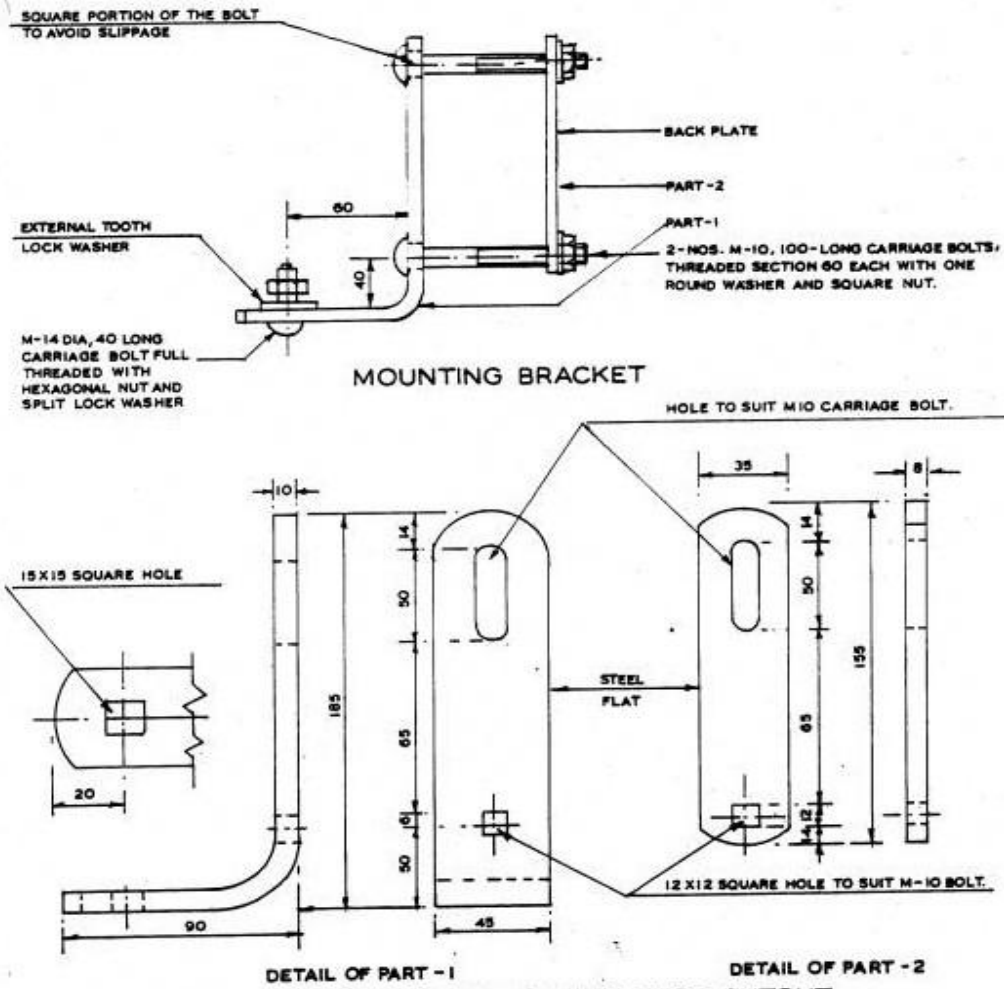


FIG.2:- MOUNTING DETAILS OF 11KV FUSE CUTOUT

ALL DIMENSIONS ARE IN MM.

११ के. वी. ड्रॉप-आउट फ्यूज कटआउट 11KV DROP-OUT FUSE CUTOUT	
SCALE :- N.T.S	JULY, 1967

31 33& 11 kV Station Class Lightning Arrestor & 11 kV Distribution Class Surge Arrestors

1. 33kV VOLTAGE CLASS SURGE ARRESTORS

Lightning Arrestors at Grid Substation shall be of Station class only in 33 & 11 KV System.

1.1. INTRODUCTION

The section covers the specification of 33kV voltage level, 10 kA, and Station class heavy duty, gapless metal (zinc) oxide Surge Arrestors complete with insulating base, terminal clamps, complete fittings & accessories for installation on outdoor type 33kV switchgear/transmission lines / transformers.

1.2. STANDARDS

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

IS:2071-1993 (Part-1)	Methods of High Voltage Testing General Definitions & Test Requirements.
IS:2071-1974(Part-2)	Test Procedures
IS:2629-1985	Recommended Practice for hot dip galvanizing on Iron & Steel
IS:2633-1986	Method for Testing uniformity of coating of zinc coated Articles.
IS:3070-1993 (Part – 3)	Specification for surge arrester for alternating current systems. Metal-Oxide lightning Arrestors without gaps
IS:4759-1996	Specification for hot dip zinc coating on Structural Steel and Other allied products.
IS:5621-1980	Hollow Insulators for use in Electrical Equipment.
IS:6209-1982	Methods of Partial discharge measurement.
IS:6745	Method for determination of mass of zinc coating on zinc coated iron and steel articles
ANSI/IEEE-C.62.11	Metal oxide, Surge Arrester for AC Power Circuits.
IEC –60099-4	Surge Arrestors

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

1.3. GENERAL REQUIREMENT

1.3.1. The metal oxide gap less Surge Arrester without any series or shunt gap shall be suitable for protection of 33kV switchgear, transformers, associated equipment and 33 kV lines from voltage surges resulting from natural disturbance like lightning as well as system disturbances.

1.3.2. The surge arrester shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current.

1.3.3. The surge arrester shall consist of non-linear resistor elements placed in series and housed in electrical grade porcelain housing / silicon polymeric of specified creepage distance.

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

- 1.3.5. The surge arrester shall be provided with line and earth terminals of suitable size. The ground side terminal of surge arrester shall be connected with 25x6 mm galvanized strip, one end connected to the surge arrester and second end to a separate ground electrode. The bidder shall also recommend the procedure which shall be followed in providing the earthing system to the Surge Arrester.
- 1.3.6. The surge arrester shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrester shall change over to the conducting mode.
- 1.3.7. The surge arrester shall be suitable for circuit breaker performing 0-0.3sec.-CO-3 min-CO- duty in the system.
- 1.3.8. Surge arrestors shall have a suitable pressure relief system to avoid damage to the porcelain/silicon polymeric housing and providing path for flow of rated fault currents in the event of arrester failure.
- 1.3.9. The reference current of the arrester shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.
- 1.3.10. The arrestors for 33 kV system shall be suitable for mounting on transformers, Bus, Line & structure as per scheme. The supplier shall furnish the drawing indicating the dimensions, weights etc. of the surge arrestors for the design of mounting Structure.
- 1.3.11. The arrester shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltages.

1.4. ARRESTOR HOUSING

- 1.4.1. The arrester housing shall be made up of porcelain/silicon polymeric housing and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be of uniform brown (for porcelain)/Grey (for silicon polymeric) colour, free from blisters, burrs and other similar defects.

Arrestors shall be complete with fasteners for stacking units together and terminal connectors.

- 1.4.2. The housing shall be so coordinated that external flashover shall not occur due to application of any impulse or switching surge voltage up to the maximum design value for arrester. The arrestors shall not fail due to contamination. The 33 kV arrestors housing shall be designed for pressure relief class as given in Technical Parameters of the specification.
- 1.4.3. Sealed housings shall exhibit no measurable leakage.

1.5. FITTINGS & ACCESSORIES

- 1.5.1. The surge arrester shall be complete with fasteners for stacking units together and terminal connectors.
- 1.5.2. The terminals shall be non-magnetic, corrosion proof, robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. The top metal cap and base of surge arrester shall be galvanized. The line terminal shall have a built in clamping device which can be adjusted for both horizontal and vertical take off.

1.6. TESTS

1.6.1. Test on Surge Arrestors

The Surge Arrestors offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS : 3070 (Part-3)/IEC-60099-4. In addition, the suitability of the surge arresters shall also be established for the followings

- i) Acceptance tests
 - a) Measurement of power frequency reference voltage of arrester units.
 - b) Lightning impulse residual voltage on arrester units (IEC clause 6.3.2)
 - c) Internal ionization or partial discharge test

- ii) Special Acceptance tests
 - a) Thermal stability test (IEC 99-4clause 7.2.2)
 - b) Watt loss test.

- iii) Routine tests
 - a) Measurement of reference voltage
 - b) Residual voltage test of arrester unit
 - c) Internal ionization or partial discharge test
 - d) Sealing test
 - e) Verticality check on completely assembled surge arresters as a sample test on each lot if applicable.

- iv) Type Tests

Following shall be type test as per IS 3070 (Part 3): 1993 or its latest amendment.

1.	Insulation Withstand test a) Lightning Impulse b) Power Frequency (Dry/Wet)
	Residual Voltage Test a) Steep current impulse residual voltage test b) Lightning impulse residual voltage test c) Switching Impulse Residual voltage test
	Long duration current impulse withstand test
	Switching surge operating duty test
	Power frequency voltage Vs. Time characteristics
	Accelerated Ageing test

	Pressure relief test a) High Current b) Low Current
	Artificial pollution test (for porcelain housing)
	Seismic Test
	Partial Discharge test
	Bending test
	a) Temperature cycle test (for porcelain housing) b) Porosity test (for porcelain housing)
	Galvanising test on metal parts
	Seal Leakage test (for porcelain housing)
	Seal leak test and operation tests (for surge monitor)
	Weather ageing test (for polymer housing)

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

1.6.3. The contractor shall furnish the copies of the type tests and the characteristics curves between the residual voltage and nominal discharge current of the offered surge arrester and power frequency voltage v/s time characteristic of the surge arrester subsequent to impulse energy consumption as per clause 6.6.7 of IS:3070 (Part-3) offered along with the GTP/Drawing.

1.6.4. The surge arrester housing shall also be type tested and shall be subjected to routine and acceptance tests in accordance with IS: 5621.

1.6.5. Galvanization Test

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

1.7. NAME PLATE

1.7.1. The name plate attached to the arrester shall carry the following information:

- Rated Voltage
- Continuous Operation Voltage
- Normal discharge current
- Pressure relief rated current
- Manufacturers Trade Mark
- Name of Sub-station
- Year of Manufacturer
- Name of the manufacture
- Name of Client-“ ”
- Purchase Order Number along with date

1.8. DRAWINGS AND INSTRUCTION MANUALS

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

- (i) Outline dimensional drawings of Surge Arrestor and all accessories.
- (ii) Assembly drawings and weights of main component parts.
- (iii) Drawings of terminal clamps.
- (iv) Arrangement of earthing lead.
- (v) Minimum air clearance to be maintained of line components to ground.
- (vi) Name plate
- (vii) Instructions manual
- (viii) Drawing showing details of pressure relief valve
- (ix) Volt-time characteristics of surge arrestors
- (x) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height, profile, creepage distance, dry arcing distance etc.

1.9. TECHNICAL PARTICULARS

1.9.1. The surge arrestors shall conform to the following standard technical requirements. The Insulation values shall be enhanced considering the altitude of operation & other atmospheric conditions.

System Parameters:

Nominal system voltage	:	33 kV
Highest system voltage	:	36 kV
System earthing	:	Solidly earthed system
Frequency (Hz)	:	50
Lightning Impulse withstand Voltage (kVP)	:	170

Power frequency withstand Voltage (kV rms)	:	70
Connection to system	:	Phase to earth

1.9.2. Surge Arrestors

Type of Surge Arrestor	:	Gapless Metal oxide outdoor
Arrestor rating (kV rms)	:	30
Continuous Operating voltage (kV rms)	:	25
Standard Nominal Discharge Current Rating (kA) (8x20 micro impulse shape)	:	10
Line discharge class	:	2
Degree of protection	:	IP-67
Lightning Impulse at 10 kA	:	85
Partial discharge at 1.05 COV not greater than	:	50 (PC)
Energy capability corresponding to		
a) Arrestor rating (kJ/kV)	:	4.5
b) COV (kJ/kV)	:	4.9
Peak current for high current impulse operating duty of arrestor classification 10 kA	:	100

1.9.3. Insulator Housing

Power frequency withstand test voltage (wet) (kV rms)	:	70
Lightning impulse withstand/tests voltage (kVP)	:	170
Pressure Relief Class	:	40
Creepage distance not less than	:	900 mm

1.9.4. Galvanisation

<u>Fabricated Steel Aticles</u>		
-- 5 mm thick cover	:	610 g/m ²
-- Under 5 mm but not less than 2 mm thickness	:	460 g/m ²
-- Under 2 mm but not less than 1.2 mm thickness	:	340 g/m ²
<u>Castings</u>		
-- Grey Iron, malleable iron	:	610 g/m ²
<u>Threaded works other than tubes & tube fittings</u>		
-- Under 10 mm dia		270 g/m ²
-- 10 mm dia & above		300 m ²

2. 11kV VOLTAGE CLASS SURGE ARRESTORS

2.1. INTRODUCTION

This section covers the specification of 11kV voltage station Surge Arrestors for installation on outdoor type 11kV switchgear, transmission lines, transformers etc. 11kV side of which is not enclosed in a cable box. Station class surge arrestors shall be complete with fasteners for stacking units.

2.2. STANDARDS

The design, manufacture and performance of Surge Arrestors shall comply with IS: 3070 Part-3 and other specific requirements stipulated in the specification. Unless otherwise specified, the equipment, material & processes shall conform to the latest amendments of the following:

IS:2071-1993 (Part-1)	Methods of High Voltage Testing General Definitions & Test Requirements.
IS:2071-1974 (Part-2)	Test Procedures.
IS: 2629-1985	Recommended Practice for hot dip galvanizing on Iron & Steel.
IS: 2633-1986	Method for Testing uniformity of coating of zinc coated Articles.
IS:3070-1993 (Part – 3)	Specification for surge arrestor for alternating current systems. Metal-Oxide lightning Arrestors without gaps.
IS: 4759-1996	Specification for hot dip zinc coating on structural steel and other allied products.
IS: 5621-1980	Hollow Insulators for use in Electrical Equipment.
IS: 6209-1982	Methods of Partial discharge measurement.
IS: 6745	Method for determination of mass of zinc coating on zinc coated iron and steel articles.
ANSI/IEEE-C.62.11	Metal oxide, Surge Arrestor for AC Power Circuits.
IEC –60099-4	Surge Arrestors.

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

2.3. GENERAL REQUIREMENT

- 2.3.1. The metal oxide gap less Surge Arrestor without any series or shunt gap shall be suitable for protection of 11 kV side of power transformers, associated equipment and 11kV lines from voltage surges resulting from natural disturbance like lightning as well as system disturbances.
- 2.3.2. The surge arrestor shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current.
- 2.3.3. The surge arrestor shall consist of non-linear resistor elements placed in series and housed in electrical grade porcelain housing / silicon polymeric of specified Creepage distance.
- 2.3.4. The assembly shall be hermetically sealed with suitable rubber gaskets with effective sealing system arrangement to prevent ingress of moisture.

- 2.3.5. The surge arrester shall be provided with line and earth terminals of suitable size. The ground side terminal of surge arrester shall be connected with 25x6 mm galvanized strip, one end connected to the surge arrester and second end to a separate ground electrode. The bidder shall also recommend the procedure which shall be followed in providing the earthing system to the Surge Arrester.
- 2.3.6. The surge arrester shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrester shall change over to the conducting mode.
- 2.3.7. The surge arrester shall be suitable for circuit breaker performing 0-0.3 min-CO-3 min-CO- duty in the system.
- 2.3.8. Surge arrestors shall have a suitable pressure relief system to avoid damage to the porcelain/ silicon polymeric housing and providing path for flow of rated fault currents in the event of arrester failure.
- 2.3.9. The reference current of the arrester shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.
- 2.3.10. The Surge Arrester shall be thermally stable and the bidder shall furnish a copy of thermal stability test with the bid.
- 2.3.11. The arrester shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltages.
- 2.3.12. The surge arrester shall be provided with line and earth terminals of suitable size.

2.4. ARRESTOR HOUSING

- 2.4.1. The arrester housing shall be made up of porcelain/silicon polymeric housing and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be of uniform brown (for porcelain)/Grey (for silicon polymeric) colour, free from blisters, burrs and other similar defects.

Arrestors shall be complete with fasteners for stacking units together and terminal connectors.

- 2.4.2. The housing shall be so coordinated that external flashover shall not occur due to application of any impulse or switching surge voltage upto the maximum design value for arrester. The arrestors shall not fail due to contamination. The 11kV arrestors housing shall be designed for pressure relief class as given in Technical Parameters of the specification.
- 2.4.3. Sealed housings shall exhibit no measurable leakage.

2.5. ARRESTOR MOUNTING

The arrestors shall be suitable for mounting on 4 pole/2 pole structure used for pole/plinth mounted transformer and for incoming and outgoing lines. Arrester may also be required to be mounted on a bracket provided in the Transformers.

2.6. FITTINGS & ACCESSORIES

- 2.6.1. The surge arrester shall be complete with fasteners and terminal connectors.

2.6.2. The terminals shall be non-magnetic, corrosion proof, robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. The top metal cap and base of surge arrestor shall be galvanized. The line terminal shall have a built in clamping device which can be adjusted for both horizontal and vertical take off.

2.7. TESTS

2.7.1. Test on Surge Arrestors

The Surge Arrestors offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS : 3070 (Part-3)-/IEC:600994. In addition, the suitability of the surge arresters shall also be established for the followings.

- i) Acceptance tests
 - a) Measurement of power frequency reference voltage of arrester units.
 - b) Lightning impulse residual voltage on arrester units (IEC clause 6.3.2)
 - c) Internal ionization or partial discharge test

- ii) Special Acceptance tests:
 - a) Thermal stability test (IEC clause 7.2.2)
 - b) Watt loss test.

- iii) Routine tests
 - a) Measurement of reference voltage
 - b) Residual voltage test of arrester unit
 - c) Internal ionization or partial discharge test
 - d) Sealing test
 - e) Verticality check on completely assembled surge arresters as a sample test on each lot if applicable.

- iv) Type Tests
 Following shall be type test as per IS 3070 (Part 3): 1993 or its latest amendment

1.	Insulation Withstand test a) Lightning Impulse
2.	Residual Voltage Test a) Steep current impulse residual voltage test b) Lightning impulse residual voltage test
3.	Long duration current impulse withstand test
4.	Switching surge operating duty test
5.	Power frequency voltage Vs. Time characteristics
6.	Accelerated Ageing test
7.	Pressure relief test c) High Current

8.	Artificial pollution test (for porcelain housing)
9.	Seismic Test
10.	Partial Discharge test
11.	Bending test
12.	a) Temperature cycle test (for porcelain housing) b) Porosity test (for porcelain housing)
13.	Galvanising test on metal parts
14.	Seal Leakage test (for porcelain housing)
15.	Seal leak test and operation tests (for surge monitor)
16.	Weather ageing test (for polymer housing)

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

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

2.7.4. The surge arrester housing shall also be type tested and shall be subjected to routine and acceptance tests in accordance with IS :5621.

2.7.5. Galvanization Test

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

2.8. NAME PLATE

2.8.1. The name plate attached to the arrester shall carry the following information:

- Rated Voltage
- Continuous Operation Voltage
- Normal discharge current
- Pressure relief rated current

- Manufacturers Trade Mark
- Name of Sub-station
- Year of Manufacturer
- Name of the manufacture
- Name of Client-
- Purchase Order Number along with date

2.9. DRAWINGS AND INSTRUCTION MANUALS

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

- (i) Outline dimensional drawings of Surge Arrestor and all accessories.
- (ii) Assembly drawings and weights of main component parts.
- (iii) Drawings of terminal clamps.
- (iv) Arrangement of earthing lead.
- (v) Minimum air clearance to be maintained of line components to ground.
- (vi) Name plate
- (vii) Surge monitor, if applicable.
- (viii) Instructions manual
- (ix) Drawing showing details of pressure relief valve
- (x) Volt-time characteristics of surge arrestors
- (xi) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height, profile, creepage distance, dry arcing distance etc.

2.10. TECHNICAL PARTICULARS

2.10.1. The surge arrestors shall conform to the following standard technical requirements. The Insulation values shall be enhanced considering the altitude of operation & other atmospheric conditions.

System Parameters

i)	Nominal system voltage	11kV
ii)	Highest system voltage	12 kV
iii)	System earthing	Effectively earthed system
iv)	Frequency (Hz)	50
v)	Lightning Impulse withstand	75 Voltage (kVP)
vi)	Power frequency withstand	28 Voltage (kV rms)
vii)	Arrestor duty	
	-- Connection to system	Phase to earth
	-- Type of equipment to be protected	transformers & switchgear

2.10.2. Surge Arrestors

i)	Type	Gapless Metal oxide outdoor
ii)	Arrestor rating (kV rms)	9
iii)	Continuous Operating voltage	7.65 (kV rms)
iv)	Standard Nominal Discharge Current	10 Rating (kA) (8x20 micro impulse shape)
v)	Degree of protection	IP 67
vi)	Line discharge Class	2
vii)	Steep current at 10 kA	45
viii)	Lightning Impulse at 10 kA	40
ix)	Energy capability corresponding to	
	a) Arrestor rating (kj/kV)	4.5
	b) COV (kj/kV)	4.9
x)	Peak current for high current impulse operating duty of Standard TS for arrester classification 10 kA	100

2.10.3. Insulator Housing

i)	Power frequency withstand test voltage (Wet) (kV rms)	28
ii)	Lightning impulse withstand/tests voltage (kVP)	75

2.10.4. Galvanisation

i)	Fabricated Steel Articles	
	a) 5 mm thick cover	610 g/m ²
	b) Under 5 mm but not less than 2 mm thickness	460 g/m ²
	c) Under 2 mm but not less than 1.2 mm thickness	340 g/m ²
ii)	Castings	
	Grey Iron, malleable iron	610 g/m ²
iii)	Threaded works other than tubes & tube fittings	
	a) Under 10 mm dia	270 g/m ²
	b) 10 mm dia & above	300 g/m ²

NOTE- Surge Monitor shall have to be provided if covered in BPS.

3. DISTRIBUTION CLASS SURGE ARRESTORS

To be used in distribution Transformer Substations only.

3.1. INTRODUCTION

This section covers the specification of Distribution class Surge Arrestor for 11kV transmission lines, transformers etc.

3.2. STANDARDS

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

IS:2071- 1993 (Part-1)	:	Methods of High Voltage Testing General Definitions & Test
IS:2071-1974 (part-2)	:	Test Procedures
IS:2629-1985	:	Recommended Practice for hot dip galvanizing on Iron & Steel
IS:2633-1986	:	Method for Testing uniformity of coating of zinc coated Articles.
IS3070-1993 (Part-3)	:	Specification for surge arrester for alternating current systems. Metal-Oxide lightning Arrestors without gaps
IS:4759-1996	:	Specification for hot dip zinc coating on Structural Steel and Other allied products.
IS:5621-1980		Hollow Insulators for use in Electrical Equipment.
IS:6209-1982		Methods of Partial discharge measurement.
IS:6745		Method for determination of mass of zinc coating on zinc coated iron and steel articles
ANSI/IEEE-C.62.11 :		Metal oxide, Surge Arrester for AC Power Circuits. (1982)
IEC –60099-4		Surge Arrestors

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

3.3. GENERAL REQUIREMENT

3.3.1. The metal oxide gap less Surge Arrester without any series or shunt gap shall be suitable for protection of 11 kV side of Distribution Transformers, associated equipment and 11 kV lines from voltage surges resulting from natural disturbance like lightning as well as system disturbances.

3.3.2. The surge arrester shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current.

3.3.3. The surge arrester shall consist of non-linear metal oxide resistor elements placed in series and housed in electrical grade porcelain housing / silicon polymeric of specified Creepage distance.

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

3.3.5. The surge arrester shall be provided with line and earth terminals of suitable size. The ground side terminal of surge arrester shall be connected with 25x6 mm galvanized strip, one end connected to the surge arrester and second end to a separate ground electrode. The contractor shall also recommend the procedure which shall be followed in providing the earthing/system to the Surge Arrester.

- 3.3.6. The surge arrestor shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrestor shall change over to the conducting mode.
- 3.3.7. The surge arrestor shall be suitable for circuit breaker performing 0-0.3 min-CO-3 min-CO- duty in the system.
- 3.3.8. The reference current of the arrestor shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.
- 3.3.9. The Surge Arrestor shall be thermally stable and the contractor shall furnish a copy of thermal stability test with the bid.
- 3.3.10. The arrestor shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltages.

3.4. ARRESTOR HOUSING

- 3.4.1. The arrestor housing shall be made up of porcelain/silicon polymeric housing and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be of uniform brown (for porcelain)/ Grey (for silicon polymeric) colour, free from blisters, burrs and other similar defects.
- 3.4.2. The housing shall be so coordinated that external flashover shall not occur due to application of any impulse or switching surge voltage upto the maximum design value for arrestor. The arrestors shall not fail due to contamination.
- 3.4.3. Sealed housings shall exhibit no measurable leakage.

3.5. ARRESTOR MOUNTING

The arrestors shall be suitable for mounting on 4 pole/2 pole structure used for pole mounted transformer and for incoming and outgoing lines.

3.6. FITTINGS & ACCESSORIES

- 3.6.1. The surge arrestor shall be complete with disconnecter and terminal connectors and all other accessories.
- 3.6.2. The terminals shall be non-magnetic, corrosion proof, robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. The top metal cap and base of surge arrestor shall be galvanized. The line terminal shall have a built in clamping device which can be adjusted for both horizontal and vertical take off.

3.7. TESTS

3.7.1. Test on Surge Arrestors

The Surge Arrestors offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS : 3070 (Part-3)-1993. In addition, the suitability of the surge arresters shall also be established for the followings

- a) Acceptance tests:
 - i) Measurement of power frequency reference voltage of arrester units.
 - ii) Lightning impulse residual voltage on arrester units (IEC clause 6.3.2)

- iii) Internal ionization or partial discharge test

- b) Special Acceptance tests:
 - i) Thermal stability test (IEC clause 7.2.2)

- c) Routine tests:
 - Measurement of reference voltage

- i) Residual voltage test of arrester unit
- ii) Internal ionization or partial discharge test
- iii) Sealing test
- iv) Verticality check on completely assembled surge arresters as a sample test on each lot if applicable.

- d) Type tests: Following shall be type test As per IS 3070 (Part 3)-/IEC;60094 or its latest amendment

1.	Insulation Withstand test a) Lightning Impulse voltage test b) Power Frequency (Dry & Wet)
2.	Residual Voltage Test a) Steep current impulse residual voltage test b) Lightning Impulse Residual Voltage Test
3.	Long duration current impulse withstand test
4.	High current impulse operating duty test
5.	Power frequency voltage Vs. Time characteristics
6.	Accelerated Ageing test
7.	Artificial pollution test (for porcelain housing)
8.	Partial discharge test
9.	Visual Examination (for porcelain housing)
10.	a) Temperature cycle test (for porcelain housing)
11.	Mechanical Failing Load test (Bending Strength test)

12.	Uniformity of Zinc coating, Mass of zinc coating
13.	Time versus current curve (for disconnecter)
14.	Weather ageing test (for polymer housing)

3.7.2. The maximum residual voltages corresponding to nominal discharge current of 5 kA for steep current, impulse residual voltage test, lightning impulse protection level and switching impulse level shall generally conform to Annex-K of IEC-99-4.

3.7.3. The contractor shall furnish the copies of the type tests and the characteristics curves between the residual voltage and nominal discharge current of the offered surge arrestor and power frequency voltage v/s time characteristic of the surge arrestor subsequent to impulse energy consumption as per clause 6.6.7 of IS:3070 (Part-3) offered alongwith the GTP.

3.7.4. The surge arrestor housing shall also be type tested and shall be subjected to routine and acceptance tests in accordance with IS: 5621

3.7.5. GALVANIZATION TEST

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

3.7.6. TEST ON SURGE ARRESTOR DISCONNECTORS

The test shall be performed on surge arrestors which are fitted with arrestor disconnecter or on the disconnecter assembly alone if its design is such as to be un-affected by the heating of adjacent parts of the arrestor in its normally installed portion in accordance with IS:3070 (Part-3)

3.8. NAME PLATE

3.8.1. The name plate attached to the arrestor shall carry the following information:

- Rated Voltage
- Continuous Operation Voltage
- Normal discharge current
- Manufacturers Trade Mark
- Year of Manufacturer
- Name of the manufacture
- Name of Client-
- Purchase Order Number along with date

3.9. DRAWINGS AND INSTRUCTION MANUALS

The successful bidder shall furnish to the purchaser the following drawings and literature for approval:

- (i) Outline dimensional drawings of Surge Arrestor and all accessories.
- (ii) Assembly drawings and weights of main component parts.
- (iii) Drawings of terminal clamps.
- (iv) Arrangement of earthing lead.
- (v) Minimum air clearance to be maintained of line components to ground.
- (vi) Name plate
- (vii) Instructions manual
- (viii) Drawing showing details of pressure relief valve
- (ix) Volt-time characteristics of surge arrestors
- (x) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height, profile, creepage distance, dry arcing distance etc.

3.10. TECHNICAL PARTICULARS

3.10.1. The surge arrestors shall conform to the following standard technical requirements. The Insulation values shall be enhanced considering the altitude of operation & other atmospheric conditions.

System Parameters

i)	Nominal system voltage	11kV
ii)	Highest system voltage	12 kV
iii)	System earthing	Solidly earthed system
iv)	Frequency (Hz)	50
vii)	Lightning Impulse withstand	75 Voltage (kVP)
viii)	Power frequency withstand	28 Voltage (kV rms)
vii)	Arrestor duty	
	-- Connection to system	Phase to earth
	-- Type of equipment to be protected	11 kV transformers & switchgear

3.10.2. Surge Arrestors

i)	Type	Gapless Metal oxide outdoor
ii)	Arrestor rating (kV rms)	9
iii)	Continuous Operating voltage (kV rms)	7.65
v)	Nominal Discharge Current	5 Rating (kA) (8x20 micro impulse shape)

v)	Long Duration discharge class	Distribution class
vi)	Maximum residual voltage (kV peak) a) at 5 kA	27
vii)	Partial discharge at 1.05 COV not greater than	50 (PC)
viii)	High current impulse withstand voltage at 5 kA (kVp)	65

3.11. INSULATOR HOUSING

i)	Power frequency withstand test voltage (Wet) (kV rms)	28
ii)	Lightning impulse withstand/tests voltage (kVP)	75
iii)	Creepage distance not less than (mm)	300

3.12. GALVANISATION

i)	Fabricated Steel Articles	
	a) 5 mm thick cover	610 g/m ²
	b) Under 5 mm but not less than 2 mm thickness	460 g/m ²
	c) Under 2 mm but not less than 1.2 mm thickness	340 g/m ²
ii)	Castings	
	Grey Iron, malleable iron	610 g/m ²
iii)	Threaded works other than tubes & tube fittings	
	a) Under 10 mm dia	270 g/m ²
	b) 10 mm dia & above	300 g/m ²

32 LED Self Ballasted Lamps (Retrofit LED Lamp)

1. Lamp Terminology: Self Ballasted LED Lamp retrofits for GLS lamp, cap size E27.
2. Technical Requirement: The lamps shall conform to 16102 (Part 1) for safety requirements. The test method for performance requirement shall be as per IS 16102(Part 2). The performance of lamps shall be as specified in the following table.
3. LED Chip conformity should mandatory be as per LM80.
4. Lamp Specifications:

Sl. No.	Test Parameters	Requirements	Referred Standard IS/IEC
1	Rated Wattage	Upto 9 W	IS 16102 (Part 2)
2	Cap Type	E27	IS 16102 (Part 1)
3	Efficacy (lm/w)	Minimum 80 lumen/watt	IS 16102 (Part 2)
4	Minimum operating input voltage	AC 144 V to 288 V	Shall be able to operate satisfactorily
5	Rated Voltage	Up to and including 250 V AC; in case of voltage range - 220 V to 240 V, AC	
6	Rated frequency	50 Hz	IS 16102(Part 1)
7	Light Source (LED chips/Die)	COB/SMD LED	LM 80 Compliant (Certified by the supplier)
8	CCT	Cool White (Cool daylight) 5700K (5665 ± 270) to 6500K(6432±340) Colour variation category, initial and maintained-B	IS 16102 (Part 2)
9	Beam angle	Minimum 140°	IS 16102 (Part 2)
10	Power factor	Minimum 0.9°	IS 16102 (Part 2)
11	Life	Average life 25,000 hrs	IS 16102 (Part 2)
12	CRI	Minimum 70	IS 16102 (Part 2)
13	Lumen Maintenance	Maximum 10% at 25% of rated lamp life(with a maximum duration of 6000hrs).	IS 16102 (Part 2)
14	Rated Luminous flux	Minimum 710 lm	IS 16102 (Part 2)
15	Safety requirement	Lamp shall meet all the safety requirements	IS 16102 (Part 1)
16	Guarantee	Minimum 3 years	
	Making	On the product of packaging 1. This lamp is specially made for distribution under DDUGJY scheme 2. Year of Mfr/Batch No./Serial no. 3. Name/ Address of Manufacturer 4. "Not for SALE or retail market"	Marking shall be on the carton and the product as specified in IS 16102 (Part 1) and (Part 2)

Certification endurance and switching immediately	For life, immediately self-certification to deter from sub-standard supply. Later final life test after 9 months	
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5. Testing: LED lamps are tested for acceptance test as per clause 19.2, Page No.8 of IS 16102 (Part-II).
The sampling of testing shall be as per clause 15, 16 & 17 of IS 16102 (Part-I).

Note- The rating of LED lamp shall be upto 9W and the lamp shall be capable to produce 710 Lumen conforming to IS 16102 (Part-II)

33 1KV & 33 KV Metering Units

1 SCOPE:

This specification covers design, engineering, manufacture, assembly, stage testing, inspection, testing before dispatch, supply and delivery of 11KV & 33KV CT PT Combined Metering unit Sets of class of accuracy 0.5 for 11 KV MU, 0.2 for 33 KV MU as per the particulars given in the schedule attached.

2 STANDARD: Except where modified by this specification the component parts of the equipment shall comply with the following ISS available (the latest versions).

Current T Transformers	:	IS 105/1992
Potential Transformers	:	IS 56/1992
HV Porcelain Bushing	:	IS 99/1986
Oil	:	IS 5/1983
Galvanization	:	IS 33
Primary Terminals	:	IS 601
	:	IS 5

3 TYPE FOR 11 KV: The metering transformer equipment should be of pole mounting type for outdoor use. They are to be used in 11KV Three Phase with solidly earthed neutral and suitable for 3 Phase 4 Wire 50 cycles network. The equipment is required for operation of HT Trivector Meters and should be oil cooled. The CTPT sets shall have the following ratings:

- i) Rated Voltage: 11 KV
- ii) Highest system voltage: 12 KV
- iii) Insulation level: 12 KV
- iv) Standard Impulse withstand voltage: 75 KV Peak
- v) One minute power frequency withstand Voltage

Primary	28 KV
Secondary	3 KV

- vi) Short time thermal current and its duration
 6 KA for 1 sec for CT ratio below 50/5 A
 13.1 KA for 1 sec for CT ratio = 50/5 A (including 50/5 A)
- vii) Class of Accuracy: 0.5 (Negative (-ve) errors will not be acceptable.)
- viii) Rated burden per phase
 For CTs: 15 VA
 For PTs: 50 VA
- ix) Frequency: 50 HZ
- x) Maximum attainable winding temperature = 80 deg C
- xi) Minimum Phase to Phase distance = 255 mm
- xii) Shortest distance between metal part & earth = 190mm
- xiii) Creepage distance of HV bushing 300mm (Min)
- xiv) Gauge of MS Tank Min 5mm for top & bottom cover & 3.15 mm all other sides

- xv) Entire tank shall be hot dip galvanized.
- xvi) Bi-metallic terminal connector with a nut, plane washer, spring washer & Check nut suitable for aluminum conductor required for different rating of metering units. Six nos. to be provided with each metering units.

4. TYPE FOR 33 KV: The metering transformer equipment should be of pole mounting type for outdoor use. They are to be used in 33 kV Three Phase with solidly earthed neutral and suitable for 3 Phase 4 Wire 50 cycles network. The equipment is required for operation of HT Trivector Meters and should be oil cooled.

The CTPT sets shall have the following ratings.

- i) Rated Voltage: 33 KV
- ii) Highest system voltage: 36 KV
- iii) Insulation level: 36 KV
- iv) Standard Impulse withstand voltage: 170 KV peak
- v) One minute power frequency withstand Voltage

a. Primary	:	70 KV
b. Secondary	:	3 KV

- vi) Short time thermal current and its duration
 - 6 KA for 1 sec for CT ratio below 50/5 A
 - 13.1 KA for 1 sec for CT ratio for > 50/5 A (including 50/5A)
- vii) Class of Accuracy: 0.2 (Negative (-ve) errors will not be acceptable.)
- viii). Rated burden per Phase
 - 1. For CTs: 5 VA up to 50/5 A & 10 VA for => 50/5 A
 - 2. For PTs: 50 VA
- ix). Frequency: 50 HZ
- x). Maximum attainable winding temperature =80 deg C
- xi). Minimum Phase to Phase distance=430 mm
- xii). Shortest distance between metal part & earth = 380 mm
- xiii). Creepage distance of HV bushing 900mm (Min)
- xiv). Thickness of MS Tank Min 5mm for top cover & 3.15 mm bottom & all other side.
- xv). Entire tank shall be hot dip galvanized.
- xvi). Bi-metallic terminal connector with a nut, plane washer, spring washer & check nut suitable for aluminium conductor required for different rating of metering units. Six nos to be provided with each metering units.

5. DESIGN:

- a) The equipment shall be designed to ensure satisfactory operation under all conditions of service to facilitate easy inspection, cleaning and repairs.
- b) The design shall incorporate every reasonable precaution and provisions for safety of all those concerned in the operation and maintenance of the equipment. A pressure relief valve shall be invariably provided to the CT PT set. IT shall be provided at the top cover of the tank.
- c) All outdoor apparatus shall be so designed that water cannot collect at any point and enter the CT/PT set. The top cover of the tank, secondary terminal cover, inspection chamber cover plate is suitable bent at the edges (at least 25mm bent) so that the gaskets are not exposed to moisture.
- d) All connections and terminals shall be of sufficient size for carrying the specified currents

continuously without undue heating.

- e) All bolts, nuts, washers in contact with non-ferrous parts shall be of brass.
- f) All ferrous parts including bolts & nuts liable to corrosion, forming integral part of the equipment shall be smoothly and continuously hot dip galvanized.
- g) The secondary terminal box, inspection cover and oil gauge shall be arranged with MU.
- h) The core shall be high grade non-ageing electrical silicon laminated steel or of better grade of low hysteric loss and high permeability to ensure high accuracy, at both normal and over current/voltage.
- i) All winding shall be of insulated high grade Electrolytic copper wire and the manufacturing of the units shall be done completely closed and air-conditioned room otherwise fibre glass insulation sleeves are to be provided for primary winding. Details of winding and core shall be furnished.
- j) The CTPT set should have Three CTs and Three PTs with star/star connection.

6. SEALING:

Sealing bolts for sealing at 4 points on the secondary terminal box (both inner & outer door), inspection cover, the top cover of the tank shall be provided. This may be made by providing a hole on tail of corner bolts of adequate size to pass the sealing wire or above 13 SWG.

7. FLUCTUATION IN VOLTAGE AND FREQUENCY:

For continuous operation, entire equipment shall be subjected to variation of voltage up to plus 20 minus 30 frequency of plus or minus 5 percent.

8. INSTRUMENT TRANSFORMERS:

- d) The voltage and current transformers shall have normal continuous rating as per the schedule of requirement.
- b) The voltage transformer shall be so designed that the increased magnetizing currents due to any persisting over voltage, does not produce injurious over heating Phase barriers shall be provided.
- c) The peak value of the rated dynamic current shall not be less than 2.5 times the rated short time thermal current unless stated otherwise. (4.62 of ISS: 2705/Part-I of 1992, latest version).
- d) Modified polyester enamel copper wire is to be used for winding and it shall conform to IS-4800/Part-V (latest version).
- e) The terminals of the instrument transformer shall be clearly marked by distinctive letters as stated in Annex "C" of ISS: 3156/Part.I/1992 (latest version) for voltage transformer and Annex "C" of IS-2705/Part.I/1992 (latest version) for current transformers.
- f) The winding shall be neatly laid and anchored.
- g) The metering set tank and other metal parts shall be galvanized both inside & outside as per latest IS applicable.

9. INCOMING SIDE:

TERMINALS: Brass rods 12mm dia for Primary and 6 mm dia for secondary.
Bushing for outgoing side of CT/PT set :
The porcelain portion of HT bushings shall be of standard make and conform to IS-2099/1996.

The dimensions of the bushings shall conform to IS - 3347

/Part.III/19 The minimum phase-to-phase clearance shall be as per IS.

The tests as per IS-2099/1962 shall be conducted on the transformer bushings as detailed below:

- a) Dry flash over voltage.
- b) Wet flashover voltage.
- c) Dry 1 Min. withstand volt.
- d) Impulse withstand voltage (1.2/50 Micro Seconds –ve wave)
- e) Manufacturer's test certification may be furnished for every lot of offer.

The bushings shall be of reputed manufacturers like M/s. Jayashree Insulators, M/s. WS Industries, M/s. BHEL, M/s. Allied Ceramics, M/s. India Potteries and M/s. IEC which are having complete testing facilities.

The bushing stems shall be provided with suitable bimetallic connectors so as to connect the jumper without disturbing the bushing stem.

f) The bush rod stem length should be at least 40 mm and 3 nuts with 2 flat washers of brass material should be provided with each bush rod.

10. STEEL TANK:

The oil filled container incorporating the voltage transformers and current transformers should be fitted with incoming and outgoing primary terminals and secondary terminal box. The secondary terminal box shall be arranged on sides. The general arrangement drawing with 3 bushing on the incoming side and 3 bushings on the outgoing side shall be submitted along with tender.

The tank shall be built with a plate of 5 mm thick top and 3.15 mm sides and bottom end with all fittings shall be capable of withstanding without leakage or distortion at the standard test pressure. All joints of the tank and fittings shall be hot oil tight and no leakage should occur during service. Both side of the joint should have continuous welding.

- a) It shall be provided with an oil gauge as shown. The oil gauge glass shall be fixed to the side of the raised wall of the inspection box.
- b) The tank shall be provided with necessary lifting lugs. Tank including top cover shall be hot deep Galvanized.
- c) The secondary terminal box cover, tank cover and inspection cover and other vertical joints where gaskets are used shall be suitably bent at least 25 mm bent with necessary sealing arrangement with sealing bolts at all corners and bolts should be at least 10 mm diameter GI bolts spaced maximum 70 mm apart. This is to safeguard against seepage of water into tank in case of damaged gasket.
- d) The 6 mm gaskets shall be dovetailed without joints to prevent moisture entry. In case of dovetailed joint, they shall not be more than two. The gaskets shall be of good quality Neoprene or superior quality rubberized gasket.
- e) EARTHING: Two earthing terminals shall be adequate size protected against corrosion and metallicly clean and identified by means of the sign marked in a legible and indelible manner on or adjacent to the terminals.

- 1 All bolts should be provided with 2 flat washers and a spring washer with a nut.
- 2 Conservator should not be provided for these CTPT sets.
- 3 The Secondary terminal box incoming hole should be 32 mm diameter and at a suitable height from bottom to avoid replacement/ modification of secondary wires pipe when CTPT set is replaced. The secondary terminals size should be 6 mm diameter, 25 mm stem length, 2 flat washers with 3 nuts of brass material should be provided. The terminals should be provided at least 70 mm height from incoming hole and clearances shall be as per IS to avoid shorting terminals due to secondary wires pipe.
- f) Secondary chamber shall have double door (inner & outer) with suitable arrangement for sealing of both the doors. The inner door shall be of transparent Polycarbonate so that secondary terminal connections can be viewed without breaking the inner door seals.
- g) The following details of equipment shall be engraved on tank with at least 10 mm letters.
 1. Make
 2. Ratio
 3. Class of accuracy
 4. Serial No:
 5. Month & year of manufacturing
 - 6 . Property of Employer.

66 months guarantee embossed plate shall be welded opposite side of name plate.

11. MOUNTING ARRANGEMENT:

The under base of all CTPT sets shall be provided with two 75x40mm GI channels and foundation dimensions shall be suitable placing with tank base uniform for all sets with only ± 2 mm tolerance, to avoid modification of structure / plinth, whenever CTPT set is replaced

12. OIL: The insulation oil used in the tank shall comply with the requirements specified in latest relevant IS: 335/93 and as per Annexure-C.

13. GUARANTEED TECHNICAL PARTICULARS:

The Technical Particulars as specified in IS shall be guaranteed. Every tenderer should furnish the particulars required and guarantee the values so furnished for the supplies.

14. TESTS:

TYPE TESTS: The equipment offered shall be fully type tested from recognized standard govt. national laboratory by the bidder as per the relevant certificates shall be furnished. The bidders also furnish type test certificates for bushings and oil along with the Bid. The type test certificates shall be not older than (5) years.

TYPE TESTS FOR CTs:

- a) Verification of terminal marking and polarity
- b) Short time current Test.
- c) Temperature rise test.
- d) Lightning Impulse test
- e) High Voltage Power frequency wet withstand voltage test.
- f) Determination of errors or other characteristics according to the requirements of the appropriate designation or accuracy class.

TYPE TESTS FOR PTs:

- a) Verification of terminal marking and polarity.
- b) High voltage Power frequency wet withstand voltage test.
- c) Power frequency dry withstand tests on Primary winding.
Power frequency dry withstand test on Secondary winding.
- d) Determination of errors according to the requirements of the appropriate accuracy class.
- e) Temperature rise test.
- f) Impulse Voltage test.
- g) Lightning Impulse test

TYPE TESTS FOR TRANSFORMER BUSHINGS:

- i) Dry flash over voltage.
- ii) Wet flash over voltage.
- iii) Dry 1 Minute withstand voltage.
- iv) Impulse withstand voltage (1.2/50 Micro Seconds –ve wave)

ACCEPTANCE AND ROUTINE TESTS:

The following shall be conducted as per IS: 3156 (Latest version).

- i) Verification of Terminal marking and polarity.
- ii) Power frequency/ dry withstand tests on primary windings.
- iii) Power frequency dry withstand tests on secondary windings.
- iv) Determination of errors according to the requirements of the appropriate accuracy class.
- v) Temperature rise test.
- vi) Air pressure test on empty tank of M U opened for verification test (One for every lot offered for pre-dispatch inspection)
- vii) All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the manufacturer in presence of Employer representatives.

15. DRAWINGS AND LEAFLETS (along with tender):

Two sets of drawings showing clearly the general arrangements, sectional views, fitting details, electrical connections, foundation details, overall dimensions and design features of each component part should accompany the tender. The contractor has to submit clear & detail drawing with description how he will arrange the double door system in secondary chamber with sealing. Technical leaflets giving the operating instructions should also be furnished along with tender. Literature and drawings are to be sent along with each equipment while dispatching, after approval of Project Manager.

16. DEVIATIONS:

The deviations between these CTPT sets and NABL approved Standard Lab (CPRI, ERDA, etc..) type tested CTPT set along with detailed reasons for deviations if any shall be submitted along with tender.

17. TOLERANCES:

Unless otherwise specified herein the test value of the transformers supplied should be within the tolerance permitted in the IS on the guarantee values.

18. SEALING OF CTPT SETS AFTER TESTING AND INDIVIDUAL TEST REPORTS:

After witnessing testing on sample quantity and physical inspection of all offered CTPT sets, the purchaser's representative will provide numbered plastic seal bits to two opposite corners of tank, Secondary Chamber and inspection cover of all offered CTPT sets, for delivery of correct inspected materials only. The manufacturer has to provide test report duly mentioning all test results, seal bit

numbers and name & address of Employer representative after inspection is over. The seal bit numbers shall also be mentioned in the test reports signed by Employer representative submitted for delivery instructions.

19. **INSPECTION AND TESTING OF TRANSFORMER OIL:**
To ascertain the quality of transformer oil the manufacturer's test report should be submitted at the time of inspection. Arrangements should also be made for testing the transformer oil, after taking out the samples from the manufactured CTPT sets and tested in the presence of Employer representative (or) if desired, in an independent laboratory manufactured CTPT sets and tested in the presence of Employer representative (or) if desired, in an independent laboratory.
20. **DEPARTURE FROM SPECIFICATION:**
If the tenderer wishes to depart from this specification in any respect, he shall draw the attention to such points of departure explaining fully the reasons therefore. Unless this is done the requirements of this specification will be deemed to have been accepted in every respect.
21. **NAME PLATE:**
The Purchase order No. and Date of purchase order, the words "PROPERTY OF EMPLOYER NAME". The name plate shall be non-detachable type & fixed with rivets, not with bolts & nuts. The name plate should bear year & month of manufacture & other data as per IS. Space should be provided to punch the date of installation by user group.
22. **WARRANTY:**
The manufacturer will warrant for the satisfactory functioning of the material / equipment as per specification for a minimum period of 66 months from the date of dispatch of the material / equipment in good condition indicating GP covering date upto -----
23. The tenderer shall indicate the source of all materials. He shall also indicate the name of the manufacturer and make of conductor, Transformer oil Electrical Steel Laminations, Construction Steel etc.
24. **FITTINGS:**
The following standard fittings shall be provided.
 - a) Rating and terminal marking plates non detachable -1no.
 - b) Earthing terminals with bolt, nuts & washers for connecting earth wire - 2Nos.
 - c) Lifting lugs -4Nos.for main tank and 2Nos. for top cover.
 - d) Pressure relief valve. – 1 no.
 - e) Bimetallic terminal connectors on the HV bushings – 6 Nos.
 - f) HV bushings Outdoor – 6 Nos.
 - g) Secondary terminals bushings – 10 Nos
 - h) Base channels 75 x 40 mm.
 - i) 66 months guarantee embossed plate welded to tank opposite side of name plate.
 - j) Tank and over all dimensions.
 - k) Weight content of a) core b) windings c) tank & fittings d) weight/qty. of oil e) over all weight.

SCHEDULE OF MATERIALS:

Sl. No.	Name of the Materials
1	11KV Metering Unit (CTR = 10/5A)
2	11KV Metering Unit (CTR = 15/5A)
3	11KV Metering Unit (CTR = 20/5A)
4	11KV Metering Unit (CTR = 25/5A)
5	11KV Metering Unit (CTR = 30/5A)
6	11KV Metering Unit (CTR = 50/5A)
7	11KV Metering Unit (CTR = 100/5A)
8	11KV Metering Unit (CTR = 200/5A)
9	11KV Metering Unit (CTR = 400/5A)
10	33KV Metering Unit (CTR = 5/5A)
11	33KV Metering Unit (CTR = 10/5A)
12	33KV Metering Unit (CTR = 15/5A)
13	33KV Metering Unit (CTR = 20/5A)
14	33KV Metering Unit (CTR = 25/5A)
15	33KV Metering Unit (CTR = 30/5A)
16	33KV Metering Unit (CTR = 50/5A)
17	33KV Metering Unit (CTR = 100/5A)
18	33KV Metering Unit (CTR = 200/5A)

34 Energy Meter

1.1 GENERAL

This Chapter describes the common requirement for static energy meter required for HT feeder, 3-Phase Distribution Transformer, 1-Phase Distribution Transformer, Single Phase whole current meter.

Necessary software for downloading the data through CMRI and uploading to computer shall be provided. No cost shall be charged for providing the software by the manufacturer to Owner.

The seals & sealing specifications are given in Annexure A

All meter shall have BIS certification mark. Valid BIS license must be submitted along with the bid.

1.2 STANDARDS APPLICABLE

Unless otherwise specified elsewhere in this specification, the performance & testing of the meters shall conform to the following Indian/International standards with updated and latest amendments/revisions thereof.

Sl.No.	Standard No.	Title
1.	IS 14697-1999	AC Static Watt-hour Meters for active energy Class0.5 & 0.2
2.	IS 12063	Specification for degree of protection
3.	IS 14772	Specification for boxes for enclosure of electrical accessories
4.	IS 13779/1999	AC Static Watt-hour Meters for active energy Class 1.0 & 2.0
5.	CBIP Report No.-325	Specification for AC Static Electrical Energy Meters
6.	CBIP Technical Report No. 111	Specification for common meter reading instrument
7.	IS:9000	Basic environment testing procedure for electric and electronic item
8.	IS:15959 with latest amendment	Data Exchange for Electricity Meter Reading, tariff & load control – Companion Specification

1.3 CLIMATIC CONDITION

The meter should be able to perform satisfactorily in moderately hot and humid climate, conducive to rust and fungus growth as specified in Section-I. The climate conditions are also prone to wide variations in the ambient conditions. The meter shall work satisfactorily even under lightning conditions and also the meter performance and life shall not be affected due to smoke present in the atmosphere.

* The specifications are applicable for meter installation upto an altitude of 2200 meter above mean sea level. For meters to be used for an altitude of above 2200 MSL necessary corrections shall have to be carried out in BIL and one minute power frequency with stand voltage capability as per relevant standard.

1.4 SUPPLY SYSTEM

Type of meter	Input Voltage	Input Current	Burden	Type /Phase	Starting Current	Accuracy
HT Feeder meter	3 x 110 volt phase to phase	1A / 5A	1.5 Watts/phase or 10 VA/phase for voltage circuit and 1 VA phase for each current circuit	3 phase 4 wire	0.1 % of basic	0.5
3-phase DT meter	415±20% phase to phase	5A	1.5 Watts/phase or 10 VA/phase for voltage circuit and 1 VA phase for each current circuit	3 phase 4 wire	0.1 % of basic	0.5
1-phase DT meter	240+20% -30% phase to neutral	5A	1.5 Watts/phase or 10 VA/phase for voltage circuit and 1 VA phase for each current circuit	1 phase 2 wire	0.1 % of basic	0.5
1-phase consumer meter	240 V Phase to neutral	5-30A, 10-60A	1.5 Watts/phase or 8 VA/phase for voltage circuit and 4 VA phase for each current circuit	1 phase 2 wire	0.4 % of basic	1.0
3-phase consumer meter	3x 240 V Phase to neutral	10-60A	1.5 Watts/phase or 8 VA/phase for voltage circuit and 4 VA phase for each current circuit	3 phase 4 wire	0.4 % of basic	1.0

1.5 POWER FACTOR RANGE

The meter shall be suitable for full power factor range from Zero (lag) to Unity to Zero (lead).

1.6 POWER SUPPLY VARIATION

Energy meter along with its accessories shall withstand following extreme operating conditions.

Voltage : 70% to 120 % of V ref

Frequency : 50 ± 5% Hz

The manufacturer can also offer meters, which can withstand higher variations.

1.7 MAXIMUM CONTINUOUS CURRENT

The maximum continuous current in meters shall be the current at which the meter purports to meet the accuracy requirement of the specification.

1.8 CALLIBERATION

The meter should be only factory calibrated and no modification of calibration should be possible at site to ensure non tampering of meter at site.

1.9 COMMUNICATION CAPABILITY

The Meter shall be provided with a galvanically isolated optical communication port and communication capability as per IS 15959, so that it can be easily connected to a CMRI for data transfer.

1.10 NAME-PLATE MARKING OF THE METER

The marking on every meter shall be in accordance with relevant clauses of standard. Every meter shall have name plate beneath the meter cover such that the name plate cannot be accessed without opening the meter cover and without breaking the seals of the meter cover and the name plate shall be marked distinctly and indelibly. The basic marking on the meter nameplate shall be as follows:

- a) –DDUGJY/IPDS
- b) Manufacturer's name & trade mark
- c) Type Designation
- d) No. of phases & wires
- e) Serial number
- f) Month and Year of manufacture
- g) Reference Voltage
- h) Rated secondary Current of CT, if applicable
- i) Reference Standard as applicable
- j) Principal unit(s) of measurement
- k) Meter Constant
- l) Class index of meter
- m) Property of <Name of owner>
- n) Purchase Order No. & Date
- o) Guarantee period

1.11 CALIBRATION AND TEST OUTPUT

The meter should have test output accessible from the front and be capable of being monitored with suitable testing equipment. The operation indicator must be visible from the front. Test output device shall be provided in the form of one common/separate LED for KWh and KVARh as applicable with provision of selecting the parameter being tested. The test output device should have constant pulse rate in terms of pulse/unit energy.

The meter shall be tested, calibrated and sealed at works before dispatch. Further, no modification or calibration shall be possible at site by any means.

The resolution of the test output shall be sufficient to enable the static current test in less than 10 minutes.

1.12 GUARANTEE

Manufacturer shall undertake a guarantee to replace the meters upto a period of 24 months from the date of installation or 36 months from date of supply, whichever is earlier. The meters, which are found defective/inoperative at the time of installation, or became inoperative/defective within the guarantee period shall be replaced by manufacturer within two months from receipt of report for such defective/inoperative meters.

2.0 3 PHASE 4 WIRE 0.5 CLASS ENERGY METER FOR FEEDER

2.1 GENERAL & CONSTRUCTIONAL REQUIREMENTS

- 2.1.1 Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured.
- a) Personal safety against electric shock
 - b) Personal safety against effects of excessive temperature.
 - c) Protection against spread of fire
 - d) Protection against penetration of solid objects, dust & water
 - e) Detection against fraud
 - f) Detection against pilferage
- 2.1.2 The meter shall be designed with latest technology. The meter circuit should be housed in a safe, high grade engineering plastic / polycarbonate casing, which is of projection mounting type and is dust/moisture proof, conforming to IP-51. .
- 2.1.3 All insulating material used in the construction of meters shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion during operating life by providing suitable protective coating.
- 2.1.4 The meter shall be supplied with a terminal block cover. The meter base, meter cover, terminal block and shall be made of high grade fire resistant non-flammable reinforced, polycarbonate (not bakelite) or equivalent high grade engineering plastic and have terminal holes with sufficient size to accommodate insulation of the conductors, meeting the requirement of CBIP technical report CBIP325.
- 2.1.5 The terminal block cover should be separately sealable at two places and housed at the bottom of the meters and once sealed should prevent unauthorized tampering.
- 2.1.6 The terminal block should have sufficient insulating properties, mechanical strength and should have tin or nickel plated solid brass terminals with two fixing screws per terminal. The terminals should be designed to withstand high overload.
- 2.1.7 The meter should not get damaged or substantially influenced by the electromagnetic disturbances and electrostatic discharges caused by harmonics, voltage dips and short interruptions, transients, DC and AC magnetic field as per IS 14697
- 2.1.8 The meter shall have an operation indication device such as a blinking LED. The operation indicator shall be visible from the front of the meter and capable of being monitored conveniently with suitable testing equipment.
- 2.1.9 The meter shall conform to the degree of protection IP 51 but without suction in the meter as per IS: 12063 for protection against ingress of dust, moisture and vermin's.
- 2.1.10 The meter-base, meter cover, terminal block and terminal cover shall be made of, high grade, fire resistant, reinforced, non-flammable, polycarbonate or equivalent high grade and good quality engineering plastic.
- 2.1.11 The meter cover shall have transparent window or shall be transparent for easy reading of all the displayed values/parameters, name plate details and observation of operation indicator.
- 2.1.12 The terminal block, the terminal cover and the meter case shall ensure reasonable safety against the spread of fire. They should not be ignited by thermic overload of live parts in contact with them.

- 2.1.13 The meter shall have tin/nickel plated brass terminals. The terminals shall have suitable construction with barriers and cover to provide firm and safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles).
- 2.1.14 The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The clearance and creepage distance shall conform to relevant clause of IS 14697:1999/CBIP technical report No.325.
- 2.1.15 The meter shall be compact in design. The entire construction shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.
- 2.1.16 The meter shall have a design life to operate satisfactory for 10 years under normal electrical condition and guaranteed life of 24 months from the date of installation against manufacturing and design defects. The meters found defective within guaranteed period shall be replaced by manufacturer free of cost within two months of intimation.
- 2.1.17 The meter shall be provided with accurate quartz crystal based real time clock and calendar with the accuracy limit as per relevant standards. Meter shall have provision to synchronise the meter time with standard time through CMRI with proper security system.
- 2.1.18 The integration period shall be set as 30 minutes and subsequently can be changed using CMRI.
- 2.1.19 Vendor will give one copy of all the software's (meter reading software for CMRI, software for uploading data from CMRI to computer).
- 2.1.20 It should be possible to check the healthiness of phase voltages by displaying all the voltages on the meter display.
- 2.1.21 The Meter should have appropriate facilities to be read in absence of Power Supply.
- 2.1.22 The meter should work accurately irrespective of phase sequence of the mains supply.
- 2.1.23 The meter should remain powered up and functional even when either any two phases or phase & neutral are available to the meter
- 2.1.24 The meter shall record forwarded active energy, even if one or more CT"s are reversed. The current vector direction shall always be considered as positive (import) for computation of energy and shall be added in main active energy register.
- 2.1.25 Data Security: The Meter shall have multilevel password for data protection and security as per IS 15959. The meter data retrieval shall be possible through authenticated CMRI. The meter shall support the event of change of TOD register timings / no. of TOD registers, demand integration period and /or setting the meter time through authenticated transaction and shall be logged as an event. The transaction events shall be available for viewing at BCS end.
- 2.1.26 The meter data shall be retrievable through CMRI and will be downloaded in the Base computer software for viewing, analysing and printing. The meter data downloaded at BCS end should be in user-friendly formats. The manufacturer shall supply the required software for base computer system. The base computer software shall have the facility to convert the required data (For billing, Energy Audit, tamper analysis purpose) in to xml format. This data should be possible to be used as input data for any other software to generate desired reports as per the utility requirement.
- 2.1.27 The meter shall have radio interference suppression such that it should not generate noise, which could interfere with the other equipment as per IS 14697.

2.1.28 The meter shall have three fixing holes, one at the top and two at the bottom. The top hole shall be provided at the back of the meter so that holding screw is not accessible to the consumer after fixing the meters. The lower fixing screws shall be provided under the sealed terminal cover. The requisite fixing screws shall be supplied with each meter.

2.2 SEALING OF METER

Reliable sealing arrangement should be provided to make the meter tamper proof and avoid fiddling or tampering by unauthorized persons. For this, at least two no. of seals on meter body, two no. of seals on meter terminal cover and one no. of seal on each communication port shall be provided. All the seals shall be provided in front side only. Please refer Annexure A for specification for sealing system.

2.3 CONNECTION DIAGRAM & TERMINAL MARKINGS

The terminals shall be marked properly on terminal block for giving external connections. A diagram of connections should be provided inside the cover of terminal block. The terminal cover shall be extended such that when it is placed in position it is not possible to approach the connections or connecting wires. The terminals and the screws shall be suitable to carry upto 150% of I_{max} safely. The terminals shall have suitable construction with barriers and covers to provide secure and safe connections.

2.4 REMOTE READOUT FACILITY, COMMUNICATION CAPABILITY

The meter also shall have a sealable RS-232 / RS-485 communication port conforming to IS 15959 protocol to communicate to central location.

2.5 SOFTWARE

Licensed copies of the software (meter reading software for CMRI, software for downloading/uploading data from CMRI to computer) shall be made available and shall be installed on each common meter reading instrument (CMRI) and Base computer by the manufacturer. Software shall be provided to owner by the manufacturer free of cost.

Common Meter Reading Instrument (CMRI) would be loaded with user-friendly software (MS-DOS 5.0 or higher version compatible) for reading, downloading meter data and Time of Day (TOD) programming in the meter.

Windows based user interactive Software for receiving data from CMRI and downloading instructions from base computer to CMRI. This software should have, amongst other requirements, features and facilities as described later in this specification, the facility to convert meter reading data into a user definable DBF (Access) or spreadsheet or ASCII format or any other format for integrating with the Employer's billing system as desired/required by the utility. Here again an "Export wizard" or similar utility shall be available whereby user can select file format, the variable data to export, the field width selection of each variable so that it may be possible for the user to integrate the same with the user's billing data and process the selected data in desired manner.

The software shall have the flexibility to generate the following sets of reports.

- Load survey reports
- Tamper reports

Tamper reports to include for a pre-determined duration or month wise, tamper count, tamper duration and tamper history for each of the meters.

2.5.1 Vendor will provide soft copy of all the software in CD form along with the meters supplied.

- 2.5.2 Vendor to install & demonstrate working of software programmes of other meter manufacturers on the CMRI's to be supplied with this package

The specification of CMRI are presented as Annexure B

2.6 DISPLAY

A real time quartz clock shall be used in the meter for maintaining time and calendar date. The maximum drift shall not exceed 5 minutes per year. The uncertainty of setting initial time shall not exceed ± 30 Seconds with respect to Indian standard time (Ref NPL New Delhi).

Facility for adjustment of real time shall be provided through CMRI with proper security.

The meter shall have a minimum 7 digits, 7segment display of liquid crystal display (LCD). The minimum digit height shall be 7 mm. Provision shall be made to read consumption in either whole units or decimal multiples. .

The display shall remain on the screen till operator presses button for subsequent display or 10 sec whichever is earlier.

The meter should have non-volatile memory, so that the registered parameters will not be affected by loss of power. The non-volatile memory should have a minimum retention time of 10 years under unpowered condition.

2.7 DISPLAY SEQUENCE

The meter shall display the required parameters in two different modes as follows:

A. Auto Display Mode

Display test (LCD Segment check)

- Real time & date
- Active energy forwarded
- Reactive energy lag
- Reactive energy lead
- Apparent energy
- Maximum Demand forwarded
- MD occurrence date and time
- MD reset count
- Instantaneous average 3 ϕ PF
- Instantaneous frequency
- Phase voltages R,Y,B
- Phase currents R,Y,B
- Cumulative power on hours of current month

B. Push Button Mode

All above & the following

- Present CT status
- Last occurrence tamper ID
- Date and time of last tamper occurrence
- Last restoration tamper ID
- Date and time of last tamper restoration
- Cumulative tamper count
- TOD Register [Active forwarded energy (8 Nos)]
- TOD Register [Apparent forwarded energy (8 Nos)]
- TOD Register [Apparent forward MD (8 Nos)]
- Cumulative power on hours

C. Download Parameters with CMRI

All above including following

- Energy registers
- Billing registers
- TOD Registers
- Load survey data
- Tamper and fraud (all event details with date and time)
- History of monthly Energy, Maximum Demand, Average power factor for the last 12 months

2.8 MAXIMUM DEMAND REGISTER

The maximum demand is to be monitored during each demand interval set with 15 / 30 minutes integration and the maximum of these in a month shall be stored. Whenever MD is reset the maximum demand value so registered shall be stored along with date and time. The registered demand and the number of times the MD is reset shall also be displayed and the information stored.

2.9 MAXIMUM DEMAND RESET

Facility for auto reset of MD at 00.00 hrs of first of every month shall be provided for which minimum 30 years calendar shall be programmed by the manufacturer.

The meter shall display the maximum demand reset count.

2.10 LOAD SURVEY CAPABILITY

Load survey shall be available for at least 35 days with 30 minutes load survey integration period for following parameters. Vendor shall provide necessary facility to transfer data through CMRI.

- a. kWh forwarded
- b. kVAh forwarded
- c. kVARh lag/lead

- d. Voltage Phase wise
- e. Current Phase wise

In addition meter should have facility for daily profile for active and apparent energy.

The load survey data, abnormality event information and instantaneous parameters data shall all be retrievable through the meter's communication port from a common meter reading instrument (CMRI) and shall be transferred (downloaded) to a PC with user friendly Windows based software to get complete details in numerical and/or graphic form. The necessary feature shall be available in the software used for uploading data from CMRI to computer and shall be provided by the manufacturer with complete details.

The meter shall have sufficient non-volatile memory for recording history of energy parameters for last twelve billing cycles (Bill date shall be 00 hrs of the 1st date of the calendar month by default – programmable) and information should be made available at the BCS end:

2.11 TIME-OF-DAY (TOD) TARIFF/DEMAND

The meter should have provision of registering the time-of- day energy and maximum demand. It shall be possible to define TOD register for active forwarded, apparent forwarded energy type.

The meter should have in-built capacity to define up to eight (8) time zones through operation of CMRI .The change of the TOD time-period(s) or changing number of TOD zones should be possible through CMRI with special authenticated command from the software used for uploading data from CMRI to computer so that only authorised person(s) can make such changes.

2.12 SELF DIAGNOSTIC FEATURE

2.12.1 The meter shall be capable of performing complete self-diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of data memory location at all times. The meter shall have indications for unsatisfactory/nonfunctioning/malfunctioning of the following:

- a) Real Time and Date
- b) All display segments as per the requirement

2.12.2 While installing the meter, it should be possible to check the correctness of Current and Voltage Transformer connections to the meter and their polarity from the functioning of the meter for different voltage injections with the help of vector/phasor diagrams. For this purpose a suitable software for field diagnosis of meter connections with the help of Meter Reading Instrument should be supplied.

2.13 TAMPER & FRAUD PROTECTION

The meter shall function properly under following common abnormal conditions:

1. Phase sequence reversal	The meter shall keep working accurately irrespective of the phase sequence of the supply.
2. Current reversal/CT polarity reversal	The meter shall log energy in forward direction even if the current is flowing in reverse direction in one or more phases.
3 External magnetic influence	The meter shall comply to influence of external magnetic field (AC Electro Magnet or DC Magnet) as per IS 14697

Beside this the meter should have features to detect the occurrence and restoration of, at least, the following common abnormal events:

- i. Missing Potential & Potential imbalance: The meter shall be capable of detecting and recording occurrence and restoration with date and time the cases of Potential failure which could happen due to disconnection of potential leads (one or two), failure of phase line fuse from the Potential Transformer primary side. Meter shall also detect and log cases of voltage unbalance (5% or more than 5 minutes) of voltages.
- ii. Voltage High / Voltage Low: In case the average 3 phase voltage remains less (below 0.75Vref by default) than or above (above 1.15Vref by default) for a predefined period (30 minutes by default), the meter shall log such incidences with date & time. This abnormal condition shall be logged only when all the three-phase voltage is available.
- iii. Current imbalance: The meter shall be capable of detecting and recording occurrence and restoration with date and time of Current unbalance (30% or more for more than 15 minutes).
- iv. Current Circuit Open: The meter shall be capable of detecting and recording occurrences and restoration of opening of any one or two phases of current circuit which can happen due to intentional / accidental disconnection of current circuits. The meter shall be able to log abnormality conditions in current open event like CT leads burns, loose connection, CT winding open etc in the meter memory. No load condition should not be recorded in meter memory as a Current circuit open event.
- v. Power on/off: The meter shall be capable to record power on /off events in the meter memory. All potential failure should be recorded as power off event.

The meter shall record the total duration of the above abnormalities, time and date of their occurrences & restorations with a snap shot of electrical conditions viz. Voltage , current ,PF etc

Logic for calculation of voltage and current imbalance shall be furnished by the tenderer.

The meter shall keep records for the minimum last 250 events (occurrence + restoration) for above of abnormal conditions. It shall be possible to retrieve the abnormal event data along-with all related snap- shots' data through the meter's optical port with the help of a CMRI and download the same to the BCS where it shall be available for viewing. All this information shall be made available in simple and easily understandable format.

2.14 TAMPER LOGIC

Properly designed meter event logic should be provided. There shall be separate compartments for logging of potential related event, current related event and power on/off event. The bidder should explain the events details in each compartment under their offer.

The logging of various events in each compartment should be as under:

Once one or more compartments have become full, the last event pertaining to the same compartment will be entered and the earliest (first one)-event should disappear. Thus, in this manner each succeeding event will replace the earliest recorded event, compartment wise. Events of one compartment/category should overwrite the events of their own compartment/category only.

A properly defined meter tamper logic should be provided. The tamper logic should be capable of discriminating the system abnormalities from source side and load side and it should not log/record tamper due to source side abnormalities.

There shall be three separate compartments for logging of different types of tampers as per IS 15959.

2.15 TESTS

Unless specifically waived off all acceptance tests shall be witnessed by the Employer.

2.15.1 Type Test

Energy Meters offered shall be fully type tested as per IS 14697 & IS 15959 with latest amendments at any of the NABL accredited test laboratories.

Type test certificate shall not be older than 3 years from the date of bid submission. Bid shall not be accepted without valid type test certificate.

2.15.2 Acceptance Test

Acceptance test shall be carried out as per IS 14697.

2.15.3 Routine Test

All routine tests as specified in IS 14697 shall be carried out on each individual meter.

2.16 OTHER SALIENT FEATURES

2.16.1 It should be possible to check the healthiness of phase voltages by displaying all the voltages on the meter display.

2.16.2 The meter shall have provision of reading through communication port in the absence of power.

2.16.3 The meter should work accurately irrespective of phase sequence of the mains supply.

2.16.4 The meter should remain powered up and functional even when either of the two phases or one phase along with neutral is available to meter.

2.16.5 The meter casing arrangement shall be break to open type.

3.0 Three Phase, Four Wire, 0.5 Class, Energy Meter for 3-Phase Distribution Transformer

3.1 CT REQUIREMENT

The Meter shall be supplied with four nos of C.T's with primary current capacity as required for its intended use. Since the meters are to be used with external CT of suitable ratio please refer CT specification provided separately.

Alternatively meters with Integrated CT complying with IS 13779 for outdoor installation shall be acceptable.

3.2 DISPLAY

The Three phase meters shall be capable to measure & display parameters as given below. The meter should have provision for automatic recording of cumulative kWh at 24 hrs on the last day of the month for each calendar month and same should go to memory.

The digitally measured and processed value shall be displayed through LCD having minimum six digits to read upto one-tenth of kWh. The minimum character height shall not be less than 7 mm.

The Meter should have appropriate facilities to be read in absence of Power Supply.

3.3 AUTO SCROLL DISPLAY

- i) Cumulative kWh
- ii) Instantaneous Voltages
- iii) Instantaneous Currents
- iv) Cumulative kVAh
- v) Instantaneous pf phase-wise
- vi) Power on hours

3.4 DISPLAY PARAMETERS (PUSH BUTTON)

The display of following parameters shall be continuously scrolling one after another thru Push Button. The scrolling time for each display parameters for minimum of 10 secs..

- i) Cumulative active Energy (kWh) for each calendar month for previous Six months.
- ii) Cumulative apparent energy (kVAh) for each calendar month for previous Six months
- iii) Maximum demand (MD) in apparent for last billing month
- iv) Maximum demand (MD) in apparent for current month
- v) Tamper Data :
 - a) Present status of Tamper
 - b) Date & time of last tamper occurrence & tamper identification.
 - c) Date & time of last tamper removal.
 - d) Cumulative tamper occurrence count.

3.5 LOAD SURVEY CAPABILITY & BILLING POINT REQUIREMENTS

Meter shall have load survey capabilities as per table 28 of IS 15959.

The predefined date and time for registering the billing parameters of kWh, kVAh, PF and kVA MD as well as Tamper Count and Power-On hours readings shall be 00.00 hours of the first day of each calendar (billing) month. All billing parameters shall be transferred to billing registers and shall be displayed on auto cyclic display mode referred to as "BILLING PARAMETERS".

3.6 INTERFACE BETWEEN METER AND CMRI

The interface between a meter and CMRI shall be with a flexible cable of adequate length having suitable female connector. This cable shall be supplied along with meter. TAMPER & FRAUD PROTECTION

The meter registration shall be immune to reversal in current direction. The meter shall have following anti-tamper features and shall record forward under the following conditions:

- a) Potential failure: The meter shall be capable of detecting and recording occurrences and restoration of potential failure (one phase/two phases) which can happen due to intentional / accidental disconnection of potential leads. The meter should also record event as a potential failure, when one phase line fuse failure from the main side.
- b) Current Circuit Bypass: The meter shall be capable of detecting and recording occurrences and restoration of CT circuit bypass.
- c) Current Circuit Open: The meter shall be capable of detecting and recording occurrences and restoration of opening of any one or two phases of current circuit which can happen due to intentional / accidental disconnection of current circuits. No load condition should record in meter memory as a Current circuit open event.
- d) Current Unbalance: The meter shall be capable of detecting and recording occurrences and restoration of current unbalance as an event. The above information should be possible to download from the meter through hand held unit and available at BCS end. The current unbalance more than 30 % should be recorded as an event in the meter memory.
- e) Voltage Unbalance: The meter shall be capable of detecting and recording occurrences and restoration of voltage unbalance as an event. The voltage unbalance more than 30 % should be recorded as an event in the meter memory.
- f) The meter shall comply to influence of external magnetic field (AC Electro Magnet or DC Magnet) as per IS 14697.

All types of abnormality event with date and time shall be available in the meter memory on first-in, first-out basis as per IS 15959. It shall be possible to retrieve the event data along-with all related snapshots' data through the meter's optical port with the help of a CMRI and download the same to the BCS where it shall be available for viewing. All this information shall be available in simple and easily understandable format.

3.7 NON INFLAMMABILITY

The terminal block, the terminal cover and the case shall ensure reasonable safety against spread of fire. They shall not be ignited by thermic over load of live parts in contact with them. To comply with this these parts shall fulfill the conditions of the glow wire test as per IS 14697.

3.8 CONSTRUCTIONAL REQUIREMENTS

Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. The following should be ensured: -

- i. Personal safety against electric shock
- ii. Protection against spread of fire.
- iii. Protection against effects of excessive temperature.
- iv. Protection against penetration of solid objects, dust & water
- v. Protection against fraudulence
- vi. Protection against pilferage
- vii. Meter base and meter cover shall be break to open type

3.9 METER CASE

The meter should be housed in a safe, high grade engineering polycarbonate meter casing of projection mounting type and is dust, vermin and moisture proof, with enclosure having degree of protection conforming to IP-51 as per IS 14697. The meter case shall seal the meter such that the internal parts of meter are accessible only after breaking the seals of meter cover.

All insulating material used in the construction of meters shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against such corrosion during operating life by providing suitable protective coating.

3.10 COVER

The cover shall be transparent, made of UV stabilized polycarbonate / engineering plastic material, which would enable easy reading the display. It should not fade in course of time and become opaque causing inconvenience for reading.

The cover shall permit clear view of the register.

3.11 TERMINAL AND TERMINAL BLOCK

The meter terminal block and terminal cover shall ensure safety against the spread of fire. They should not be ignited by overload of live parts in contact with them. To comply with this, these parts shall fulfill the conditions of the glow wire test as per IS 14697.

The terminal block cover shall be fixed to the meter terminal block by at least one screw. The terminal block cover shall be provided with minimum one seal.

The meter terminal block and terminal cover shall be moulded type and made of high grade non-hygroscopic, fire retardant, low tracking, reinforced poly-carbonate (not bakelite) or equivalent high grade engineering plastic which should form an extension of the meter case and have terminal holes and shall be of sufficient size to accommodate the insulation of the conductors. The terminals shall be of suitable rating to carry 150% of I_{max} and made of electro-plated (or tinned brass). Terminals shall be of adequate size so as to ensure proper tightening of the cable and shall be of replaceable type.

3.12 TERMINATION

The terminals shall have suitable construction with barriers to provide firm and safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles).

The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections shall be such that the risk of

corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The meter shall have a design life of 10 years against design defects. The Manufacturer shall stand 24 months Guarantee from date of installation on the meter against any kind of failure/defects/mal-operation within above period. Meter shall be replaced by manufacturer free of cost within two months of intimation by owner / Employer.

3.13 CONNECTION DIAGRAM

Each meter shall be indelibly marked with a connection diagram which shall be provided on the terminal block cover. In case any special precautions need to be taken at the time of testing the meter, the same may be indicated along with circuit diagram. The meter terminals shall also be marked and this marking should appear in the above diagram.

3.14 TERMINAL ARRANGEMENT

Three phase: The terminal arrangement and connection diagram shall be marked in accordance with clause 7.2 of IS 14697. Terminal arrangement shall be in sequence : Ir(in), Vr, Ir(out), Iy(in), Vy, Iy(out), Ib(in), Vb, Ib (out), Neutral (in), Vn, Neutral(out)

3.15 SEALING OF METER

Reliable sealing arrangement should be provided to make the meter tamper evidence and avoid fiddling or tampering by unauthorized persons by way of providing adequate no. of seals on meter, meter terminal cover, wherever necessary. All the seals shall be provided in front side only. Rear side sealing arrangement will not be acceptable.

The manufacturer shall provide minimum two seals for the meter at the factory after calibration and testing. The meter cover shall have provision for placing minimum two nos. additional seals by the Employer. The manual switch and the terminal block cover shall be provided with minimum one seal each.

The holes for sealing wire shall be minimum 2 mm dia.

3.16 ELECTRO-MAGNETIC COMPATIBILITY AND INTERFERENCE

The meter shall remain un-influenced with EMI/EMC interference. The meter shall withstand impulse voltage test of 6 kV as per IS 14697-1999. It shall also withstand ac high voltage test as per IS 14697.

3.17 TESTS

3.17.1 Routine & Acceptance Tests : All routine & acceptance tests shall be carried out as stipulated in IS 14697.

3.17.2 Type Tests

Energy Meters offered shall be fully type tested as per IS 14697 & IS 15959 with latest amendments at any of the NABL accredited test laboratories.

Type test certificate shall not be older than 3 years from the date of bid submission. Bid shall not be accepted without valid type test certificate.

4.0 SINGLE PHASE, TWO WIRE, ACCURACY CLASS 0.5, ENERGY METER FOR SINGLE PHASE DISTRIBUTION TRANSFORMER

4.1 CT EQUIREMENT

The Meter shall be supplied with C.T with primary current capacity required for its intended use.

4.2 Since the meters are to be used with external CT of suitable ratio please refer CT specification provided separately. DISPLAY

The Single phase meters shall be capable to measure & display parameters as given below. The meter should have provision for automatic recording of cumulative kWh at 24 hrs on the last day of the month for each calendar month and same should go to memory.

The digitally measured and processed value shall be displayed through LCD having minimum six digits to read upto one-tenth of kWh. The minimum character height shall not be less than 7 mm.

The Meter should have appropriate facilities to be read in absence of Power Supply.

4.3 AUTO SCROLL DISPLAY

- i) Cumulative kWh
- ii) Instantaneous Voltage
- iii) Instantaneous Current
- iv) CumulativekVAh
- v) Instantaneous pf
- vi) Power on hours

4.4 DISPLAY PARAMETERS (PUSH BUTTON)

The display of following parameters shall be continuously scrolling one after another thru Push Button. The scrolling time for each display parameters for minimum of 10 secs.

- i) Cumulative active Energy (kWh) for each calendar month for previous Six months.
- ii) Cumulative apparent energy (kVAh) for each calendar month for previous Six months
- iii) Instantaneous voltage, current, frequency, load in kW
- iv) Maximum demand (MD) in active & apparent for last billing month
- v) Maximum demand (MD) in active & apparent for current month
- vi) Tamper Data :
 - a. Present status of Tamper
 - b. Date & time of last tamper occurrence & tamper identification.
 - c. Date & time of last tamper removal.
 - d. Cumulative tamper occurrence count.

4.5 LOAD SURVEY CAPABILITY & BILLING POINT REQUIREMENTS

Following load survey parameters for 35 days for 30 minute shall be logged:

- Active energy
- Apparent energy
- Voltage

The predefined date and time for registering the billing parameters of kWh, kVAh, PF and kVA MD as well as Power-On hours readings shall be 00.00 hours of the first day of each calendar (billing) month. All billing parameters shall be transferred to billing registers and shall be displayed on auto cyclic display mode referred to as "BILLING PARAMETERS".

In addition meter should have facility for daily profile for active and apparent energy.

4.6 INTERFACE BETWEEN METER AND CMRI

The interface between a meter and CMRI shall be with a flexible cable of adequate length having suitable female connector.

4.7 TAMPER & FRAUD PROTECTION

The meter shall be capable of recording correctly in following anti-tamper condition:

- i. The meter shall be capable of recording energy correctly even if input and output terminals are interchanged. Also the meter shall record correctly even if phase and neutral are interchanged.
- ii. The registration must occur whether input phase/neutral wires are connected properly or they are interchanged at the input terminals.
- iii. Performance of the meter should comply to IS 14697/CBIP report 325 under influence of external DC/AC magnetic field..
- iv. The meter shall withstand phase-to-phase voltage between phase and neutral terminals for at least 30 minutes.

Minimum one hundred fifty (100) events (including occurrence & restoration) of all types of abnormality event with date and time shall be available in the meter memory on first-in, first-out basis. It shall be possible to retrieve the event data along-with all related snap- shots' data through the meter's optical port with the help of a CMRI and download the same to the BCS where it shall be available for viewing. All this information shall be available in simple and easily understandable format.

4.8 SELF DIAGNOSTIC FEATURES

The contractor shall provide details of self-diagnostics features available and indication on the single phase meter for unsatisfactory / non-functioning of the following:

- i) Time and date
- ii) Real time clock battery
- iii) Non Volatile memory

4.9 NON INFLAMMABILITY

The terminal block, the terminal cover and the case shall ensure reasonable safety against spread of fire. They shall not be ignited by thermic over load of live parts in contact with them. To comply with this these parts shall fulfill the conditions of the glow wire test as per IS 14697.

4.10 CONSTRUCTIONAL REQUIREMENTS

4.10.1 Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured: -

- i. Personal safety against electric shock
- ii. Protection against spread of fire

- iii. Protection against penetration of solid objects, dust & water
- iv. Protection against fraudulence
- v. Protection against pilferage
- vi. Meter base and meter cover should be ultrasonically welded

4.10.2 Meter Case:

The meter should be housed in a safe, high grade engineering polycarbonate meter casing of projection mounting type and is dust, vermin and moisture proof, with enclosure having degree of protection conforming to IP-51. The meter case shall seal the meter such that the internal parts of meter are accessible only after breaking the seals of meter cover. The meter case shall have provision with deep cut for hanging the meter.

All insulating material used in the construction of meters shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against such corrosion during operating life by providing suitable protective coating

4.10.3 COVER:

The cover shall be transparent, made of UV stabilized polycarbonate material, which would enable easy reading the display. It should not fade in course of time and become opaque causing inconvenience for reading.

The cover shall permit clear view of the register.

4.11 TERMINAL AND TERMINAL BLOCK

The meter terminal block and terminal cover shall ensure safety against the spread of fire. They should not be ignited by overload of live parts in contact with them. To comply with this, these parts shall fulfill the conditions of the glow wire test as per IS 14697.

The terminal block cover shall be fixed to the meter terminal block by at least one screw. The terminal block cover shall be provided with minimum one seal.

The meter terminal block and terminal block cover shall be moulded type and made of high grade non-hygroscopic, fire retardant, low tracking, reinforced poly-carbonate (not bakelite) or equivalent high grade engineering plastic which should form an extension of the meter case and have terminal holes and shall be of sufficient size to accommodate the insulation of the conductors.

The terminals shall be of suitable rating to carry 150% of I_{max} and made of tin/nickel plated brass. Terminals shall be of adequate size so as to ensure proper tightening of the cable..

4.12 TERMINATION

The terminals shall have suitable construction with barriers to provide firm and safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles).

The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material.

4.13 CONNECTION DIAGRAM

Each meter shall be indelibly marked with a connection diagram which shall be provided on the terminal block cover. The meter terminals shall also be marked and this marking should appear in the above diagram.

4.14 TERMINAL ARRANGEMENT

Single phase: Connecting terminals of current and voltage shall be in following sequence: Phase (in), Neutral (in), Neutral (out), phase (out).

4.15 SEALING OF METER

Reliable sealing arrangement should be provided to make the meter tamper evidence and avoid fiddling or tampering by unauthorized persons by way of providing adequate no. of seals on meter, meter terminal cover, wherever necessary. All the seals shall be provided in front side only. Rear side sealing arrangement will not be acceptable.

The manufacturer shall provide minimum one seal for the meter at the factory after calibration and testing. The meter cover shall have provision for placing minimum one additional seal by the Employer. The Terminal block cover shall be provided with minimum one seal.

The holes for sealing wire shall be minimum 2 mm dia.

4.16 ELECTRO-MAGNETIC COMPATIBILITY AND INTERFERENCE

The meter shall remain un-influenced with EMI/EMC interference. The meter shall withstand impulse voltage test of 6 kV as per IS 14697-1999. It shall also withstand ac high voltage test as per above IS.

4.17 TESTS

4.17.1 Routine & Acceptance Tests: All routine tests shall be carried out and acceptance tests as stipulated in IS: 14697.

4.17.2 Type Tests

Energy Meters offered shall be fully type tested as per IS 14697 with latest amendments at any of the NABL accredited test laboratories.

Bid shall not be accepted without valid type test certificate.

5.0 SINGLE PHASE WHOLE CURRENT STATIC ENERGY METER OF CLASS 1.0 FOR CONSUMER

5.1 SCOPE

The static whole current meter shall offer current range of -5-30A, 10-60A (first digit indicates the Basic Current & second digit indicates the Maximum Current of the respective meters) for tariff purposes, as per requirement given in this specification.

5.2 Running at no load

When voltage at 115% of V_{ref} is applied and no current flows in the current circuit, the test output of the meter shall not produce more than one pulse.

GENERAL & CONSTRUCTIONAL REQUIREMENTS

5.2.1 Meter Shall bear BIS mark

5.2.2 Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured: -

- a) Personal safety against electric shock
- b) Personal safety against effects of excessive temperature
- c) Protection against spread of fire
- d) Protection against penetration of solid objects, dust & water
- e) Protection against fraudulence
- f) Protection against pilferage
- g) Meter base and meter cover break open type

The accuracy of the meter shall not be affected with the application of abnormal voltage / frequency generating device such as spark discharge of minimum 35 kV. The meter shall be tested by feeding the output of the device to meter in any of the following manner for 10 minutes.

1. On any of the phase or neutral terminals.
2. On any connecting wires of the meter (Voltage discharge with 0-10 mm spark gap).
3. At any place in load circuit.

The accuracy of the meter shall be checked before and after the application of above device.

5.2.3 The meter shall be designed with latest technology and shall be manufactured using SMT (Surface Mount Technology) components. Power supply and voltage divider circuits may be of PTH Technology. The meter shall be housed in a safe, high grade engineering plastic/polycarbonate meter block casing and which is of projection mounting type and is dust/moisture proof, conforming to IP-51.

5.2.4 All insulating material used in the construction of meters shall be on-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion throughout during operating life by providing suitable protective coating.

5.2.5 The meter shall have an operation indication device such as a blinking LED. The operation indicator shall be visible from the front window and capable of being monitored conveniently with suitable testing equipment.

5.2.6 The meter shall conform to the degree of protection IP 51 as per IS:12063 for protection against ingress of dust, moisture and vermins.

- 5.2.7 The meter shall be supplied with a terminal block cover. The meter terminal block and terminal cover shall be made of high grade, fire resistant, reinforced, non-flammable, polycarbonate or equivalent high grade and good quality engineering plastic.
- 5.2.8 The meter terminal block and terminal block cover shall ensure safety against the spread of fire. They should not be ignited by thermic overload of live parts in contact with them.
- 5.2.9 The meter block shall be of transparent, high grade engineering plastic for easy reading of all the displayed values/parameters, name plate details and observation of operation indicator. The transparency of the box shall remain un-influenced with the environmental conditions.
- 5.2.10 The terminal block shall be made of high grade non-hygroscopic, fire retardant, low tracking, fire resistant, reinforced poly-carbonate (not bakelite) or equivalent high grade engineering plastic which should form an extension of the meter case and have terminal holes and shall be of sufficient size to accommodate the insulation of the conductors, meeting the requirement of IS 13779: 1999.
- 5.2.11 The terminals shall have suitable construction with barriers to provide firm and safe connection of current and voltage leads of stranded copper conductors or copper reducer type terminal ends (thimbles).
- 5.2.12 The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The internal diameter of the terminal holes shall be 5.5 mm for 5-30A and 8.5mm for 10-60A meter. The clearance and creepage distance shall conform to relevant clause of IS 13779:1999.
- 5.2.13 The meter shall be compact in design. The meter block unit shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.
- 5.2.14 The meter shall have minimum two fixing holes. The top hole shall be provided at the back of the meter so that holding screw is not accessible to the consumer after fixing the meters. The lower fixing screws shall be provided under the sealed terminal cover. The requisite fixing screws shall be supplied with each meter.
- 5.2.15 The meter shall be provided with adequate protection against damage by high current/short circuit current.
- 5.2.16 The meter shall work satisfactory as per IS 13779 under presence of various influencing conditions like external Magnetic Field, Electromagnetic Field, Radio Frequency Interference, Vibrations, harmonic Distortion, Voltage/Frequency Fluctuations, electromagnetic High Frequency Fields etc. The meter shall be capable of recording even in case of application by fraudulent means any of the tempering methods. The Meter shall have following anti-tamper features :
- i. The meter shall be capable of recording energy correctly even if input and output terminals are interchanged. Also the meter shall record correctly even if phase and neutral are interchanged.
 - ii. The meter shall register energy correctly even when the load is not terminated back to the meter and instead current is drawn through a local earth under the conditions:-
 - a) When phase and neutral are connected correctly.
 - b) When phase and neutral wires are interchanged at the input terminals.

- iii. The registration must occur whether input phase/neutral wires are connected properly or they are interchanged at the input terminals.
- iv. Performance of the meter should not be affected under influence of external DC/AC magnetic field of high intensity as mentioned in IS 13779/CBIP report 325.
- v. The meter shall be factory calibrated and shall be sealed suitably before dispatch.
- vi. The meter shall withstand phase-to-phase voltage between phase and neutral terminals for at least 30 minutes.
- vii. The Meter shall record even when the Neutral is removed or opened from both ends (source & load) and when phase and Neutral are interchanged. When neutral is removed meter should start recording energy for current of 1 amp and above.
- viii. The meter shall be able to log in the memory in case the meter cover is opened.

The meter shall be capable of recording the following tamper events in memory (minimum 5 each) with date and time stamp along with snapshots of V, I, PF and Kwh as per IS 15959.

- Neutral Missing
- Magnet Tamper (if applicable)
- Cover open tamper (occurrence only)

5.3 SEALING OF METER

All meter shall be sealed by the manufacturer at its works. In addition to the seal provided by the manufacturer at its works, reliable sealing arrangement should be provided to make the meter tamper evidence and avoid fiddling or tampering by unauthorized persons by way of providing adequate no. of seals on meter, meter terminal cover, wherever necessary. The meter cover shall be sealable to the meter base with at least 2 nos. seals. Also terminal cover shall have provision for sealing with at least one seal. All the seals shall be provided in front side only. Rear side sealing arrangement will not be acceptable. Please refer Annexure- for specification for sealing system.

5.4 DISPLAY

- 5.4.1 The measured value(s) shall be displayed on a Liquid Crystal display (LCD) register. The height of the digit shall be minimum 7 mm. The KWh energy registration shall take place with 6 complete digits. The display shall have backlit capability for easy reading.
- 5.4.2 The data should be stored in non-volatile memory (NVM). The non-volatile memory should retain data for a period of not less than 10 years under un-powered condition. Battery back-up memory will not be considered as NVM.
- 5.4.3 The register shall be able to record and display starting from zero, for a minimum of 1500 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.
- 5.4.4 In addition to providing serial number of the meter on the display plate, the meter serial number shall also be programmed into meter memory for identification through communication port for CMRI/meter reading print out.

5.5 DISPLAY SEQUENCE

The meter shall display the required parameters in two different modes as follows:

Apart from this in case of cover open the same shall be displayed on the meter.

A) Auto Display Mode:

The following parameters hereinafter referred to as "Billing Parameters" (B.P) shall be displayed in an auto-cycle mode, in the following sequence:-

1. LCD Test
2. Real Time
3. Date
4. Cumulative Active energy (forwarded) reading (kWh)
5. Last Bill Active Forwarded energy
6. Instantaneous Load (KW)
7. Last Bill Maximum demand (kW)

Each parameter shall be on meter display for 10 seconds.

B) Push Button Mode:-

In addition to the auto display mode parameters, the following parameters shall be displayed on pressing the push button

1. LCD Test
2. Real Time
3. Date
4. Instantaneous voltage, current
5. Maximum demand kW for Current month
6. Supply Frequency
7. Instantaneous PF

The meter shall also be capable of offering a high resolution display which shall enable conducting of dial testing by the user in the shortest possible time and as a minimum, the meter shall be capable of offering a resolution of 4 digits after decimal (and 2 digits before decimal) for the high resolution KWh display.

5.6 MAXIMUM DEMAND REGISTRATION & RESET

Meter shall continuously monitor & calculate the average maximum demand for each demand interval time of 30 minutes and maximum of these in a calendar month shall be stored along with date and time when it occurred. The maximum demand shall automatically reset at 24:00 hrs. of the last date of each calendar month for which minimum 30 years calendar shall be programmed by the manufacturer.

The integration period by default shall be set as 30 minutes and programmable as per IS 15959.

The billing purpose parameters (active forwarded energy, maximum demand in kW) shall be registered and shall be available for a minimum period of atleast 6 month.

5.7 LOAD PROFILE RECORDING

The meter shall be capable of monitoring and recording load profile information for KW demand for every 30 minutes interval for at least 35 days duration. The load profile shall be configurable as per IS 15959.

5.8 SELF DIAGNOSTIC FEATURE

The meter shall be capable of performing complete self-diagnostic check to monitor integrity of data memory location at all time. The meter shall have indication for unsatisfactory /nonfunctioning /malfunctioning of the following:

- a) Time and date on meter display
- b) All display segments on meter display
- c) Real Time Clock (RTC) status in meter reading prints out at BCS end

5.9 CMRI/BCS REQUIREMENTS

The communication protocol of the meter shall be as per IS 15959 with latest amendment. The Common Meter Reading Instrument (CMRI) should be capable of being loaded with user friendly software (MS-DOS 5.0 or higher version compatible) for reading/downloading meter data. Windows based Base Computer Software (BCS) shall be provided for receiving data from CMRI and downloading instructions from base computer software to CMRI.

This BCS should have, amongst other requirements, features and facilities described later in this specification, the facility to convert meter reading data into user definable xml file format so that it may be possible for the user to integrate the same with the user's billing data and process the selected data in desired manner. All the data available in the meter including energy, MD, and history data should be convertible to user defined xml file format for integration with third party software. The vendor shall supply necessary base computer software for reading / viewing of meter data and converting to user defined xml files formats. The user shall have the flexibility to select the parameters to be converted into xml file. The vendor shall also supply the necessary CMRI software.

5.10 DISPLAY POWER UP IN ABSENCE OF MAINS SUPPLY

The meter shall have the provision of providing the display of billing parameters in absence of main supply through internal battery..

5.11 CONNECTION DIAGRAM & TERMINAL MARKINGS

The connection diagram of the meter shall be clearly shown on the meter. The meter terminals shall also be marked and this marking should appear in the above diagram.

5.12 ELECTRO-MAGNETIC COMPATIBILITY AND INTERFERENCE

The meter shall remain un-influenced with EMI/EMC interference. The meter shall withstand impulse voltage test of 6 kV as per IS 13779-1999.

5.13 TESTS

Unless specifically waived off all acceptance tests shall be witnessed by the Employer.

5.13.1 Type Tests

Energy Meters offered shall be fully type tested as per IS 13779 & IS 15959 with latest amendments at any of the NABL accredited test laboratories.

Type test certificate shall not be older than 3 years from the date of bid submission. Bid shall not be accepted without valid type test certificate.

5.13.2 Acceptance Test

Acceptance test shall be carried out as per IS 13779.

5.13.3 Routine Tests

All routine tests as per IS 13779 shall be carried out.

Annexure-A

SPECIFICATION OF POLY CARBONATE SEALS REQUIRED FOR SEALING OF SINGLE / POLY PHASE METERS

- 1.01 Seal should be made of polycarbonate & should not be affected by boiling water & acid.
- 1.02 The seal should withstand temperature up to 147 ° C.
- 1.03 Seal should be available in Clear / Red / Blue / Yellow / Amber / Green / Grey colour and should be transparent.
- 1.04 Every seal should have 6" long, 20 gauge, twisted strand stainless steel wire.
- 1.05 Seal should have facility to print mono gram / name of company
- 1.06 Every Seals should have a unique seven-digit number. Numbers shall be printed on seal including the anchor cap-using laser marking which shall not be erased using any tool or by any chemical reaction. Both the seven digit seal numbers should be visible separately after closing the seal.
- 1.07 Seals should have tamper proof, internal " anchor " locking mechanism that permanently secures the wire upon closing. The mechanism should be designed in such a way that its original position can't be restored after any effort of tamper or breaking of seals
- 1.08 Sealing mechanism shall be designed in such a way that it can be sealed without using any pliers or tools.
- 1.09 Seal should be constructed of two parts, first the main body (female type) & second the anchor (male type) having locking mechanism. Both the part should be designed in such a way that once the seal is closed the two parts can't be separated.
- 1.010 Seal should be patented. Copy of patent shall be submitted along with offer.
- 1.011 Packaging: Seals shall be supplied in packet of 100 seals. Each packet shall be labelled for following information
 - Client Name
 - Purchase order number & date
 - Serial number range in the form of bar coding.
- 1.012 Seals shall be provided with tracking & recording software. The software shall have following features
 - Software should have facility of defining the system controller
 - Facility to enter serial number of seals with the help of bar code scanner.
 - Receiving of seal in the system and with authentication like signature.
 - Facility to identify the concern who is responsible for receiving of seals and nominated by system supervisor.
 - Provision to define different type of seals for various uses.
 - Software should have facility of report generation for inventory & issue records.
 - Facility to track for relevant data for individual seal entered in the system.

Annexure-B

TECHNICAL SPECIFICATION FOR COMMON METER READING INSTRUMENT (CMRI)

This specification covers supply and delivery of Common Meter Reading Instrument (CMRI) for reading (uploading) the data of different make of meters and to have a capability to dump (download) the same to the base computer system. The CMRI shall have memory / space to reside software of reading at least 3 different makes of electronic meters as specified by Employer.

A. Portable Common Meter Reading Instrument (CMRI)

These shall be tailor-made for tapping all data stored in the memory of electronic meters of type, three phase 3 wire, three phase 3 wire HT/LT Tri-vector meters, whole current meters, single phase meter, and faithfully transferring it to the local PC in the BCS. Each device shall be supplied complete with

- i) a lead with optical head for coupling it to the meter,
- ii) a lead for plugging it to a personal computer;
- iii) an internal battery for powering the devices;
- iv) a case for safely carrying it about
- v) a battery charger

The total arrangement shall be such that one (1) operator can carry out the whole operation himself, in about five (5) minutes per meter.

- B. The CMRI shall have a key for starting the data tapping from the coupled meter's memory, a key to start data transfer to the PC, and a lamp, which would light up on completion of data collection, remain 'on' while the data is held in the device and would go 'off' when all data has been transferred to the PC. Data tapping operation shall not erase the data from the meter's memory, or effect the meter operation in any way. The memory of the CMRI shall get automatically cleared when the data has been transferred to the PC only then the CMRI shall accept data from another meter. CMRIs shall also have the necessary provision for meter clock correction. CMRIs should have adequate memory, to host application software, for enabling downloading of meter data of 3 makes of meters.
- C. The Contractor shall provide the necessary software which would enable a local IBM-Compatible PC to (i) accept the data from the CMRI and store it in its memory, (ii) display the collected data on PC's screen, with forward/backward rolling, (iii) print out the data collected from one or more meters, starting from a certain date and time, as per operator's instructions, (iv) transmit the collected data through an appropriate communication link to the central computer, starting from a certain date and time, as per operator's instructions, and (v) store the collected data on a floppy disc.
- D. The above software shall further ensure that absolutely no tampering (except total erasures) of the collected metering data is possible during its handling by the PC. The software shall be suitable for the commonly available PCs, and shall be supplied to SEB in a compatible form to enable its easy loading into the PCs available (or to be installed by the SEB) at the various substations/ locations in the circle.
- E. CMRI should be compatible with Low Power Radio module to be provided by the bidder for receiving the data from the meter to the CMRI/Hand Held UNIT and ultimately transferring to BCS & vice versa for loading required instructions to the meters.

F. CMRI should conform to CBIP Technical Report No. 111 with latest amendments with Level (2) IP 67 protection and following climatic condition & standards

1.0 Standards

The CMRI shall conform in all respects to the following standards.

- i) CBIP Technical Report no. 111 – Specification for common Meter reading Instrument.
- ii) IEC – 529 – Degree of Protection provided by enclosures
- iii) IS : 12063 : 1987 – Classification of Degree of Protection provided by enclosures of electrical items
- iv) IS 9000: 1979 – Basic environmental testing procedure for electronic & electronic items.
- v) IEC – 1000 – Electromagnetic compatibility
- vi) IEC – 1000-4-2 : 1995 – Electrostatic discharge immunity test
- vii) IEC – 1000-4-3 : 195 – Radiated, radio – frequency electromagnetic field immunity test, Magnetic immunity test
- viii) CISPAR 22 – Limits and method of measurement of radio disturbance characteristics of information technology equipment.

2.0 Climatic Conditions:

The detail climatic condition is specified in Section-I.

3.0 Principal Parameter

For downloading data from electronic meters of type, single phase, 230 V, whole current, three phase 415 V Whole current, three phase 415 V, CT operated, 33kV, 11kV, HT Trivector CT, PT operated meters. The offered meter reading device should be portable, compact and battery powered. Its memory shall be adequate to enabling transfer of data from three makes of meters equipped with suitable communication port and transferring them on to a base computer system such as an IBM compatible PC or an external peripheral & vice-versa.

The offered CMRI should have capacity compatible to read minimum 20 meters for billing & tamper data but without load survey and minimum 10 meters for billing and tamper data with load survey.

CMRI shall be able to display phase / vector diagram of phase current, phase voltage with respective phase angles and phase sequence of voltage at SITE when these data are read from the meter.

4.0 GENERAL TECHNICAL REQUIREMENT:

Physical Characteristics:

i. Size:

CMRI should be handy, lightweight and small in size for ease of portability.

ii. Enclosure:

CMRI casing shall be of electrical insulating material of high thermal stability and mechanical strength. Its degree of protection conforms to IP 67 LEVEL (2) as per IS 12063 / IEC-529. The enclosure should be solvent resistant and shall be provided with a suitable holding Strap for proper gripping.

- iii. Ruggedness: CMRI is able to withstand harsh field environment without physical damage or loss of data.
- iv. Display: The display of CMRI is having the following characteristics.
 - a) Easy readability in varying ambient light conditions.
 - b) 4 lines and 20 characters per line on the screen
 - c) The size of the character shall be 4 mm
 - d) The contrast and intensity control to get a clear display in varying ambient light.
- v. Key Board: The keyboard of the CMRI is having the following attributes.
 - a) Long operation life i.e. minimum 100000 operations (typical).
 - b) Feedback for key press acknowledgement to user.
 - c) Legible and non-fading keypad imprints for all alphanumeric characters/symbols.
 - d) Each English alphabet shall have a separate key.

vi. Input / Output ports (I/O Ports) :

The CMRI shall be having two serial input/output Ports, one port shall be serial port RS 232C compatible. Another optional port can be used for convenience of connecting peripherals such as bar-code reader, printer, battery charger, loader charger etc.

The offered CMRI shall be able to provide power supply for optical sensor used for meter reading applications.

5.0 Physical interface:

zInterface between meter and CMRI:

The interface between a meter and CMRI shall consist of 2 parts.

- a) Meter optical sensor terminating in to a 9 pin D type male connector with a cable of 500 mm +/- 10 mm. Length.
- b) The interface between a meter and the offered CMRI shall be with a flexible shielded cable of length 1500mm +/-10mm having 9 pin D-type female connector with electrical circuit. This cable shall be supplied along with CMRI. The two ends of the cable is stress relieved.

Interface between CMRI and Base computer station:

Suitable flexible shielded cable of sufficient length for communication between CMRI and base computer station shall be provided. This communication shall be serial RS232C. On the base computer station end of the cable a 9 pin D-type female connector shall be provided. The two ends of the cable are stress relieved.

This cable shall also be supplied along with the CMRI.

6.0 Hardware and Software requirement:

i. Operating system :

To facilitate use of various meters, specific MRI programs in one CMRI, MS DOS version 5.0 or higher system shall be used. The facility to upgrade the BIOS/OS by a CMRI manufacturer shall be available without exposing the hardware of the CMRI.

The additional program necessary to transfer application programs with serial port shall be provided.

ii. Memory:

- a) The CMRI shall be having a minimum memory capacity of 3 MB Static RAM (SRAM) with battery backup and upgradeable.
- b) BIOS/OS on FLASH memory / EEPROM MEMORY

iii. Communication:

The CMRI shall be able to communicate for-

- a) Down loading / up loading data from / to the meter
- b) Uploading / downloading data to / from the Base computer station
- c) CMRI shall be capable to read bar code information using a bar code scanner from barcodes of ac static \ electromechanical electricity meters by using appropriate scanner and bar code software.
- d) CMRI shall support flexible baud rate ranging from 300 Baud to 19200 (or higher) Baud rates to cater communication needs stated above.

iv. Real time clock :

A real time clock is provided in the CMRI, which have the following features:

Power requirement: The clock shall have a minimum of 15 days battery backup.

Calendar: The clock shall have 20 years calendar.

Time drift: The time drift shall be negligible and shall not exceed 20 seconds per day.

v. Time Setting Facility:

The CMRI shall have the facility to get its time set from Base computer station. Proper security for this is ensured using password

vi. Power supply (Battery) for CMRI:

The CMRI shall have the following features for its power requirements:

- a) The CMRI shall be powered by rechargeable battery housed within its enclosure.
- b) The average capacity of charged battery shall be sufficient to communicate with meters and base computer station for at least :
 - i) 6 hours while communicating through optical interface of meters and
 - ii) 8 hours without powering Input / Output ports for optical interface.

- c) To reduce the equipment down time and inventories, there shall be provision to charge the CMRI battery without being removed from the equipment. A suitable battery charger for charging of CMRI battery shall be provided.
- d) There would be a provision for AUTO POWER SAVE, which force the instrument in the power saving mode in case of no activity within 5 minutes.
- e) The battery used for data retention in SRAM would have a minimum of 3 years backup capacity.
- f) The CMRI would have battery low indication and automatic cutoff to avoid further drain of the battery.

7.0 Communication Protocol and Software

Software:

- a) The following software shall be provided in the offered CMRI.
 - i) Operating system compatible to MS DOS 5.0 or (latest versionver 7.0).
 - ii) Necessary software for loading application programs via a serial port for uploading and down loading between CMRI and Base computer Station (BCS)
- b)
 - i. Provision for loading the software into the CMRI of the specific makes of the meters, for the purpose of reading and programming of the specific make(s) of static meters, such Software shall be provided by respective meter manufacturers.
 - ii. BCS software accepting data from CMRI, processing generating reports and downloading instruction from BCS to CMRI.
- c) Special Requirement:

The offered CMRI shall have provision for storing the third party software and can also be loaded for special applications such as manual meter reading, data entry through keyboard of CMRI, printing, display of balance memory etc.
- d) The CMRI shall have facility to draw/display vector diagram of the electrical conditions existing at site to check the healthiness of the connections.
- e) The CMRI shall have provision to read the energy registers so that accuracy testing can be done at site with standards calibrating equipments.
- f) The CMRI shall have the provision to read the various instantaneous electrical parameters at site like voltages, current, PF, phase angles, power (kW, KVA, and KVA) frequency etc.
- g) The CMRI shall have facility to estimate the memory space available before reading the meter.

8.0 DATA SECURITY

The meter manufacturers are responsible for maintaining the security of the data extracted from the meters using manufacturer specific algorithm in the software up to down loading to BCS.

9.0 CMRI shall be type tested as per clause 5 of CBIP Technical Report No. 111.

10.0 Acceptance Tests for CMRI and PC Software

All CMRI after final assembly and before dispatch from Bidder's/Manufacturer's works shall be duly tested to verify that they are suitable for supply to the Employer. In particular, each and every CMRI shall be subjected to the following acceptance test:

- (i) Functional Checks
- (ii) Downloading Meter Data from the Meter(s)
- (iii) Compatibility with PC software
- (iv) Downloading the meter data on PC
- (v) Functioning of advance and retard time commands
- (vi) Per meter downloading time verification
- (vii) Capacity of CMRI for data storage

35 Earthing Coil

Earthing Coils shall be fabricated from soft GI Wire Hot Dip Galvanized. The Hot Dip galvanized wire shall have clean surface and shall be free from paint enamel or any other poor conducting material. The coil shall be made as per REC constructions standard (Refer tender drawing No. REC-XI Plan-Gen-005). The Hot Dip galvanizing shall conform to IS:2629/1966, 2633/1972 and 4826/1969 with latest amendments. Galvanizing should be heavily coated and should stand for the following tests.

Galvanizing Tests

- i) Minimum Mass of Zinc
 - a) ON GI Wire used 280 gm/m²
 - b) After Coiling – 266 gm/m². The certificate from recognized laboratory shall be submitted towards mass of zinc.
- ii) Dip Test Shall stand 3 dips of 1 minute and one dip of ½ minute before coiling and 43 dips of 1 minute after coiling as per IS : 4826/1979.

THE DIMENSIONAL REQUIREMENT SHALL BE AS FOLLOWS

- a) Nominal dia of GI Wire 4 mm (Tolerance $\pm 2.5\%$)
- b) Minimum no. of turns – 115 Nos.
- c) External dia of Coil (Min) – 50 mm
- d) Length of Coil (Min) – 460 mm
- e) Free length of GI Wire at one end coil (Min.) – 2500 mm

The turns should be closely bound. Weight of one finished Earthing Coils (min.) – 1.850 Kg.

Adhesion test – As per ISS 4826 – 1979.

36 Earthing Conductors

All conductors buried in earth and concrete and above ground level shall be galvanised steel. Galvanised steel shall be subject to four one minute dips in copper sulphate solution as per IS:2633.

37 Deep Drawn Metal Meter Box (MMB) for Single Phase Energy Meter.

1. SCOPE

This specification covers the design, manufacture, testing at manufacturer's place, pre-dispatch inspection and supply of MS sheet, Deep Drawn Metal Meter Box (MMBs). MMBs shall be used for housing Single phase energy meter for electric connections.

2. CONSTRUCTIONAL AND TECHNICAL PARTICULARS

- 2.1 The Deep Drawn Metal Meter Box (MMBs) shall conform to drawings attached. It shall be for housing Single Phase energy meter of any make. The internal dimensions of MMB shall be 285mmx200mmx150mm (i.e. height x width x depth).
- 2.2 The MMB shall be made from 20 SWG MS sheet by Deep Drawn Method. The base and cover of the MMB shall be individually in one piece without any welding except for fixing of the accessories like hinges, clamps, handle etc. which shall be spot-welded. The cover of MMB shall be fixed on two-tamper proof inside hinges not visible from outside. The hinge pin diameter should be 3mm. Hinges shall be made from 1.6mm MS sheet. The pin of hinges shall have head on top so that it does not fall down after wear & tear. The door of MMB shall open from right to left by minimum 90°. The collar of the door (cover) in closed position shall rest on the collar of body (Base) of MMB. The collar of the door shall overlap the collar of the body of MMB by minimum 8mm. The collar of the body shall be provided with good quality rubber gasket lining of min. 3mm thickness. Thickness of rubber lining shall be such that it provides proper sealing between the cover & base of MMB to avoid penetration of dust & ingress of water. Rubber lining should be fixed with the best quality adhesive so that the same does not get removed by itself on opening of the door. Two numbers 'U' shaped latch arrangement shall be provided to Seal the cover with base as shown in the drawing. 2.5mm & 8mm diameter hole shall be provided in U-shaped latch for sealing wires & padlock. U-latch shall be joined with stainless steel rivet. Holes provided for sealing & padlock should be aligned when latch is in closed position. 'U' shaped latch arrangement shall be made from 1.6 mm thick MS sheet and shall be welded from inner side of the box.
- 2.3 A viewing window opening of the size 90mmx100mm as indicated in the drawing shall be provided about 40mm below top edge of MMB to facilitate taking of meter readings. Viewing window shall be provided with toughened glass of 5mm thickness. This glass shall be fixed from inside of the cover of MMB, with powder coated single piece drawn metal frame (Glass Holder) made of 20 SWG MS sheet fixed with min. four welded studs & nuts. Glass holder studs & nuts shall be inside the cover so that it can not be opened from outside. Glass holder shall have rectangular cuttings as per details shown in drawing. The size of toughened glass shall be 110mmx120mm. This glass has to be filled with a wrap around single piece rubber ring without joint having minimum depth of 8mm made from good quality rubber so that it can withstand weather effect.
- 2.4 A handle of minimum 70mm length and 10mm width and 20 SWG sheet thicknesses should be provided for opening and closing of the cover at the place as shown in the drawing.
- 2.5 The mounting arrangement of the meter shall be as shown in the drawing. It should be raised from the base of MMB body by 15mm (minimum). Zinc Plated adjustable strip shall be provided on meter mounting arrangement for fixing of the meter. The supplier shall supply three mounting MS screws, one for upper (M4 threads x length 12mm) & two (M4 threads x 25mm length) in moving slotted strip.
- 2.6 Two Nos. fixing holes of 6.5mm diameter at the back of surface of MMB shall be provided to fix the MMB at flat wall. For fixing of MMB on wall, 2 Nos. Plastic fixing plugs of 50mm length and 2 Nos. 5mm diameter 40mm long pan head self tapping screws and washers shall be provided with every MMB.

- 2.7 2 Nos. holes with superior quality rubber cable glands shall be provided at the bottom of MMB. Glands shall be properly fixed such that the same does not get removed from the box. Internal diameter for incoming/outgoing gland shall be suitable for 2Cx10mm² Aluminum conductor PVC cable. Glands shall be made such that internal diameter of glands provided for cables should be closed with the film of minimum 1mm thickness. Cable will go through the glands by piercing the film of the glands. Overlapping of glands from outer side should be approximately 5mm, such that the gland is not removed when cable is inserted inside the box.
- 2.8 Louvers for ventilation shall be provided on the sidewalls of the box as shown in drawing. 20SWG perforated sheet shall be welded from inside of the louvers.
- 2.9 MMB shall be adequately protected against rust, dust, water and corrosion both from inside and outside. The MMB shall have Light Admiralty Grey shade (IS-5:1993 Colour No. 697) on outside & inside. The MMB shall be powder coated. The surface of the MMB shall be properly pre-treated and cleaned in 7 tank process and shall be applied with a powder coating of about 40 micron thickness on outer side and inside. The facility for 7-Tank Phosphating & powder coating shall be in house of the tenderer / MMB manufacturer to ensure proper quality.
- 2.10 Earthing screw of diameter M6 threads with washer shall be provided in the threads of L-shape clamp welded to main body on left side. There should be no powder coating on earthing screws. Earth marking shall be duly embossed near the earth clamp.
- 2.11 All the screws, studs and washers shall be properly Zinc Plated. The tolerance permissible on the overall dimensions shall be (±) 3%. Danger marking shall be provided on the box in red color. Utility and Manufacturer name shall be provided on the door of meter box. Each box shall be supplied with proper packing in 3ply- corrugated box.
3. The box shall comply with the requirement of IP-33. The box shall be fully type tested along with dimensional drawing as per requirement of IS 13947 (Part-1):1993 and latest amendment, from the govt.-approved laboratories. Government approved laboratories should be accredited by the National Board of Testing & Calibration Laboratories (NABL) of Govt. of India. Test certificate (not older than 5 years) shall be submitted.

4. ACCEPTANCE TESTS:

Following acceptance tests shall be carried out at manufacturer's premises during the inspection of material before dispatch:

a) Visual Examination:

The MMB will be inspected visually, externally and internally for proper Powder Coating layer, fitting of all the components in accordance with technical Specification.

b) Verification of dimensions:

Verification of dimensions, external / internal clearances will be carried out as per technical specifications.

c) Verification of fittings:

Components like Glass, 'U' shaped latch arrangement, glands, clamps, hinges etc will be verified as per technical specification and usage requirement.

d) Painting:

Deep Drawn, 7-Tank Phosphating & Powder coating facilities shall be verified at the place of inspection.

38 Three Phase 4 Wire L.T. Distribution Box for Aerial Bunched Conductor

1 SCOPE:

- 1.1 The L.T. Distribution Box shall be used for connection through overhead conductors or ABC line and for giving connections to the consumers. This specification covers the design, manufacture, inspection, testing and supply of L.T. Distribution Box. The L.T. Distribution Box will be installed at the Poles and it shall withstand solar radiations, rain, wind pressure and pollution.

2 CONSTRUCTIONAL AND TECHNICAL PARTICULARS:

- 2.1 The Distribution Box shall be made from 20 SWG CRCA MS sheet by Deep Drawn Method with Powder Coating. Size of the box shall be 418mm x 300mm x 120mm as shown in drawing. There shall not be any welding joint to make base and cover of the Distribution box. Roof of the box shall be tapered on both sides to drain the rain water.
- 2.2 Distribution box shall have Insulated Multiple Outgoing Connectors for R, Y, B Phases and Neutral. Distribution box shall have arrangement for one incoming cable of three phase of size up to 4core 35mm². Arrangement for four outgoing cables of size up to 4core 16mm² for three phase connection shall be provided in the distribution box. Each Incoming & outgoing cable shall be fixed inside the connection terminals by two screws of size not less than M8. The connection terminals shall be such that the outgoing cables can be fixed or removed easily without disconnecting the power supply. No current carrying part shall be approachable by hand or finger. Any current carrying part should be at a minimum distance of 5mm from the outer edge of the insulation. Insulation shall be Fire retardant.
- 2.3 Connection terminals for R, Y, and B Phases shall be mounted horizontally in a single line and Neutral shall be mounted parallel to R, Y, and B Phases in stepped pattern. Mounting arrangement shall be such that minimum clearance of 40mm is maintained between each phase and neutral. Fixing of connection terminals with the distribution box shall be preferably non-removable type to avoid theft of connection terminals.
- 2.4 Box shall be provided with U-latch sealing arrangement. A hole of 8mm & 2.5mm shall be provided in the U-latch to provide a padlock & sealing of the box respectively. U-latch shall be joined with stainless steel rivet. Box should be duly powder coated after 7-tank Phosphating process. Box should be of Light Admiralty Grey color (IS-5:1993, COLOUR NO-697). The L.T. Distribution box shall be powder coated only. The facility for 7-Tank Phosphating and powder coating shall be in-house of the tenderer to ensure proper quality, since these boxes are for outdoor applications.
- 2.5 4 Holes for incoming cables and 4 Nos. holes for outgoing cables shall be provided on the lower wall of the box. Cable holes shall be provided with rubber / plastic glands duly pasted with the box. Incoming and outgoing cable gland shall have internal diameter of 20mm. Cable Glands shall be made such that internal diameter of glands provided for cables should be closed with the film of minimum 1mm thickness. Cable will go through the cable glands by piercing the film of the glands. Gap of minimum 100mm shall be maintained between the lower wall and neutral mounted inside the distribution box for easy handling of incoming and outgoing cables.
- 2.6 MARKING: Following shall be provided on the cover of box.
- Manufacturers name duly embossed
 - Utility name duly embossed
 - Name of scheme duly embossed
 - Danger marking in red color.
- 2.7 M.S. Earthing Screw of diameter 6mm with washer shall be provided in the threads of the earth clamp welded to the main body of the box.

- 2.8 The box shall comply with the requirement of IP54. The box shall be fully type tested along with dimensional details as per the requirement of relevant Indian Standard (latest edition) IS13947: Part-I and latest amendments. Tests shall be carried out from laboratories which are accredited by the National Board of Testing & Calibration Laboratories (NABL) of Govt. of India to prove that the complete box meet the requirement of IP54. The tests report shall be submitted along with the tender failing which the tender of the firm shall not be opened. Government approved laboratories should be accredited by the National Board of Testing & Calibration Laboratories (NABL) of Govt. of India. The type test reports shall not be older than 5 years.
- 2.9 Distribution Box shall be duly packed in 3Ply corrugated box. The tolerance permissible on the overall dimensions of the MMB shall be (\pm) 3%.

3.0 TESTS:

Following tests shall be performed on the box during inspection:

- 3.1 Visual Examination:
The L.T. Distribution box will be inspected visually, externally and internally for proper Powder Coating layer, fitting of all the components in accordance with technical Specification.
- 3.2 Verification of dimensions:
Verification of dimensions, external / internal clearances will be carried out as per technical specifications.
- 3.3 Verification of fittings: Components like insulated connection terminals, screws etc will be verified as per technical specification.
- 3.4 High voltage withstand test at 2.5KV:
The A.C. voltage of 2.5KV, 50HZ shall be applied for one minute as follows:
a) Between each Phase
b) Between each Phase and earth screw
c) On the insulation of connection terminals
There shall not be any puncture or flash over during this test.
- 3.5 Current Carrying Capacity: The Current of 200 AMP shall be applied for 30 minutes through high current source on the each Phase. There shall not be overheating of the terminals during this test.

39 Deep Drawn Metal Meter Box (MMB) for Three Phase Energy Meter

1. SCOPE

This specification covers the design, manufacture, testing at manufacturer's place, pre-dispatch inspection by Employer and supply of MS sheet, Deep Drawn Metal Meter Box (MMBs). MMBs shall be used for housing Three phase energy meter for electric connections of General category i.e. Domestic & Commercial connections.

2. CONSTRUCTIONAL AND TECHNICAL PARTICULARS

- 2.12 The Deep Drawn Metal Meter Box (MMBs) shall conform to drawings attached. It shall be for housing Three Phase energy meter of any make. The internal dimensions of MMB shall be 400mmx300mmx160mm (i.e. height x width x depth).
- 2.13 The MMB shall be made from 20 SWG MS sheet by Deep Drawn Method. The base and cover of the MMB shall be individually in one piece without any welding except for fixing of the accessories like hinges, clamps, handle etc. which shall be spot-welded. The cover of MMB shall be fixed on two-tamper proof inside hinges not visible from outside. The hinge pin diameter should be 3mm. Hinges shall be made from 1.6mm MS sheet. The pin of hinges shall have head on top so that it does not fall down after wear & tear. The door of MMB shall open from right to left by minimum 90°. The collar of the door (cover) in closed position shall rest on the collar of body (Base) of MMB. The collar of the door shall overlap the collar of the body of MMB by minimum 8mm. The collar of the body shall be provided with good quality rubber gasket lining of min. 3mm thickness. Thickness of rubber lining shall be such that it provides proper sealing between the cover & base of MMB to avoid penetration of dust & ingress of water. Rubber lining should be fixed with the best quality adhesive so that the same does not get removed by itself on opening of the door. Two numbers 'U' shaped latch arrangement shall be provided to Seal the cover with base as shown in the drawing. 2.5mm & 8mm diameter hole shall be provided in U-shaped latch for sealing wires & padlock. U-latch shall be joined with stainless steel rivet. Holes provided for sealing & padlock should be aligned when latch is in closed position. 'U' shaped latch arrangement shall be made from 1.6 mm thick MS sheet and shall be welded from inner side of the box.
- 2.14 A viewing window opening of the size 90mmx100mm as indicated in the drawing shall be provided about 50mm below top edge of MMB to facilitate taking of meter readings. Viewing window shall be provided with toughened glass of 5mm thickness. This glass shall be fixed from inside of the cover of MMB, with powder coated single piece drawn metal frame (Glass Holder) made of 20 SWG MS sheet fixed with min. four welded studs & nuts. Glass holder studs & nuts shall be inside the cover so that it cannot be opened from outside. Glass holder shall have rectangular cuttings as per details shown in drawing. The size of toughened glass shall be 110mmx120mm. This glass has to be filled with a wraparound single piece rubber ring without joint having minimum depth of 8mm made from good quality rubber so that it can withstand weather effect.
- 2.15 A handle of minimum 70mm length and 10mm width and 20 SWG sheet thicknesses should be provided for opening and closing of the cover at the place as shown in the drawing.
- 2.16 The mounting arrangement of the meter shall be as shown in the drawing. It should be raised from the base of MMB body by 15mm (minimum). Zinc Plated adjustable strip shall be provided on meter mounting arrangement for fixing of the meter. The supplier shall supply three mounting MS screws, one for upper (M4 threads x length 12mm) & two (M4 threads x 35mm length) in moving slotted strip.
- 2.17 Four Nos. fixing holes of 6.5mm diameter at the back of surface of MMB shall be provided to fix the MMB at flat wall. For fixing of MMB on wall, 4 Nos. Plastic fixing plugs of 50mm length and 4 Nos. 5mm diameter 40mm long pan head self-taping screws and washers shall be provided with every MMB.
- 2.18 2 Nos. holes with superior quality rubber cable glands shall be provided at the bottom of MMB. Glands shall be properly fixed such that the same does not get removed from the box. Internal diameter for incoming/outgoing gland shall be suitable for 4Cx25mm² Aluminum conductor PVC cable. Glands shall

be made such that internal diameter of glands provided for cables should be closed with the film of minimum 1mm thickness. Cable will go through the glands by piercing the film of the glands. Overlapping of glands from outer side should be approximately 5mm, such that the gland is not removed when cable is inserted inside the box.

- 2.19 Louvers for ventilation shall be provided on the sidewalls of the box as shown in drawing. 20SWG perforated sheet shall be welded from inside of the louvers.
- 2.20 MMB shall be adequately protected against rust, dust, water and corrosion both from inside and outside. The MMB shall have Light Admiralty Grey shade (IS-5:1993 Colour No. 697) on outside & inside. The MMB shall be powder coated. The surface of the MMB shall be properly pre-treated and cleaned in 7-tank process and shall be applied with a powder coating of about 40 micron thickness on outer side and inside. The facility for 7-Tank Phosphating & powder coating shall be in house of the tenderer / MMB manufacturer to ensure proper quality.
- 2.21 Earthing screw of diameter M6 threads with washer shall be provided in the threads of L-shape clamp welded to main body on left side. There should be no powder coating on earthing screws. Earth marking shall be duly embossed near the earth clamp.
- 2.22 All the screws, studs and washers shall be properly Zinc Plated. The tolerance permissible on the overall dimensions shall be (\pm) 3%. Danger marking shall be provided on the box in red color. Utility name shall be provided on the door of meter box.
- 2.23 Each box shall be supplied with proper packing in 3ply- corrugated box.
3. The box shall comply with the requirement of IP-33. The box shall be fully type tested along with dimensional drawing as per requirement of IS 13947 (Part-1):1993 with latest amendment, from the govt.-approved laboratories. Government approved laboratories should be accredited by the National Board of Testing & Calibration Laboratories (NABL) of Govt. of India.
4. ACCEPTANCE TESTS:
Following acceptance tests shall be carried out at manufacturer's premises during the inspection of material before dispatch:
- a) Visual Examination:
The MMB will be inspected visually, externally and internally for proper Powder Coating layer, fitting of all the components in accordance with technical Specification.
- b) Verification of dimensions:
Verification of dimensions, external / internal clearances will be carried out as per technical specifications.
- c) Verification of fittings:
Components like Glass, 'U' shaped latch arrangement, glands, clamps, hinges etc will be verified as per technical specification and usage requirement.
- d) Verification of Deep Drawn Facility, 7-Tank Phosphating, Powder Coating Process:
Deep Drawn, 7-Tank Phosphating & Powder coating facilities shall be verified at the place of inspection.

40 Single Phase L.T. Distribution Box for Aerial Bunched Conductor

1 SCOPE:

The LT Distribution box for ABC single phase is used for Connection through overhead conductors or ABC line and for giving connections to the consumers. This specification covers the design, manufacture, inspection, testing and supply of the LT Distribution box. The LT Distribution box suited for ABC single phase cable will be installed at the Poles and it shall withstand solar radiations, rain, wind pressure and pollution.

2 CONSTRUCTIONAL AND TECHNICAL PARTICULARS:

2.1 The Distribution Box shall be made from 20 SWG CRCA MS sheet by Deep Drawn Method with Powder Coating. Internal size of the box shall be 225mm x 285mm x 120mm as shown in drawing. There shall not be any welding joint to make base and cover of the Distribution Box. Roof of the box shall be tapered on both sides to drain the rain water.

2.2 Distribution Box shall have insulated Multiple Outgoing Connector for Phase and Neutral. Each Multiple Outgoing Connector shall have arrangement for one incoming cable of Single phase of size up to 25mm² and 8 outgoing cables of single phase of size up to 2core 10mm². Each Incoming & outgoing cable shall be fixed inside the Multiple Outgoing Connector by two screws of size not less than M6. The Multiple Outgoing connector shall be such that the outgoing cables can be fixed or removed easily without disconnecting the power supply. No current carrying part shall be approachable by hand or finger. Any current carrying part should be at a minimum distance of 5mm from the outer edge of the insulation. Insulation shall be Fire retardant.

2.3 Multiple Outgoing Connectors shall be mounted horizontally. Mounting arrangement shall be such that minimum clearance of 40mm is maintained between phase and neutral. Fixing of Multiple Outgoing Connectors preferably shall be non-removable type to avoid theft of connectors.

2.4 Box shall be provided with U-latch sealing arrangement. A hole of 8mm & 2.5mm shall be provided in the U-latch to provide a padlock & sealing of the box respectively. U-latch shall be joined with stainless steel rivet. Box should be duly powder coated after 7-tank Phosphating process. Box should be of Light Admiralty Grey color (IS-5:1993, COLOUR NO-697). The LT Distribution box for ABC single phase shall be powder coated only. The facility for 7-Tank Phosphating and powder coating shall be in-house of the tenderer / manufacturer to ensure proper quality, since these boxes are for outdoor applications.

2.5 One Hole for incoming cable and 8 Nos. holes for outgoing cables shall be provided on the lower wall of the box. Cable holes shall be provided with rubber / plastic glands duly pasted with the box. Incoming and outgoing cable gland shall have internal diameter of 30mm & 15mm respectively. Cable Glands shall be made such that internal diameter of glands provided for cables should be closed with the film of minimum 1mm thickness. Cable will go through the cable glands by piercing the film of the glands. Gap of minimum 100mm shall be maintained between the lower wall and neutral mounted inside the Distribution Box for easy handling of incoming and outgoing cables.

2.6 MARKING: Following shall be provided on the cover of box.

- a) Manufacturers name duly embossed
- b) Utility name duly embossed
- c) Name of the scheme
- d) Danger marking in red color.

2.7 M.S. Earthing screw of diameter 6mm with washer shall be provided in the threads of the earth clamp welded to the main body of the box.

2.8 The box shall comply with the requirement of IP54. The box shall be fully type tested along with dimensional drawings as per the requirement of relevant Indian Standard (latest edition) IS13947: Part-I and latest amendments. Tests shall be carried out from laboratories which are accredited by the National Board of Testing & Calibration Laboratories (NABL) of Govt. of India to prove that the complete box meet the requirement of IP54. The tests report shall be submitted along with the tender failing which the tender of the firm shall not be opened. Government approved laboratories should be accredited by the National Board of Testing & Calibration Laboratories (NABL) of Govt. of India. The type test reports shall not be older than 5 years. In case order is placed on a firm, no change in design / manufacturer of LT Distribution box shall be allowed in supplies.

2.9 Box shall be duly packed in 3Ply corrugated box. The tolerance permissible on the overall dimensions shall be (\pm) 3%.

3 TESTS:

Following tests shall be performed on the box during inspection:

3.1 Visual Examination: -

The LT Distribution box for ABC single phase will be inspected visually, externally and internally for proper Powder Coating layer, fitting of all the components in accordance with technical Specification.

3.2 Verification of dimensions: -

Verification of dimensions, external / internal clearances will be carried out as per technical specifications.

3.3 Verification of fittings: -

Components like insulated Multiple Outgoing Connectors, screws etc will be verified as per technical specification.

3.4 High voltage withstand test at 2.5KV: -

The A.C. voltage of 2.5KV, 50HZ shall be applied for one minute as follows:

- a) Between Phase & Neutral
- b) Between Phase and earth screw
- c) On the insulation of Multiple Outgoing Connectors.

There shall not be any puncture or flash over during this test.

3.5 Current Carrying Capacity: -

The Current of 200 AMP shall be applied for 30 minutes through high current source on each Multiple Outgoing Connector. There shall not be overheating of the terminals during this test.

- 41 Cubicle (Metal Box) for Housing LT AC Three Phase Four Wire, CT Operated Static Energy Meter, Modem and 4 No. Epoxy Resin Cast CTs.
1. SCOPE
This specification covers the design, manufacture, testing, pre-dispatch inspection, supply and delivery of Cubicles (Metal Meter Boxes) with one no. LT AC Three Phase Four Wire, CT Operated Static Energy Meter, Modem and four no. Epoxy Resin Cast CTs, control cables, clamps, terminal block, etc. as required.
 2. CONSTRUCTIONAL AND TECHNICAL PARTICULARS:
 - 2.1 The Cubicles shall conform to approved drawings. It shall include LT AC, Three Phase, Four Wire, CT Operated Static Energy Meter, Modem and 4 no. Epoxy Resin Cast Ring Type CTs. The overall dimensions of the Cubicle shall be 960mmx460mmx215mm (i.e. height x width x depth). Tentative drawing is enclosed herewith Project Manager shall approve the drawings.
 - 2.2 The Cubicle shall be made from 18 SWG CRCA sheet by Deep Drawn Method. The box shall consist of two separate compartments. Lower compartment shall be for housing 4 no. CTs and lower for housing of meter. A separate and independent door shall be provided for each of the upper and lower compartments with provision of locking and sealing arrangement. Each Door shall be fixed on two tamper proof inside hinges of suitable size not visible from outside. The hinge pin diameter should be minimum 3mm. Hinges shall be made from 1.6 mm MS sheet. The pin of hinges shall have head on top so that it does not fall down after wear & tear. The door of Cubicle shall open from right to left by minimum 90°. The collar of the door (cover) in closed position shall rest on the collar of body (Base) of Cubicle. The collar of the door shall overlap the collar of the body of Cubicle by minimum 8mm. The collar of the base shall be provided with good quality rubber gasket lining of min. 4mm thickness. Rubber lining shall be such that it provides proper sealing between the cover & base of Cubicle to avoid penetration of dust & ingress of water. Rubber lining should be fixed with suitable adhesive so that the same does not get removed by itself on opening of the door. Two numbers 'U' shaped latch arrangement shall be provided to Seal each cover with base as shown in the drawing. 2.5mm & 8mm diameter hole shall be provided in U-shaped latch for sealing wires & padlock. Holes provided for sealing & padlock should be aligned when latch is in closed position. 'U' shaped latch arrangement shall be made from 1.6 mm thick MS sheet and shall be welded from inner side of the box. U-Latch shall be duly riveted with stainless steel rivet.
 - 2.3 A viewing window opening of the size 90mmx100mm as indicated in the drawing shall be provided about 50mm below top edge in the door of meter compartment to facilitate taking of meter readings. Viewing window shall be provided with toughened glass of 5mm thickness. This glass shall be fixed from inside of the cover of cubicle, with single piece drawn metal frame (Glass Holder) made of 20 SWG MS sheet fixed with min. fourwelded studs & nuts. Glass holder nuts shall be inside the cover so that it cannot be opened from outside. Glass holder should be powder coated and shall have rectangular cuttings as per details shown in drawing. The size of toughened glass shall be 110mmx120mm. This glass has to be fitted with a wraparound single piece rubber ring without joint having minimum depth of 8mm and made from good quality rubber so that it can withstand weather effect. Same arrangement shall be provided for the window provided for modem as shown in drawing.
 - 2.4 The mounting arrangement of the CTs shall be as shown in the drawing. It should be raised from the base of Box body by 20mm. CT mounting plates fixed with 2 screws shall be provided as shown in the drawing.
 - 2.5 Meter mounting arrangement shall be provided by supplier in the meter chamber for mounting of meter as shown in the drawing. It should be raised from the base of MMB body by 35mm (minimum). Galvanized/Zinc plated adjustable strip shall be provided on meter mounting arrangement for fixing of

the meter. The supplier shall supply three mounting MS screws, one for upper (M4 threads x length 12mm) & two (M4 threads x 35mm length) in moving slotted strip.

- 2.6 4 Nos. holes with superior quality rubber cable glands shall be provided on both sides of the lower compartment of the box for cable entry as per drawing. Internal diameter for incoming / outgoing gland shall be suitable for following power cable as below.

Sizes of cable with transformer capacity:

Type of DTR	approximate full load current	Sizes of cable
63	84	70
100	133	150
200	270	300
315	440	300

Similarly, 4 Nos. holes with superior quality rubber cable glands shall be provided in the Partition sheet of upper & lower compartments of the cubicle for entry of secondary wires of CTs. Internal diameter for gland used in partition sheet shall be 15mm. Glands shall be made such that internal diameter of glands provided for cables should be closed with the film of minimum 1mm thickness. Cable will go through the cable glands by piercing the film of the glands. Cable glands shall be fixed with suitable adhesive so that the same does not get removed.

- 2.7 For mounting of box on pole, four holes shall be provided the back side of the box as shown in drawing.
- 2.8 Louvers for ventilation shall be provided on both the sidewalls of the box as shown in drawing. 20SWG perforated sheet shall be welded from inside of the louvers suitable for IP-33 protection class with perforations as shown in drawing.
- 2.9 Cubicle shall be adequately protected against rust, water and corrosion both from inside and outside. The cubicle shall have Light Admiralty Grey shade. (IS-5:1993 Colour No. 697) on outside and inside. Glass holder shall also have Light Admiralty Grey shade. The surface of the MMB shall be properly pre-treated and cleaned in 7 tank process and shall be applied with a powder coating of about 40 micron thickness on outer side and inside. The facility for 7-Tank Phosphating & powder coating shall be in house of the tenderer to ensure proper quality since these boxes are for outdoor applications.
- 2.10 Two Earthing bolt of M8 and 25mm long shall be welded from inside of the box and shall be provided on the side wall with 2 nuts & washer. Earth marking shall be duly embossed near the earth bolts. There shall be no powder coating on the Earthing bolts.
- 2.11 All the screws, studs and washers shall be properly zinc plated.
- 2.12 The tolerance permissible on the overall dimensions shall be (\pm) 3%.
- 2.13 Danger marking shall be provided on the box in red color.
- 2.14 Name of Utility and name of the scheme name shall be embossed on the door of the box.
- 2.15 Each box shall be supplied with proper packing in 3ply- corrugated box.
3. Genral technical detail of L.T. current transformer for use in connection with L.T. C.T. operated energy metering are as follows:
- i. C.T. shall conform to IS:2705/1992 or its latest version thereof.
 - ii. Current transformer should be resin cast, ring type construction. Construction shall be single phase single core type. The internal diameters of the C.T. shall be approved by employer.
 - iii. CT current ration shall be approved by Project Manager.
 - iv. Suitable mounting robust clamp as per manufacturer design shall be provided.
 - v. Secondary terminal shall be of brass stud type. The size shall be minimum 6.0 mm dia 20 mm outside length with spring washer and double nuts.

- vi. Rated voltage shall be Single Phase 240 V line to neutral (+15% to – 30%)
 - vii. Accuracy class of 0.5 as per IS.
 - viii. Rated burden shall be of 5 VA.
 - ix. The instrument security factor shall be less than or equal to 5.
 - x. Rated short time current of 5 KA for 1 sec. Corresponding to rated dynamic peak current of 2.5 x 5 KA (peak)
 - xi. The ratio, name of manufacture / monogram and year of manufacturing shall be engraved on the body of C.T. In addition name plate of anodized aluminium indicating the necessary details, year of manufacture etc. engraved on it shall be provided in such a manner that the information is clearly visible after mounting.
 - xii. The secondary and primary terminals shall be clearly marked as S1 & S2.
 - xiii. The bidders should submit the drawings of offered CTs.
4. FINISHING OF DISTRIBUTION BOX:
 The surface of the box shall be properly pretreated / phosphated in 7-tank process and shall be applied with powder coating. The process facility shall be in house of the manufacturer to ensure proper quality for outdoor application.
5. ACCEPTANCE TESTS :
 Following acceptance tests shall be carried out while inspecting lot of material offered.
- a. Visual Examination:
 The Metal Meter Box (Cubicle) shall be inspected visually, externally and internally for proper powder coating layer, fitting of all the components in accordance with the technical specifications.
 - b. Verification of Dimensions:
 Verification of dimensions, external / internal clearances shall be checked as per the technical specifications.
 - c. Verification of fittings:
 Components like toughened Glass, "U" shaped latch arrangement, glands, hinges, CT fixing arrangement etc shall be verified as per the technical specifications and usage requirements.
6. TYPE TEST:
 The Metal Meter Box shall comply with the requirement of IP33. The box shall be fully type tested as per the requirement of IS 13947 (Part-1):1993 and latest amendments. The type test shall be carried out from the Govt. approved laboratories duly accredited by National Board of Testing & Calibration Laboratories (NABL) of Govt. of India. Test certificate (not older than 5 years) shall be submitted along with the tender.
7. Prototype & Drawings:-
 The manufacturer has to manufacturer the prototype Unit for each rating as per this specification before bulk manufacturing. The manufacturer should intimate the readiness of prototype to employer. The Project Manager will inspect the prototype for approval. The manufacturer should submit the final drawings in line with this specification and prototype to employer for approval before bulk manufacturing. The approval of prototype & drawings shall be a responsibility of manufacturer/Contractor. Tentative drawing of LTCT box is enclosed herewith.

42 Earthing

(AS PER IS 3043-1987)

Earthing shall generally be carried out in accordance with the requirements of Indian Electricity Rules 2003 amended from time to time and relevant regulations under Electricity Supply Authority concerned.

In case of high and extra high voltages, the neutral points shall be earthed by not less than two separate distinct connections with earth, each having its own electrodes sub-station and will be earthed at any other point provided no interference is caused by such earthing. If necessary, the neutral may be earthed through suitable impedance.

As far as possible, all earth connections should be visible for inspection. Each earthing system shall be so designed, that, the testing of individual earth electrodes is possible. It is recommended that the value of any earth system resistance shall be such as to conform to the degree of shock protection desired.

It is recommended, that a drawing showing the main earth connections and earth electrodes be prepared for each installation and submitted to Employer.

No addition to the current carrying system, either temporary or permanent, shall be made which will increase the maximum available fault current on its duration until it has been ascertained that the existing arrangement of earth electrodes, earth bus-bar etc., are capable of carrying the new value of earth fault current which may be obtained by this addition.

All materials, fittings etc., used in earthing shall conform to Indian Standard Specifications, wherever they exist.

GENERAL REQUIREMENTS AND PROCEDURES FOR EARTHING AT SUB-STATIONS.

The ground resistance for sub-stations should not exceed a value 2(two) ohms. The joints/connections in the earthing, system shall be welded only, except the connections, which require opening for testing/maintenance. Such connections should be bolted tightly, using spring and ring washers for proper contact pressure. The G.S. flats to be provided for the horizontally laid earth grid should have overlap welded joints, with length of welding at least twice the width of the flat, e.g., 100 MM for 50x6 MM G.S. flats. There should not be any dirt, grease, oil, enamel, paint or any such non-conductive coatings on the surfaces being joined/ connected. Only the finished joints/connections above ground may be provided with red-oxide or any other protective coating. Underground earth electrodes and earth grid elements, when laid, should have a clean metallic surface, free from paint, enamel, grease or any such non-conductive coatings.

As far as possible, all earth connections should be accessible for visual inspection. No cut-outs, links or switches, other than linked switches arranged to operate simultaneously on the earthed or earthed neutral conductor and the live wire shall be inserted in the supply system. Earth electrodes or mate should not be installed in close proximity to metal fence to avoid possibility of fence becoming live. Separate earth electrodes, isolated from the earth grid, are to be provided for grounding the fence wires.

Pipes or rods used as electrodes should be in one piece, as far as possible, with a minimum allowable length of 3 mtrs. Except where rock or hard stratum is encountered, the pipe/rod electrodes should be driven into the ground to a minimum depth of 3 mtrs. The strip electrodes, forming the horizontal grid, should be buried underground to a minimum depth of 0.5 mtrs. The path of earth wire should be out of normal reach of any person, as far as possible.

For high resistivity soils, above 100 Ohm-mtrs., attempts should be made to bring the soil resistivity in the range of 50 to 60 Ohm-mtrs. By digging and treating the soil mass around the earth grid/electrodes with a mixture of salt and charcoal.

In case of rocky top soil and sub-stratum, having very high resistivity, with no scope of improvement by other means, the procedure given below should be followed:

1. At least two bores of diameter little less than 40 mm, with a minimum distance of 10 mtrs. between them, should be made in the ground at suitable locations inside the S/S yard. The boring should be done until soil sub-stratum rich in moisture and low in resistivity is encountered. G.I. pipes of 40 MM dia. should be descended in each bore, such that, the soil mass around the pipes grips them tightly, Back – filling of bores, if required, with wet soil/clay may be done to ensure this condition. The G.I. pipes in these deep bores should be interconnected with the main earthing grid of the S/S through 50x6 mm G.S. flat, with all the joints/connections and terminations being either fully welded, or clamped/bolted and welded simultaneously. The G.I. pipes in the bores should also be interconnected with each other. In extreme cases, the bores may have to be made at remote locations i.e. outside the S/S yard, with inter-connections, through 50x6 MM flats, as explained before.
2. The procedures to be observed stringently for making connections and joints between various elements of the earthing system are as follows:
 - a. G.S. flat to Structure/flat - The G.S. flat should be welded to the metallic portion (leg) of the structure after thoroughly cleaning the surfaces to be welded. The length of the welding should be at least twice the width of the G.S. flat, e.g.-minimum 100 mm for 50x6 mm G.S. flat. Exactly similar procedure is to be adopted for joints between two G.S. flats.
 - b. G.I. wire to structure. The G.I. wire should be bolted to the structure after making an eye formation and kept tight with the help of spring and ring washer. Then, the entire arrangement should be welded.
 - c. G.I. wire to G.S. flat- The G.I. wire should be bolted and then welded to G.S. flat, as explained above.
 - d. G.I. rod to G.S. flat- The G.I. rod should be securely clamped to the G.S. flat with the help of bolts and washers and the entire arrangement should then be welded.
 - e. G.I. wire to G.I. pipe – GI wire should be bolted to the G.I. pipe and then welded, keeping in view the relevant precautions, mentioned before.
 - f. G.I. flat to G.I pipe – The GI flat should be bolted tightly to the G.I. pipe and then the connection should be welded.

Before making connections and joints, it should be ensured that, the elements to be joined have a clean metallic contact surface without any non-conductive coating.

EARTH GRID SYSTEM

Grid system of interconnected conductors forming a closed loop mesh is to be installed using 75x8 mm MS flat for peripheral and branch conductors. Interconnections are made by welding them. This earth grid will be laid at a depth of about 0.5 mtr. bonded to general mass of the earth by 3 mtrs. long earth electrode of solid MS rod (or pipe) of dia 25mm. The G.I. pipe 40 mm. dia 3 mtrs. long in the earthing pits, driven vertically.

It is to this earth grid that the transformer neutral, apparatus, frame work and other non-current carrying metal work associated like transformer tank, switchgear frame etc. are to be connected. All these connections should be made in such a way that reliable and good electrical connection is ensured.

Aluminum/ other paint, enamel, grease and scale should be removed from the point of contact before connections are made. No part of the ground connection leads should be embedded in concrete.

Arrangement of connection of earth connection shall be as follow:

1. STRUCTURES:

Structures including frames, metal supports within the substation grid at least two legs, preferably diagonally opposite (where more than two legs are provided) on each metal structure shall be connected to earth grid with GI wire of 4mm dia or 6 mm dia.

2. ISOLATORS/ SWITCHES:

The operating handle shall be connected to earth grid independent of the structure earthing or through the steel mounting structure, through 4 mm dia G.I. wire.

3. LIGHTNING ARRESTOR:

The bases of lightning arrestors shall be directly connected to the earth electrodes by 4 or 6 SWG G.I. wires as short and as straight as practicable, to ensure minimum impedance. Separate earth leads should be used for L.A. in each phase. In addition there shall be as direct connections as practicable from the earthed side of the lightning arrestors to the frame of the apparatus being protected. Surge counters, could also be inserted in the circuit where lightning incidences are high, but in such cases, the lightning arrestor should be mounted on insulated base. Invariably, earth connections for lightning arrestors should be separate, and in no case should they be joined looped or meshed with other conductors. For lightning arrestors mounted near transformers, earthing connections shall be done with the earthing pits and earthing leads shall be laid clear of the tank and collars in order to avoid possible oil leakage caused by arcing. The earth connection should not pass through iron pipes, as it would increase the reactive impedance of the connection.

4. POWER TRANSFORMER:

- The tank of the transformer shall be directly connected to the main earth grid. In addition there shall be a separate and as direct a connection as practicable from the tank to the earth side of protecting LA using 4 or 6 SWG GI wire.
- The earthing of the neutral shall be by two separate, distinct and direct connections of 50x6 mm GS flat to earth pits, which form a part of the earth grid, and shall be run clear of the tank and collars.
- The transformer track rails shall be connected to earth

5. OUT DOOR VCB:

At least two legs, preferably diagonally opposite of the supporting structure frame work of each circuit breaker unit shall be connected to the earth grid, through 50x6 mm G.S. flats.

6. FENCING:

Fencing and gate should be earthed separately.

7. CURRENT TRANSFORMERS / POTENTIAL TRANSFORMERS:

The bases of the current transformers should be directly connected to the earth grid through 4 or 6 SWG G.I. wires. The base (neural side) of the P.Ts. should be directly connected to the earth grid through 4 or 6 SWG G.I. wires. Separate earth leads should be used for P.Ts. in each phase. The termination of leads on the P.T. neutral should be bolted/clamped and not welded, to facilitate opening of the earth connection for testing purposes. In addition, all bolted cover plates to which bushings are attached, should be connected to the earth grid, both in case of C.Ts. and P.Ts.

8. Armoring of armored metal-sheathed cables within the station grid area shall be connected to the earth grid.
9. Substation L.T. Supply Transformer: Same as above except that the neutral earthing conductor used shall be 4 or 6 SWG G.I. wire.

43 Gi Earthing Pipe

Earthing pipe should be made of 40 mm diameter ISI marked B class GI Pipe. 12 mm dia suitable holes on its circumference shall be made as per approved drawing. The pipe should be in one piece. No joints or welding would be allowed on its length. Clamps made of 50x6mm GI flat duly drilled with 12 mm size holes should be welded at the top end for connection of earth conductor.

Pipe used shall be 40mm NB diameter, ISI marked Galvanized Mild Steel Tubes continuously welded Electric Resistance Welded ERW/High Frequency Induction welded (HFIW)/Hot finished welded (HFW) type, conforming to IS-554-1985 with latest amendment of MEDIUM quality (Class B).

1. MANUFACTURE:

GI earth pipe (40 mm diameter & 3 metre long) shall be made of tubes which shall be made from tested quality steel manufactured by any approved process as follows:

- a) Electric Resistance Welded (ERW).
- b) High Frequency Induction Welded (HFIW) and
- c) Hot finished Welded (HFW).

Tubes made by manual welding are not acceptable.

2. DIMENSIONS:

The dimensions and weights of tubes shall be in accordance with Table-I and Table-II of IS: 1239 (Part-I)/1990 with latest amendments, subject to tolerance permitted therein. Necessary 12 mm diameter holes across the circumference shall be provided as per approved drawing. Drawings shall be approved by the owner before start of the manufacturing work. The tube, earthing pipe shall be provided with 50x6mm GS clamps on one end, one clamp is to be welded with the pipe and another is removable to enable measurement of earth resistance of the pit. Other end of the earth pipe should be cut half in slop to make it a sharp.

3. GALVANIZING:

Tubes shall be galvanized in accordance with IS-4736-1986 with latest amendment for not dip zinc coating of Mild Steel Tubes. The minimum mass of zinc coating on the tubes shall be in accordance with clause 5.1 of IS-4736-1986 (specification for hot dip zinc) and when determined on a 100mm long test piece in accordance with IS: 6745:1972 shall be 400 g/m². The zinc coating shall be uniform adherent reasonably smooth and free from such imperfections as flux, ash and dross inclusions, bare patches, black spots, pimples, lumpiness, rust, stains, bulky white deposits and blisters.

4. HYDRAULIC TEST:

(Before applying holes) Each tube shall withstand a test pressure of 5 M Pa maintained for at least 3 seconds without showing defects of any kind. The pressure shall be applied by approved means and maintained sufficiently long for proof and inspection. The testing apparatus shall be fitted with an accurate pressure indicator

5. TEST ON FINISHED TUBES AND SOCKETS:

The following tests shall be conducted by the manufacturer of finished tubes and sockets.

- a) The tensile strength of length of strip cut from selected tubes when tested in accordance with IS-1894-1972, (Method for tensile testing of steel tubes), shall be at least 320N/mm².

- b) The elongation percentage on a gauge length of 5.65/s₀ (where s₀ is the original cross-sectional area of test specimen) shall not be less than 20%.
- c) When tested in accordance with IS-2329-1985 (Method for Bend test on Metallic tubes) the finished tube shall be capable of with standing the bend test without showing any sign of fracture or failure. Welded tubes shall be bent with the weld at 90 degree to the plane of bending. The tubes shall not be filled for this test.
- d) Galvanized tubes shall be capable of being bent cold without cracking of the steel, through 90 degree round a former having a radius at the bottom of the groove equal to 8 times the outside diameter of tube.
- e) Flattening Test on Tubes above 50 mm Nominal Bore: Rings not less than 40 mm in length cut from the ends of selected tubes shall be flattered between parallel plates with the weld, if any, at 90 degree (point of maximum bending) in accordance with IS-2328-1983. No opening should occur by fracture in the weld unless the distance between the plate is less than 75 percent of the original outside diameter of the pipe and no cracks or breaks in the metal elsewhere than in the weld shall occur, unless the distance between the plates is less than 60% of the original outside diameter. The test rings may have the inner and outer edges rounded.
- f) GALVANISHING TEST:
- Weight of zinc Coating: For tubes thickness upto 6 mm the minimum weight of zinc coating, when determined on a 100 mm long test piece in accordance with IS-4736-1986 shall be 400 gm/m².
 - The weight of the coating expressed in gram/m² shall be calculated by dividing the total weight of the zinc (inside plus outside) by the total area (inside plus outside) of the coated surface.
 - Test specimen for this test shall be cut approximately 100 mm in length from opposite ends of the length of tubes selected for testing. Before cutting the test specimen, 50 mm from both ends of the samples shall be discarded.
- g) Free Bore Test: A rod 230mm long and of appropriate diameter shall be passed through relevant nominal bore of the sample tubes to ensure a free bore.
- h) Uniformity of Galvanized Coating: The galvanized coating when determined on a 100 mm long test piece [see V (a) (iii)] in accordance with IS-2633-1986 (Method for testing uniformity of coating on zinc coated articles) shall with stand 4 one minute dips.

6. WORKMANSHIP:

The tubes shall be cleanly finished and reasonably free from injurious defects. They shall be reasonably straight, free from cracks, surface flaws, laminations, and other defects, both internally and externally. The screw tubes and sockets shall be clean and well-cut. The ends shall be cut cleanly and square with the axis of tube.

7. MARKING:

The medium class of tubes shall be distinguished by Blue colour bands which shall be applied before the tubes leaves the manufacturers' works. Tubes shall be marked with the standard mark.

44 GS Stay Sets (16 mm AND 20 mm)

1. 16MM DIA STAY SETS (GALVANIZED)

The stay sets (Line Guy set) will consist of the following components:-

- a) ANCHOR ROD WITH ONE WASHER AND NUT: Overall length of rod should be 1800 mm to be made out of 16 mm dia GS Rod, one end threaded upto 40mm length with a pitch of 5 threads per cm and provided with one square GS washer of size 40x40x1.6mm and one GS hexagonal nut conforming to IS:1367:1967 & IS:1363:1967. Both washer and nut to suit threaded rod of 16mm dia. The other end of the rod to be made into a round eye having an inner dia of 40mm with best quality welding.
- b) ANCHOR PLATE SIZE 200x200x6MM: To be made out of GS plate of 6mm thickness. The anchor plate should have at its centre 18mm dia hole.
- c) TURN BUCKLE & EYE BOLT WITH 2 NUTS: To be made of 16mm dia GS Rod having an overall length of 450 mm, one end of the rod to be threaded upto 300 mm length with a pitch of 5 threads per cm and provided with two GS Hexagonal nuts of suitable size conforming to IS:1363:1967 & IS:1367:1967. The other end of rod shall be rounded into a circular eye of 40mm inner dia with proper and good quality welding.
- d) BOW WITH WELDED ANGLE: To be made out of 16mm dia GS rod. The finished bow shall have an overall length of 995mm and height of 450 mm, the apex or top of the bow shall be bent at an angle of 10 R. The other end shall be welded with proper and good quality welding to a GS angle 180mm long having a dimension of 50x50x6mm. The angle shall have 3 holes of 18mm dia each.
- e) THIMBLE: To be made on 1.5 mm thick GS sheet into a size of 75x22x40mm and shape as per standard shall be supplied.
- f) Galvanizing: The complete assembly shall be hot dip galvanized.
- g) WELDING: The minimum strength of welding provided on various components of 16mm dia stay sets shall be 3100 kg. Minimum 6 mm fillet weld or its equivalent weld area should be deposited in all positions of the job i.e. at any point of the weld length. The welding shall be conforming to relevant IS: 823/1964 or its latest amendment. Minimum length of weld to be provided at various places in the stay sets shall be indicated by the bidder. Welding if, found short in lengths as per final approved drawings shall be rejected.
- h) THREADING: The threads on the Anchor Rod, Eye Bolt & Nuts shall be as per specification IS: 4218:1967 (ISO Metric Screw Threads). The nuts shall be conforming to the requirement of IS: 1367:1967 & have dimensions as per IS; 163:1967. The mechanical property requirement of fasteners shall conform to property clause 4.6 each for anchor rod & Eye bolt and property clause 4 for nuts as per IS: 1367:1967.

AVERAGE WEIGHT OF FINISHED 16MM STAY SETS 7.702 KG. (MINIMUM) (EXCLUDING NUTS THIMBLES AND WASHERS) 8.445 KG. (MAXIMUM)

2. 20 MM DIA STAYS SETS FOR 33KV LINES (GALVANIZED)

THE STAY SET (LINE GUY SET) WILL CONSIST OF THE FOLLOWING COMPONENTS:

- a) ANCHOR ROD WITH ONE WASHER AND NUT: Overall length of Rod should be 1800mm to be made out of 20mm dia GS Rod, one end threaded upto 40mm length with a pitch of a threads per cm. And provided with one square G.S. Washer of Size 50x50x1.6mm and one GS Hexagonal nut conforming to IS:1367:1967 & IS:1363:1967. Both washer & nut to suit the threaded rod of 20mm. The other end of the rod to be made into a round eye having an inner dia of 40mm with best quality welding. Dimensional and other details are indicated and submitted by bidders for owner's approval before start of manufacturing.
- b) ANCHOR PLATE: Size 300x300x8mm: To be made out of G.S. Plate of 8mm thickness. The anchor plate to have at its centre 22mm dia hole.
- c) TURN BUCKLE, EYE BOLT WITH 2 NUTS: To be made of 20mm dia G.S. Rod having an overall length of 450 mm. One end of the rod to be threaded upto 300mm length with a pitch of 4 threads per cm. The 20mm dia bolt so made shall be provided with two G.S. Hexagonal nuts of suitable size conforming to IS:1637/1967 & IS:1363/1967.

The other end of the rod shall be rounded into a circular eye of 40mm inner dia with proper and good quality of welding. Welding details are to be indicated by the bidder separately for approval.
- d) BOW WITH WELDED CHANNEL: To be made out of 16mm dia G.S. Rod. The finished bow shall have an overall length of 995 mm and height of 450 mm. The apex or top of the bow shall be bent at an angle of 10R. The other end shall be welded with proper and good quality welding to a G.S. Channel 200mm long having a dimension of 100x50x4.7 mm. The Channel shall have 2 holes of 18 mm dia and 22 dia hole at its centre.
- e) THIMBLE 2 Nos.: To be made of 1.5mm thick G.S. sheet into a size of 75x22x40mm and shape as per standard.
- f) GALVANISING: The complete assembly shall be hot dip galvanised.
- g) WELDING: The minimum strength of welding provided on various components of 20mm dia stay sets shall be 4900 kg. Minimum 6mm fillet weld or its equivalent weld area should be deposited in all positions of the job i.e. at any point of the weld length. The welding shall be conforming to relevant IS: 823/1964 or its latest amendment.
- h) THREADING: The threads on the Anchor Rods, Eye Bolts and Nuts shall be as per specification IS: 4218:1967 (ISO Metric Screw Threads). The Nuts shall be conforming to the requirements of IS: 1367:1967 and have dimension as per IS 1363:1967. The mechanical property requirement of fasteners shall conform to the properly clause 4.6 each for anchor rods and Eye bolt and property clause 4 for nuts as per IS: 1367:1967.

AVERAGE WEIGHT OF FINISHED 20MM STAYS SET: 14.523 KG. (MIN.) (EXCLUDING NUTS THIMBLE & WASHER): 15.569 KG. (MAX.)

3. TEST CERTIFICATE: The contractor shall be required to conduct testing of materials at Govt./Recognized testing laboratory during pre – dispatch inspection for Tensile Load of 3100 Kg/4900 Kg. applied for one minute on the welding & maintained for one minute for 16 mm and 20 mm dia stay sets respectively.
4. IDENTIFICATION MARK: All stay sets should carry the identification mark of word DDUGJY and size of the stay set. This should be engraved on the stay plate and on stay rods to ensure proper identification of the materials.

The nuts should be of a size compatible with threaded portion of rods and there should be no play or slippage of nuts.

Welding wherever required should be perfect and should not give way after erection.

5. TOLERANCES: The tolerances for various components of the stay sets are indicated below subject to the condition that the average weight of finished stay sets of 16mm dia excluding nuts, thimbles and washers shall not be less than the weight specified above :-

No. Item	Section Tolerances	Fabrication Tolerances	Material
1 Anchor Plate	6mm thick + 12.5% - 5%	200x200mm + 1%	GS plate 6mm thick
	8mm thick + 12.5% - 5%	300x300mm + 1%	GS plate 8mm thick
2 Anchor Rod	16mm dia + 5%- 3%	Length 1800mm + 0.5%	GS Round 16mm dia
		Rounded Eye 40 mm inside dia + 3%. Threading 40mm+11% - 5	GS Round 16mm dia
	20mm dia + 3%- 2%	Length 1800mm + 0.5%	GS Round 20mm dia
		Round Eye 40mm inside dia + 3%. Threading 40mm +11% -5%	GS Found 20mm dia
3 Turn Buckle Bow	16 mm dia + 5%- 3%	Length 995mm + 1% 16mm dia	GS Round 16mm dia
		Length 180mm + 1% 50x50x6mm	GS Angle
		Channel length 200mm + 1%	GS Channel 100x50x4.7mm
4 Eye Bolt Rod	16mm dia +	Length 450mm + 1%	GS Round

	5%- 3%	Threading 300mm + 1% Round Eye 40mm inside dia + 3%	16mm dia
	20mm dia + 3%- 2%	Length 450mm + 1% Threading 300mm + 1% Round Eye 40mm inside dia + 3%	GS Round 20mm dia

45 GI Stay Wires

1. SCOPE

This Specification covers details of G.I. stranded stay wires for use in rural distribution system.

2. APPLICABLE STANDARDS

Except when they conflict with the specific requirements of this specification, the G.I. Stranded Wires shall comply with the specific requirements of IS:2141-1979. IS:4826-1979 & IS:6594-1974 or the latest versions thereof.

3. APPLICATION AND SIZES

3.1 The G.I. stranded wires covered in this Specification are intended for use on the overhead power line poles, distribution transformer structures etc.

3.2 The G.I. stranded wires shall be of 7/2.5mm, 7/3.15mm and 7/4.0mm standard sizes.

4. MATERIAL

The wires shall be drawn from steel made by the open hearth basic oxygen or electric furnace process and of such quality that when drawn to the size of wire specified and coated with zinc, the finished strand and the individual wires shall be of uniform quality and have the properties and characteristics as specified in this specification. The wires shall not contain sulphur and phosphorus exceeding 0.060% each.

5. TENSILE GRADE

The wires shall be of tensile grade 4, having minimum tensile strength of 700 N/mm² conforming to IS:2141.

6. GENERAL REQUIREMENTS

6.1 The outer wire of strands shall have a right-hand lay.

6.2 The lay length of wire strands shall be 12 to 18 times the strand diameter.

7. MINIMUM BREAKING LOAD

The minimum breaking load of the wires before and after stranding shall be as follows :

No. of wires & const.	Wire dia (mm)	Min. breaking load of Single wire before stranding (KN)	Min. breaking load of the standard wire (KN)
7(6/1)	2.5	3.44	22.86
7(6/1)	3.15	5.45	36.26
7(6/1)	4.0	8.79	58.45

8. CONSTRUCTION

- 8.1 The galvanised stay wire shall be of 7-wire construction. The wires shall be so stranded together that when an evenly distributed pull is applied at the ends of completed strand, each wire shall take an equal share of the pull.
- 8.2 Joints are permitted in the individual wires during stranding but such joints shall not be less than 15 metres apart in the finished strands.
- 8.3 The wire shall be circular and free from scale, irregularities, imperfection, flaws, splits and other defects.

9. TOLERANCES

A tolerance of (\pm)2.5% on the diameter of wires before stranding shall be permitted.

10. SAMPLING CRITERIA

The sampling criteria shall be in accordance with IS:2141.

11. TESTS ON WIRES BEFORE MANUFACTURE

The wires shall be subjected to the following tests in accordance with IS:2141.

- i) Ductility Test
- ii) Tolerance on Wire Diameter

12. TESTS ON COMPLETED STRAND

The completed strand shall be tested for the following tests in accordance with IS:2141.

- a) Tensile and Elongation Test :
The percentage elongation of the stranded wire shall not be less than 6%.
- b) Chemical analysis
- c) Galvanising Test :
The Zinc Coating shall conform to "Heavy Coating" as laid down in IS:4826

13. MARKING

Each coil shall carry a metallic tag, securely attached to the inner part of the coil, bearing the following information:

- a) Manufacturers' name or trade mark
- b) Lot number and coil number
- c) Size
- d) Construction
- e) Tensile Designation
- f) Lay
- g) Coating
- h) Length

- i) Mass
- j) ISI certification mark, if any

14. PACKING

The wires shall be supplied in 75-100 Kg. coils. The packing should be done in accordance with the provisions of IS:6594.

46 MCCB

The MCCBs provided in these boxes shall conform in all respects to the relevant IS: 2516 (Pt-I&II)/1977 or its latest revision as applicable.

REQUIREMENT OF MCCBs:

The moulded case circuit breakers should comprise of a switching mechanism, an effective extinguishing device and a tripping unit contained in a compact moulded case cover made of high strength, heat resistance and flame retardant thermo-insulating materials. They should comprise of a spring assisted quick make/quick break type independent manual trip free mechanism rendering it easy to manually operate the MCCBs and capable of clearly indicating "TRIPPED", "ON" AND "OFF" positions from the position of the operating handle. The contact tips should be made of a suitable alloy having high arc resistance and a long electrical and mechanical life needing no replacement. The breakers should be designed with a common trip bar to break and make all the three phase together even when fault occurs on any of the phases. The breakers should provide protection against sustained overloads and short circuits through thermal-magnetic/fully magnetic releases. These MCCBs along with terminal blocks are intended to be housed in the distribution boxes made out of sheet steel of 2mm gauge. The assembly of the MCCBs and the terminal blocks should be compact, reliable from operation point of view and safe to the operating personnel. As already mentioned earlier, the MCCBs should be fully maintenance free.

TECHNICAL PARTICULARS OF MCCBs:

The LT MCCBs should have inverse current/time characteristics suitable for protection of 63KVA, 100KVA, 200KVA & 315KVA 11.0.4KV Distribution Transformers against sustained over-loads and short circuits for following operating conditions:-

i	Rated Operating Voltage	3 Phase 415 Volts AC 50 cycles with neutral solidly grounded system
ii	Standard rated current ratings for MCCBs to be used with different sizes of transformers will be as follows:-	
a)	For 63KVA 11/0.4KV Dist. Transformer	90 Amps
b)	For 100KVA 11/0.4KV Dist. Transformer	140 Amps
c)	For 200KVA 11/0.4KV Dist. Transformer	300 Amps
d)	For 315KVA 11/0.4KV Dist. Transformer	450 Amps
iii	No. of Poles	3
iv	Duty	Un-interrupted
v	Maximum ambient temperature	47°C in shade
vi	Minimum ambient temperature	4°C in shade
vii	Average altitude	A maximum of 1000 meter
viii	Maximum humidity	Frequently approaches saturation point

TIME/CURRENT CHARACTERISTICS:

The circuit breakers shall have time/current characteristics suitable for following operating conditions :-

Multiple of normal current rating	Tripping time
1.1 times	After 4 hours
1.2 times	Less than 50 minutes
1.3 times	Less than 30 minutes
1.4 times	Less than 10 minutes
2.5 times	Less than 1 minute

6 times	Less than 40 mili-seconds
12 times	Less than 40 mili-seconds

Time/Current characteristic of the Circuit Breaker (MCCB) shall be tested in accordance with Clause-7.7.2.3 (b) (2) of IS:2516-(Pt-I&II) Sec.I/1977 and the test shall be made with all the three phases loaded.

For time/current characteristic, the reference calibration temperature of the MCCBs shall be 40°C and durance, if any, upto 50°C operating temperature in the enclosure shall not exceed 10% of the value indicated above in Clause (I) above.

The MCCBs shall be calibrated and adjusted in the factory itself for the desired time/current characteristic.

The MCCB should have the following maximum resetting time under overload & short circuit conditions :-

- Overload conditions - 3 minutes
- Short Circuit conditions - Instantaneous

RATED SHORT CIRCUIT BREAKING CAPACITY:

The rated short circuit breaking capacity of the MCCBs shall be as follows: -

Transformer rating(KVA)	Rated short circuit breaking capacity of the breaker in Kilo-Amps
63 KVA	A minimum of 3 Kilo-Amps
100 KVA	A minimum of 5 Kilo-Amps
200KVA	A minimum of 10 Kilo-Amps
315KVA	A minimum of 15 Kilo-Amps

The short circuit breaking capacity test as specified above shall be based on short circuit tests carried out at 0.4 Power Factor (lagging). For the purpose of these tests, the following operating sequence shall be followed: -

Break-3 minutes interval-Make-Break-3 minutes interval-Make-Break.

47 H.R.C. Fuse

The H.R.C. fuse links of 100 Amp, 200 Amp, 300 Amp ratings, should be ISI marked & conforming to ISS: 9224-1979 with latest amendment and to be supplied with suitable base of bakelite on DMC. The knife contact should be made of tinned/silver plated copper complete with extension strips. The extension strips should be made of copper. The thickness of the copper strips should be 2mm for 100 Amp and 200 Amp, 3.0mm for 300 Amp. The strips should be in one piece. The HRC Fuse units should also be supplied with suitable lugs for 3 core 95 sq.mm, 120 sqmm and 300 sq.mm. cables for 100, 200 and 300 Amps ratings respectively. The dimension of the lugs should be as under

S.No.	Ratings of HRC Fuse unit	Cable sizes	Minimum thickness of lugs Flat (mm) / Rounded (mm)	Minimum total length of lugs (mm)
1	100 Amp	95 sq.mm	4.2 / 2.1	64
2	200 Amp	120 sq.mm	4.6 / 2.3	73
3	300 Amp	300 sq.mm	7.0 / 3.5	15

The knife contact should have pressure springs to hold the fuse links. The extension strips shall be provided with GI nut & bolts and plain and spring washer to both the end. The DMC or bakelite base should be provided with suitable fixing alignment.

The following test certificates should invariably to be performed on the HRC Fuse Units.

1. Test for temperature rise at rated current
2. Current time characteristics
3. Determination of minimum fusing current and minimum non-fusing current
4. Test for duty

The breaking capacity of HRC Fuse Units should not be less than 80 KA.

The following tests shall be performed during pre-despatch inspection at manufacturer's works: -

1. Insulation resistance test
2. Temperature rise test
3. High Voltage test

Marking on the fuse base and on the fuse links :

1. Name of the manufacturer
2. Rated current
3. Rated voltage
4. ISI marking and reference of 185 No. (only on fuse links)
5. Rated Power loss
6. Name of the Employer

48 Triple Pole Switch Fuse Units with Neutral Links
(200A, 320A & 400A/415 VOLTS RATINGS)

This specification covers manufacture, testing before dispatch and delivery of Triple Pole Switch Fuse Units with neutral Link and HRC cartridge type fuses suitable for AC 3 Phase 4 wire 415 V with neutral solidly grounded system. The working conditions and technical requirements are as under:-

TECHNICAL REQUIREMENTS

- | | | |
|--|---|---|
| a) Rated Current | : | 200 Amps, 320 Amps & 400 Amps |
| b) I) Rated Operational Voltage | : | 3 Phase 4 Wire, 415 Volts AC 50 Hz with solidly earthed neutral |
| II) Highest System Voltage | : | 415V + 10% |
| c) Type of Fuse to be used | : | Non-deteriorating quick arcing type ISI marked HRC Cartridge fuse Links suitable for Class-1 category of duty of IS:13703(Part-I). The temperature rise shall be in accordance with IS:13703 (Part-I) (with latest amendments) over and above the ambient temperature of 45°C. It shall be used for protecting the distribution circuits and distribution transformers and shall be capable of carrying continuously the above stated rated current safely. |
| d) Number of Poles | : | Three |
| e) Neutral Link | : | One |
| f) Duty | : | Un-interrupted duty |
| g) Rated fused short circuit withstands current capacity at 415V | : | 40KA for 1 second. |
| h) Utilization category as | : | AC-23 (B) as defined in IS: 13947 (Pt-III)/ 1993 |

GENERAL

1. CONTACTS AND BLADES & OPERATING MECHANISM

The switch shall be a combination of double break per pole AB switch with HRC fuses in all the three phases. The switch shall be spring assisted, quick make and quick break type having operating mechanism independent of the speed of the operator to minimize the arcing. If required, additional contact springs shall be provided to maintain correct contact pressures throughout operating life of the switches. The switch shall be so constructed that the alignment of its contacts & blades, which will be made of silver plated electrolytic copper/tinned copper, is maintained under asymmetrical fault conditions also. The tenders should furnish in their offers about the details of switching mechanism and the contacts. The switch shall have positive break feature such that it is possible to make it OFF even if the quick action spring fails due to ageing or other causes. The switch fuse unit shall be provided with double break per pole to ensure complete isolation of HRC Fuses from both incoming and outgoing circuits when the switch is in OFF position, in order to minimize the damage to the maintenance

personnel. Ample flash over distances shall be provided so as to make the unit suitable for controlling highly inductive loads.

2. ENCLOSURES

The Triple Pole Switch fuse units shall be totally enclosed in robust enclosures made out of 16 guage/1.5 mm pressed steel sheet (conforming to relevant ISS for M.S. sheet) designed to withstand humid and hot weather conditions. The enclosures should have adequate strength and rigidity to withstand rough usage without fracture or permanent distortion. Suitable mounting arrangement shall be provided on the enclosures for mounting the units on a supporting structure.

3. INTER LOCK

It should not be possible to open the switch cover when the switch is in 'ON' position and also it should not be possible to operate the switch 'ON' when the switch cover is open.

4. PAINTING

The inside and outside of the enclosure should be painted with a grey paint. Before painting the surface, the same should be chemically cleaned for removing rust, grease etc. Then it should be given phosphate coating, followed by two coats of anti-rust primer (i.e. Red zinc Chrome Primer), after which two coats of synthetic paint of light grey colour shall be applied on internal and external surfaces of the enclosures with a spray gun. The enclosures shall then be baked in oven so as to give an elegant and durable finish.

5. EARTHING

The enclosure shall be provided with earthing arrangements at two places.

6. TERMINAL CONNECTIONS

The switch shall be provided with aluminium lugs for termination of PVC coated aluminium cables of following sizes: -

S.No.	Capacity of TPN Switches	Size of Cable	No. of cable sockets required
1	200 Amps	150 sq.mm. 3.5 Core stranded aluminium cable	8 Nos. (3 Nos. phase leads and 1 natural lead for incoming and also 3 Nos. phase leads and 1 neutral for outgoing connections)
2	320 Amps	300 sq.mm. 3.5 Core stranded aluminium cable	-do-
3	400 Amps	300 sq.mm. 3.5 Core stranded aluminium cable	-do-

7. All the surface contacts (e.g. lugs, connectors, fixed contacts, moving contacts etc.) should be fitted with GI nuts & bolts having yellowish OR whitish passivation with good finish.

8. TESTING & TEST CERTIFICATES FOR SWITCHES

The performance of the switch should conform to IS:10027/1981 with latest amendments. Accordingly, certificates from reputed laboratories such as CPRI, ERDA, IITs, for the type tests in accordance with IS:10027/1981 with latest amendment would necessarily be furnished by the tenderers along with offer.

9. USE OF ISI MARK HRC FUSES

The HRC Fuses with ISI mark only should be used. These HRC fuses should conform to IS:13703 (Part-I)/1993 or as per its latest revision. The rated current of HRC fuses must be 200 Amps for 200 Amps Switches, 315 Amps for 320 Amps Switches and 400 Amps for 400 Amps Switches.

10. IMPORTANT NOTE

The firms must consider supply of 'ISI' certificate (valid on date) products on their offer in the tender, Other certification such as ISO:9001 & 9002 shall be given due weightage while considering their offer, however, the attested photo copies of such certification must be enclosed with the offer.

11. INSULATION FOR LIVE PARTS

All live parts shall be fully shielded with bakelite shrouds.

49 Clamps & Connectors

CLAMPS & CONNECTORS: Clamps & connectors shall conform to IS: 5561. The clamps and connectors shall be made of materials listed below:

For connecting ACSR conductors	Aluminium alloy casting, conforming to designation A6 of IS: 617 and shall be tested for all tests as per IS: 617
For connecting equipment terminals made of copper with ACSR conductor	Bimetallic connectors made from aluminium alloy casting conforming to designation A6 of IS:617 with 2mm thick Bimetallic liner and shall be tested as per IS:617
For connecting GS shield wire	Galvanised mild steel
Bolts, Nuts & plain washers	Hot dip galvanised mild steel for sizes M12 and above, and electro-galvanised for sizes below M12
Spring washers for items 'a' to 'c'	Electro-galvanised mild steel suitable for at least service condition 4 as per IS:1573

All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

No current carrying part of a clamp or connector shall be less than 10 mm thick. They shall be designed and manufactured to have minimum contact resistance.

For Bimetallic clamps or connectors, copper alloy liner of minimum 2 mm thickness shall be provided.

Flexible connectors, braids or laminated strips made up of copper/ aluminium for the terminal clamps for equipment shall be suitable for both expansion or through (fixed/ sliding) type connection of IPS Aluminium tube as required. In both the cases the clamp height (top of the mounting pad to center line of the tube) should be same.

Size of the terminal/conductor for which the clamp/connector is suitable shall be embossed/punched (i.e. indelibly marked) on each components of the clamp/ connector, except on the hardware.

Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/ connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.

Clamps and connector shall be designed corona controlled.

Clamps & connectors shall conform to type tests and shall be subjected to routine and acceptance tests on minimum 3 samples per lot as per IS: 5561. Type tests report for all clamps and connectors for temperature rise test, tensile test, shall be furnished by the Contractor.

50 Epoxy Based Protective Paint

1. SCOPE

This specification covers the requirement of self-priming epoxy-based protective paint both for new and old steel structures such as poles, sub-station structures etc.

2. COMPOSITION

The paint shall be epoxy-based with metallic zinc as an essential component. The paint shall be supplied in two components and shall be suitable for a single coat application. It shall have such composition as to satisfy the requirements of this standard. The mixing ratio (base-to-accelerator) shall be specified by the manufacturer.

3. REQUIREMENTS

3.1	Volume Solids	85% (\pm)3%
3.2	Theoretical covering Capacity	6.5 sq. mtrs. per litre at 125 microns dry film thickness
3.3	Weight per 10 litres of mixed paint	14 to 15 Kg. (\pm) 0.3 kg
3.4	Drying time (at 30 OC) dry	Surface : Not more than 4 hours Hard Dry : 16-18 hours Recoating Time: 16-18 hours Curing time : 7 days
3.5	Scratch hardness (with 1.5 kg.load)	No such scratch as to show the base metal
3.6	Finish	Smooth and semi-glossy
3.7	Colour	Ash Grey or Aluminium (as required)
3.8	Dry Film Thickness	The paint shall develop a dry film of minimum 100-125 microns in a single coat(measured by Elcometer)
3.9	Flash point	Not below 40 OC
3.10	Flexibility and adhesion	The paint shall not show damage, detachment or cracking.
3.11	Resistance to humidity	Shall pass 1000 hours (minimum) at 125 microns D.F.T
3.12	Resistance to lubricating oil petroleum, hydrocarbon solvent,petrol and heat	Shall show no sign of permanent injury

4. STORAGE LIFE & POT LIFE

4.1	Storage life	Minimum 6 months from the date of manufacture in original sealed container under normal covered storage conditions
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4.2	Pot life (at 300C)	Not less than 4 hours
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5. DURABILITY

Under severe surface conditions, paint shall protect the substrate at least for 5 years, if it is wire-brushed/power tool cleaned and 7 years for commercially grit-blasted steel sub-strate.

6. SURFACE PREPARATION

If possible, the surface on which the paint has to be applied shall be cleaned by grit blasting, otherwise manual wire brushing or power tool cleaning process may be used as convenient.

7. METHOD OF APPLICATION

Brushing, rollers or spraying.

8. TESTS

The following tests shall be carried out in accordance with the procedure given in the Indian Standard quoted against each, except requirements stipulated in clauses 3.1 and 3.2 which shall be tested in accordance with the procedure indicated in Annexure-II; preparation of painted panels for conducting different tests shall be done as given in Annexure-I.

8.1 Requirement stipulated in clauses 3.3 to 3.12 - IS:101

8.2 Resistance to Salt Spray
 Shall pass 1000 hours (minimum with 200 microns D.F.T.) - IS:2074

8.3 Chemical Resistance
 Shall be resistant to acid/alkaline chemicals or solvents - IS:8662

9. PACKAGE

Unless otherwise specified by the purchaser, the paint shall be normally supplied in 2 litre packs.

Annexure – I

DETAILS OF PREPARATION OF PAINTED PANELS FOR TESTING EPOXY BASED
 PROTECTIVE PAINT (TWO PACKS)

S. N.	Test	Type of Metal	Size in mm	Painting Details	Dry Film Thickness	Method of Application	Duration of air drying before commencement of test	Special Instructions
1	2	3	4	5	6	7	8	9
1	Drying Time	Mild Steel	150x100x1.25	One coat of Epoxy based protective paint	100*	Brush /Spray	-	-
2	Finish	-do -	-do-	-do -	-do -	-do -	48 hours	
3	Colour	-do -	-do -	-do -	-do-	-do -	24 hours	
4	Dry Film Thickness	-do -	-do -	-do-	-do -	-do -	24 hours	-
5	Flexibility and adhesion	Tinned	150x150x0.315	-do -	-do-	-do-	7 days	-
6	Scratch Hardness	-do -	-do -	-do-	-do -	-do -	-do -	-
7	Resistance to Salt Spray	-do -	-do -	-do-	-do -	-do -	-do -	-
7	Protection against corrosion under conditions of condensation	Mild Steel	150x150x1.25	-do -	200*	-do -	7 days	Apply a load of 1.5 Kgs. Instead of 1 kg. As specified in Col.15.1 of
8		- do -	- do -	-do-	125*	- do -	- do -	IS: 101 – 64 -

ANNEXURE-II

Procedure for determining volume solids

1. Scope :
This method is applicable to the determination of the volume non-volatile matter of paint coatings.
2. Significance :
This method is intended to provide a measure of the volume of dry coating obtainable from a given volume of liquid coating. This volume is considered to be the most equitable means of comparing the coverage (square metre of surface covered at a specific film thickness per unit volume) and also for calculating the wet film thickness of the given paint.
3. Apparatus
 - i) Analytical Balance
 - ii) Steel disc : Preferably stainless steel, 60mm dia, and 0.70mm thickness with a small hole 2 to 3mm from the edge. A fine wire such as chromel is attached through the hole and made of the appropriate length for suspending the disc in a liquid.
 - iii) Weight Box
 - iv) Beaker : 1 litre for weighing the disc in liquid.
 - v) Weight per litre cup for determining the specific gravity of the paint material and of the suspending liquid if not known.
 - vi) Oven
4. Procedure
 - i) Dry the disk in an oven at 105⁰C for 10 minutes and cool.
 - ii) Weigh the disk in air, let it be W1 grams.
 - iii) Suspend the disk in water and weigh again. Let it be W2 grams.
 - iv) Calculate the volume of disk 'V' as follows:
$$V = \frac{W1 - W2}{d}$$
where 'd' is the density of the water at room temperature
 - v) Determine the weight of non-volatile content per gram of the liquid coating material by drying a known amount of paint at 105⁰C for 3 hours. Let it be 'W' grams.
 - vi) Determine the specific gravity of the paint to the nearest 0.001 g/ml. by using weight per liter cup. Let it be 'p'.
 - vii) Dip the disk in the paint sample for 10 minutes, and take out the disc and allow the excess coating material to drain off. Blot the coating material off the bottom edge of the disc so that beads or drops do not dry on the bottom edge of the disc.
 - viii) Dry the disc in oven for 3 hours at 105⁰ C and cool.
 - ix) Weigh the coated disc in air. Let it be W3 grams.
 - x) Suspend the coated disc in water and weigh it. Let it be W4 grams.
 - xi) Calculate the volume of the coated disc as follows:

$V_1 = W_3 - W_4/d$, where 'd' is the density of the water at room temperature.

xii) Calculate the volume of the dried coating as follows:

Volume of dried coating (V_d) = $V_1 - V$

xiii) Calculate the volume of the wet coating as follows:

$V_w = W_3 - W_1/W \times P$, where W = grams of non volatile matter in one gram of wet coating

P = Specific gravity of the paint.

xiv) Calculate the percentage volume solids of the paints as follows:

$$= \frac{V_1 - V \times 100}{V_w} \quad \text{or} \quad \frac{V_d \times 100}{V_w}$$

The volume of non volatile matter or the percentage volume solids of a paint is related to the covering capacity and film thickness in the following manner:

a) Theoretical Coverage (m^2/l) = $\frac{\% \text{ volume solids} \times 10}{\text{Dry film thickness (in microns)}}$

b) Wet film thickness (in microns) = $\frac{\text{Dry Film thickness} \times 100}{\text{(in microns)}}$

% volume solids.

- 51 Mid Span Compression Joint and Repair Sleeve
- 1.0 Mid Span Compression Joint
- 1.1 Mid Span Compression Joint shall be used for joining two lengths of conductor. The joint shall have a resistivity less than 75% of the resistivity of equivalent length of conductor. The joint shall not permit slipping off, damage to or failure of the complete conductor or any part thereof at a load less than 95% of the ultimate tensile strength of the conductor.
- 1.2 In ACSR conductors, the joint shall be made of steel and Aluminium for jointing the steel core and Aluminium respectively. The steel sleeve should not crack or fail during compression. The Brinell Hardness of steel sleeve shall not exceed 200. The steel sleeve shall be hot dip galvanised. The Aluminium shall have Aluminium/alloy. Aluminium plugs shall also be provided on the line of demarcation between compression and non compression zone.
- 2.0 Repair Sleeve
- Repair Sleeve of compression type shall be used to repair conductor with not more than two strands broken in the outer layer. The sleeve shall be manufactured from Aluminium and shall have a smooth surface. The repair sleeve shall comprise of two pieces with a provision of seat for sliding of the keeper piece. The edges of the seat as well as the keeper piece shall be so rounded that the conductor strands are not damaged during installation.
- 3.0 Material and Workmanship
- 3.1 All the equipment shall be of the latest proven design and conform to the best modern practices adopted in the power line field. The Supplier shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 11/33 kV transmission line application and will give continued good performance.
- 3.2 The design, manufacturing process and quality control of all the materials shall be such as to achieve requisite factor of safety for maximum working load, highest mobility, elimination of sharp edges and corners, best resistance to corrosion and a good finish.
- 3.3 All ferrous parts shall be hot dip galvanised, after all machining has been completed. Nuts may, however, be tapped (threaded) after galvanising and the threads oiled. Spring washers shall be electro galvanised as per grade 4 of IS-1573-1970. The bolt threads shall be undercut to take care of increase in diameter due to galvanising. Galvanising shall be done in accordance with IS:2629-1985 / IS-1367 (Part-13) and satisfy the tests mentioned in IS-2633-1986. Fasteners shall withstand four dips while spring washers shall withstand three dips. Other galvanised materials shall have a minimum over range coating of Zinc equivalent to 600 gm/sq.m and shall be guaranteed to withstand at least six dips each lasting one minute under the standard Peerce test for galvanising unless otherwise specified.
- 3.4 The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanising shall be of grade Zn.99.95 as per IS:209.
- 3.5 In case of castings, the same shall be free from all internal defects like shrinkage, inclusion, blow holes, cracks etc.

- 3.6 All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum and localised heating phenomenon is averted.
- 3.7 No equipment shall have sharp ends or edges, abrasions or projections and shall not cause any damage to the conductor in any way during erection or during continuous operation which would produce high electrical and mechanical stresses in normal working. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under all service conditions.
- 3.8 Particular care shall be taken during manufacture and subsequent handling to ensure smooth surface free from abrasion or cuts.
- 3.9 The fasteners shall conform to the requirements of IS:6639-1972. All fasteners and clamps shall have corona free locking arrangement to guard against vibration loosening.

4.0 Compression Markings

Die compression areas shall be clearly marked on each equipment designed for continuous die compressions and shall bear the words 'COMPRESS FIRST' 'suitably inscribed on each equipment where the compression begins. If the equipment is designed for intermittent die compressions, it shall bear the identification marks 'COMPRESSION ZONE' and 'NON-COMPRESSION ZONE' distinctly with arrow marks showing the direction of compression and knurling marks showing the end of the zones. The letters, number and other markings on finished equipment shall be distinct and legible.

5.0 Drawings

5.1 The Supplier shall furnish detailed dimensioned drawings of the equipments and all component parts. Each drawing shall be identified by a drawing number and Contract number. All drawings shall be neatly arranged. All drafting and lettering shall be legible. The minimum size of lettering shall be 3 mm. All dimensions and dimensional tolerances shall be mentioned in mm.

5.2 The drawings shall include

- (i) Dimensions and dimensional tolerances
- (ii) Material. Fabrication details including any weld details and any specified finishes and coatings. Regarding material, designations and reference of standards are to be indicated.
- (iii) Catalogue No.
- (iv) Marking
- (v) Weight of assembly
- (vi) Installation instructions
- (vii) Design installation torque for the bolt or cap screw
- (viii) Withstand torque that may be applied to the bolt or cap screw without failure of component parts
- (ix) The compression die number with recommended compression pressure.

(x) All other relevant technical details

5.3 The above drawings shall be submitted in 3 copies with all the details as stated above along with the bid document. After the placement of award. The Contractor shall again submit the drawings in four copies to the Owner for approval. After Owner's approval and successful completion of all type tests, 10 more sets of drawings shall be submitted to Owner for further distribution and field use at Owner's end.

6.0 Tests

6.1 Type Tests

6.1.1 Mid Span Compression Joint for Conductor

- (a) Chemical analysis of materials (as per Annexure – A)
- (b) Electrical resistance test
- (c) Heating cycle test
- (d) Slip strength test

6.1.2 Repair Sleeve for Conductor

- (a) Chemical analysis of materials

6.1.3 Flexible Copper Bond

- (a) Slip Strength Test (as per Annexure – A)

6.2 Acceptance Tests

6.2.1 Mid Span Compression Joint for Conductor and Earthwire

- (a) Visual examination and dimensional verification
- (b) Galvanising test
- (c) Hardness test

6.2.2 Repair Sleeve for Conductor

- (a) Visual examination and dimensional verification

6.2.3 Flexible Copper Bond

- (a) Visual examination and dimensional verification
- (b) Slip strength test

6.3 Routine Tests

- (a) Visual examination and dimensional verification

6.4 Tests During Manufacture

On all components as applicable

- | | | | | | |
|-----|--|---|----|-----|------------|
| (a) | Chemical analysis of Zinc used for galvanising |) | | | |
| | |) | | | |
| (b) | Chemical analysis mechanical metallographic test and magnetic particle inspection for malleable castings |) | As | per | Annexure-A |
| | |) | | | |
| (c) | Chemical analysis, hardness tests and magnetic particle inspection for forgings |) | | | |
| | |) | | | |

7.0 Tests and Standards

7.1 Testing Expenses

7.1.1 Supplier shall indicate the laboratories in which they proposes to conduct the type tests. They shall ensure that adequate facilities for conducting the tests are available in the laboratory and the tests can be completed in these laboratories within the time schedule guaranteed by them in the appropriate schedule.

7.1.2 The Contractor shall intimate the Owner about carrying out of the type tests alongwith detailed testing programme at least 3 weeks in advance of the scheduled date of testing during which the Owner will arrange to depute his representative to be present at the time of carrying out the tests.

8.0 Sample Batch For Type Testing

8.1 The Contractor shall offer material for sample selection for type testing only after getting Quality Assurance Programme approved by the Owner. The Contractor shall offer at least three times the quantity of materials required for conducting all the type tests for sample selection. The sample for type testing will be manufactured strictly in accordance with the Quality Assurance Programme approved by the Owner.

8.2 Before sample selection for type testing the Contractor shall be required to conduct all the acceptance tests successfully in presence of Owner's representative.

9.0 Schedule of Testing and Additional Tests

9.1 The Supplier has to indicate the schedule of following activities

- (a) Submission of drawing for approval.
- (b) Submission of Quality Assurance programme for approval.
- (c) Offering of material for sample selection for type tests.
- (d) Type testing.

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

- 9.3 The Owner also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Contractor's premises or at any other test centre. In case of evidence of non compliance, it shall be binding on the part of Contractor to prove the compliance of the items to the technical specifications by repeat tests, or correction of deficiencies, or replacement of defective items, all without any extra cost to the Owner.
- 10 Test Reports
- 10.1 Copies of type test reports shall be furnished in atleast six copies alongwith one original. One copy shall be returned duly certified by the Owner, only after which the commercial production of the concerned material shall start.
- 10.2 Copies of acceptance test report shall be furnished in atleast six copies. One copy shall be returned, duly certified by the Owner, only after which the materials will be despatched.
- 10.3 Record of routine test report shall be maintained by the Contractor at his works for periodic inspection by the Owner's representative.
- 10.4 Test certificates of tests during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Owner.
- 11.0 Inspection
- 11.1 The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where the material and/or its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Contractor's, sub-Contractor's works raw materials. manufacturer's of all the material and for conducting necessary tests as detailed herein.
- 11.2 The material for final inspection shall be offered by the Contractor only under packed condition. The engineer shall select samples at random from the packed lot for carrying out acceptance tests.
- 11.3 The Contractor shall keep the Owner informed in advance of the time of starting and of the progress of manufacture of material in its various stages so that arrangements could be made for inspection.
- 11.4 Material shall not be despatched from its point of manufacture before it has been satisfactorily inspected and tested unless the inspection is waived off by the Owner in writing. In the latter case also the material shall be despatched only after all tests specified herein have been satisfactorily completed.
- 11.5 The acceptance of any quantity of material shall in no way relieve the Contractor of his responsibility for meeting all the requirements of the Specification, and shall not prevent subsequent rejection, if such material are later found to be defective.
- 12.0 Packing and Marking
- 12.1 All material shall be packed in strong and weather resistant wooden cases/crates. The gross weight of the packing shall not normally exceed 50 Kg to avoid handling problems.
- 12.2 The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.

- 12.3 Suitable cushioning, protective padding, dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.
- 12.4 Bolts, nuts, washers, cotter pins, security clips and split pins etc. shall be packed duly installed and assembled with the respective parts and suitable measures shall be used to prevent their loss.
- 12.5 Each component part shall be legibly and indelibly marked with trade mark of the manufacturer and year of manufacture.
- 12.6 All the packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly despatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate shall have all the markings stencilled on it in indelible ink.
- 13.0 Standards
- 13.1 The Hardware fittings, conductor and earthwire accessories shall conform Indian/International Standards which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the Specification.

ANNEXURE – A

1.0 TESTS ON HARDWARE FITTINGS

1.1 Galvanising/Electroplating Test

The test shall be carried out as per Clause no. 5.9 of IS:2486-(Part-1) - 1972 except that both uniformity of zinc coating and standard preece test shall be carried out and the results obtained shall satisfy the requirements of this specification.

1.2 Mechanical Strength Test of Each Component

Each component shall be subjected to a load equal to the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. The component shall then again be loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified UTS and held for one minute. No fracture should occur. The applied load shall then be increased until the failing load is reached and the value recorded.

1.3 Mechanical Strength Test of Welded Joint

The welded portion of the component shall be subjected to a Load of 2000 kgs for one minute. Thereafter, it shall be subjected to die-penetration/ ultrasonic test. There shall not be any crack at the welded portion.

1.4 Clamp Slip Strength Vs Torque Test for Suspension Clamp

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length of Conductor shall be fixed in the clamp. The clamp slip strength at various tightening torques shall be obtained by gradually applying the load at one end of the conductor. The Clamp slip strength vs torque curve shall be drawn. The clamp slip strength at the recommended tightening torque shall be more than 12.5% but less than 20% of conductor rated strength.

2.0 TESTS ON CONDUCTOR AND EARTHWIRE ACCESSORIES

2.1 Mid Span Compression Joint for Conductor and Earthwire

(a) Slip Strength Test

The fitting compressed on conductor/earthwire shall not be less than one metre in length. The test shall be carried out as per IS:2121 (Part-II)- clause 6.4 except that the load shall be steadily increased to 95% of minimum ultimate tensile strength of conductor/earthwire and retained for one minute at this load. There shall be no movement of the conductor/ earthwire relative to the fittings and no failure of the fittings during this one minute period.

(b) Hardness Test

The Brinell hardness at various points on the steel sleeve of conductor core and of the earthwire compression joint and tension clamp shall be measured.

2.2 Flexible Copper Bond

a) Slip Strength Test

On applying a load of 3 kN between the two ends, stranded flexible copper cable shall not come out of the connecting lugs and none of its strands shall be damaged. After the test, the lugs shall be cut open to ascertain that the gripping of cable has not been affected.

2.3 Chemical Analysis Test

Chemical analysis of the material used for manufacture of items shall be conducted to check the conformity of the same with Technical Specification and approved drawing.

3.0 TESTS ON ALL COMPONENTS (AS APPLICABLE)

3.1 Chemical Analysis of Zinc used for Galvanizing

Samples taken from the zinc ingot shall be chemically analysed as per IS-209. The purity of zinc shall not be less than 99.95%.

3.2 Tests for Forgings

The chemical analysis hardness tests and magnetic particle inspection for forgings, will be as per the internationally recognised procedures for these tests. The, sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Programme.

3.3 Tests on Castings

The chemical analysis, mechanical and metallographic tests and magnetic particle inspection for castings will be as per the internationally recognised procedures for these tests. The samplings will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Pro

52 Terminal Block

All internal wiring to be connected to the external equipment shall terminate on terminal blocks, preferably vertically mounted on the side of cabinet, junction box, terminal box and marshalling box.

The terminal blocks shall be made of moulded, non-inflammable thermosetting plastic. The material of terminal block moulding shall not deteriorate because of varied conditions of heat, cold humidity, dryness etc. that would be anticipated at the location where the equipment is proposed to be installed.

The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CAT-M4.

The conducting part in contact with cable shall be tinned or silver plated. The terminal blocks shall be of extensible design. The terminal blocks shall be of 1100 V grade and shall be rated to carry continuously the maximum current that is expected to be carried by the terminals.

The terminal blocks shall be fully enclosed with removable covers of transparent, non-deterioration type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

The terminals shall be provided with the marking tags for wiring identification.

The blocks shall be provided with 20% spare terminals unless otherwise specified. Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT/VT Minimum of two 2.5 sq.mm copper flexible

All CT/VT circuits Minimum of 4 nos. of 2.5 sq.mm copper flexible

AC/DC Power supply circuit One of 16 sq. mm. Aluminium.

There shall be a minimum clearance of 250 mm between the first row of terminal block and the cable gland plate or side of the box. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. Cabinet wiring should be suitable for 60°C as the space heaters will keep the temperature 10°C higher than the ambient.

For the Control and Relay Panels the terminal blocks for current transformer and voltage transformer secondary lead shall be provided with test links and isolating facilities. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.

53 Wiring

All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows:

1. All circuits except CT circuits 2.5 sq.mm
2. CT circuits 2.5 sq. mm (minimum number of strands shall be 3 per conductor).

All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.

Wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires shall not fall off when the wires and shall not fall off when the wire is disconnected from terminal blocks.

All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrules purposes.

All terminals including spare terminals of auxiliary equipment shall be wired upto terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be wired out. Inter-pole cabling for all equipment's shall be carried out by the Contractor.

54 Equipment Erection Notes

All support insulators, circuit breaker and other fragile equipment shall preferably be handled with cranes with suitable booms and handling capacity.

The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc.

For cleaning the inside and outside of Hollow insulators only muslin or leather cloth shall be used.

Handling equipment, sling ropes etc. should be tested before erection and periodically for strength.

Bending of compressed air piping 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, and only a proper pipe cutting tool shall be used. Hack-saw shall not be used.

The Contractor shall arrange at site all the equipments, instruments and auxiliaries required for testing and commissioning of equipment.

STORAGE OF EQUIPMENTS

The Contractor shall provide and construct adequate storage shed for proper storage of equipments. Weather sensitive equipment shall be stored indoor. All equipments during storage shall be protected against damage due to acts of nature or accidents. The storage instruction of the equipment manufacturer/Owner shall be strictly adhered to.

55 Danger Notice Plates

1. SCOPE

This Specification covers Danger Notice Plates to be displayed in accordance with rule No. 35 of Indian Electricity Rules, 2003.

2. APPLICABLE STANDARDS

Unless otherwise modified in this specification, the Danger Notice Plates shall comply with IS:2551-1982 or the latest version thereof.

3. DIMENSIONS

3.1 Two sizes of Danger Notice Plates as follows are recommended:

- a) For display at 415 V installations - 200x150mm
- b) For display at 11 KV (or higher voltages) installations - 250x200mm

3.2 The corners of the plate shall be rounded off.

3.3 The location of fixing holes as shown in Figs. 1 to 4 is provisional and can be modified to suit the requirements of the purchaser.

4. LETTERINGS

All letterings shall be centrally spaced. The dimensions of the letters, figures and their respective position shall be as shown in figs. 1 to 4. The size of letters in the words in each language and spacing between them shall be so chosen that these are uniformly written in the space earmarked for them.

5. LANGUAGES

5.1 Under Rule No. 35 of Indian Electricity Rules, 2003, the owner of every medium, high and extra high voltage installation is required to affix permanently in a conspicuous position a danger notice in Hindi or English and, in addition, in the local language, with the sign of skull and bones.

5.2 The type and size of lettering to be done in Hindi is indicated in the specimen danger notice plates shown in Fig. 2 and 4 and those in English are shown in Figs. 1 and 3.

5.3 Adequate space has been provided in the specimen danger notice plates for having the letterings in local language for the equivalent of 'Danger', '415', '11000' and 'Volts'.

6. MATERIAL AND FINISH

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

7. TESTS

The following tests shall be carried out :

- i) Visual examination as per IS:2551-1982
- ii) Dimensional check as per IS:2551-1982
- iii) Test for weather proofness as per IS:8709-1977 (or its latest version)

8. MARKING

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

9. PACKING

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

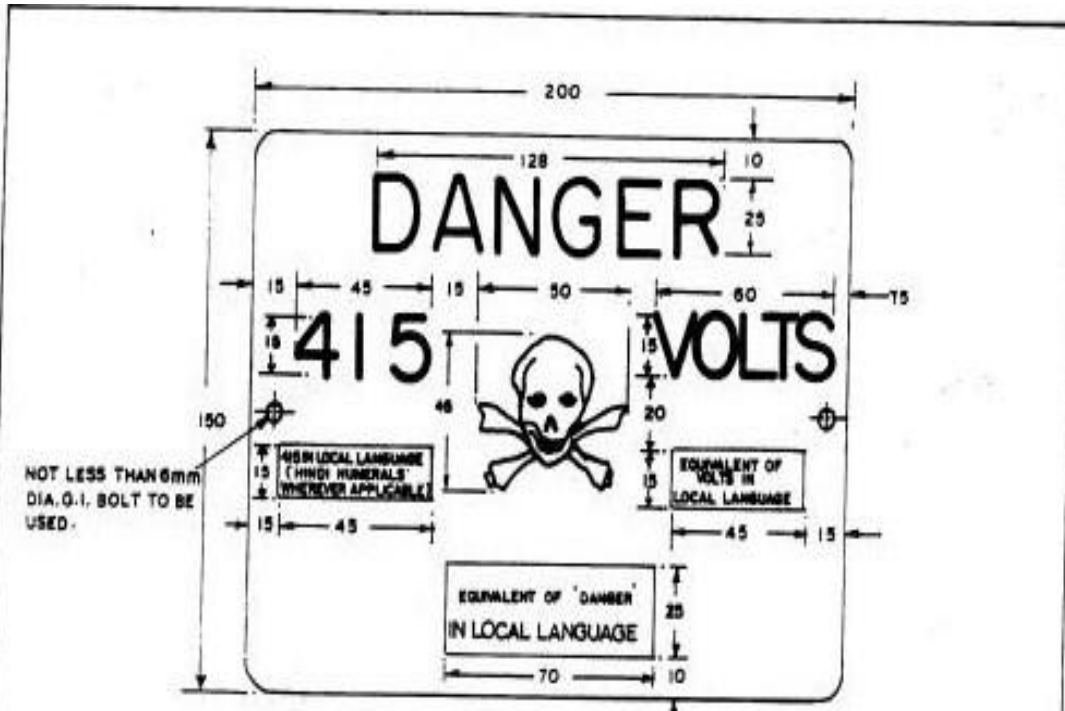


FIG:- 1

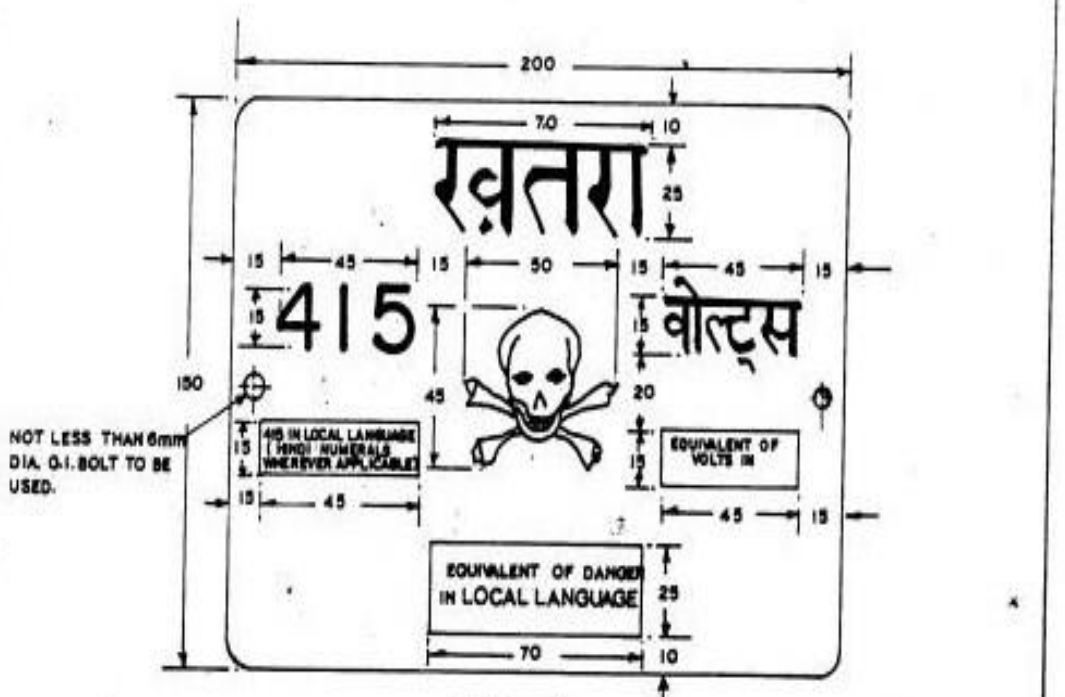


FIG. - 2

ALL DIMENSIONS ARE IN MM.

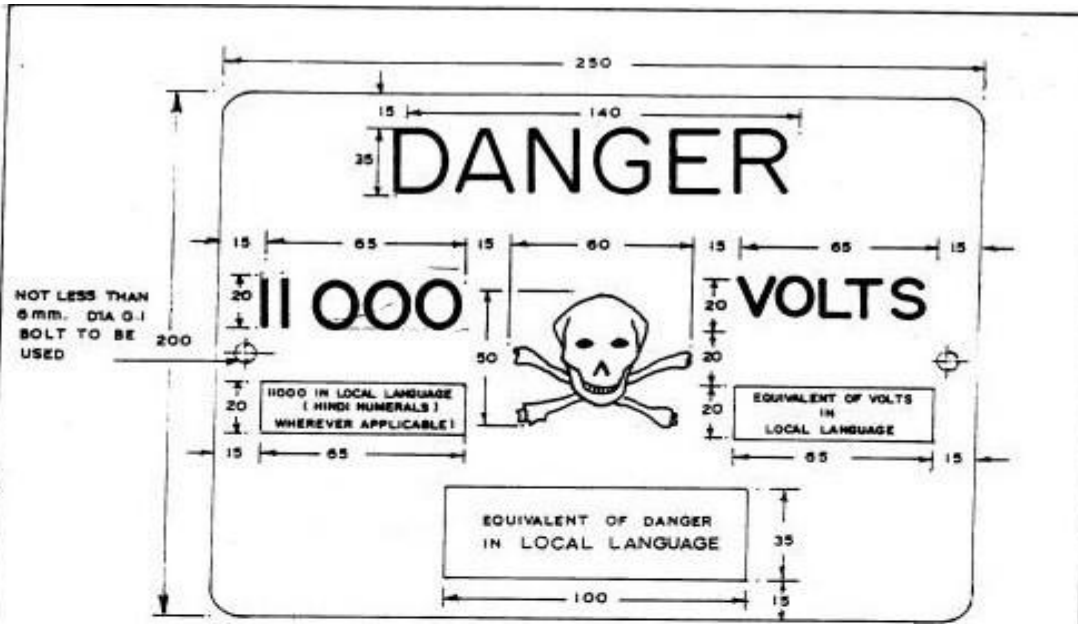


FIG:- 3

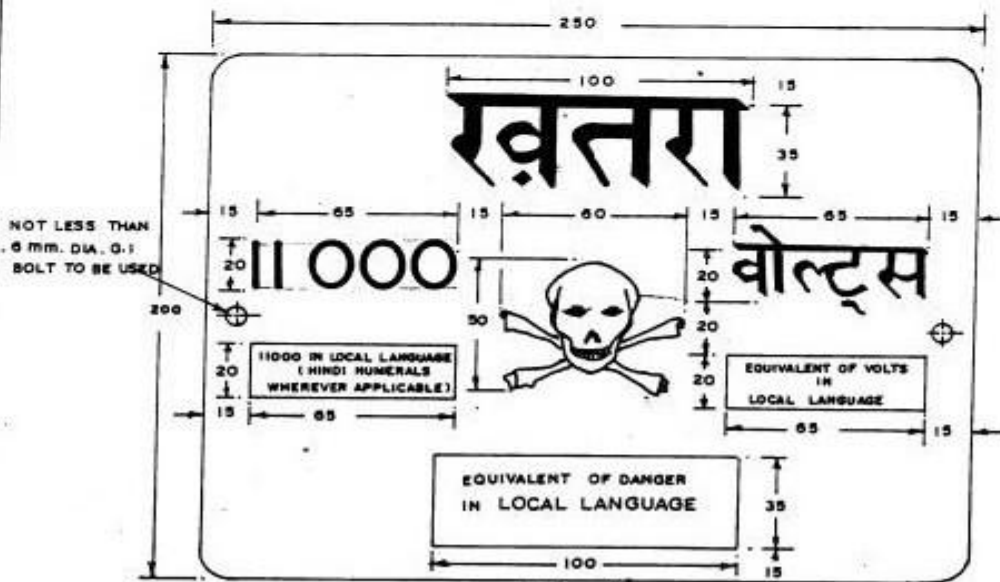


FIG:-4

NOTE: 11000 SHALL BE REPLACED BY 33000, 66000 ETC. AS REQUIRED.

ALL DIMENSIONS ARE IN MM.

56 Number Plate (Support)

Weather proof number plate shall have unique name are to be installed on the pole support. The plate shall be made from mild steel sheet of at least 1.6mm thick and vitreous enameled white, with letters in signal red color (refer IS: 5-1978) on the front side. The rear side of the plate shall also be enameled. The digits shall be as under:

110121

000001

226

Digits shall be displayed as detailed above having at-least 25mm height. The over all size of the plate shall be 200x250mmx1.6mm. The corners of the plate shall be rounded off. All lettering shall be centrally spaced. The dimensions of the letters, figures and their respective position shall be as shown above. The size of digits and spacing between them shall be so chosen that these are uniformly written in the space earmarked for them. The type and size of digits to be written in English as indicated above. The plate should be provided with 6mm dia holes in horizontal alignment for fixing to the pole by means of Galvanized MS flat clamp of 25x3 mm size. The nut & bolts used for fixing of plate should be of galvanized and washers of electro-plated. The bolt should be used of at-least 6mm diameter.

TESTS: The following tests shall be carried out:

- i) Visual examination as per IS:2551-1982
- ii) Dimensional check as per IS:2551-1982
- iii) Test for weather proof-ness as per IS 8709-1977 (or its latest version).

Numbering Transformer/ Feeders/ Equipments (in Grid Sub-Station):

All augmented/ new power transformer, Breakers, Outgoing feeders, respective control panels, Kiosks are to be named. Base should be painted with yellow paint and black digits should be displayed of at-least 25mm height. Experienced painter should be used to provide this work. LT and HT bushing should be colour coded, CT and PT panels are to be named. The Yellow base plate should be encircled by a black strip. Naming shall be in the local as well as English language.

Numbering of control panel:

Name of Feeder should be displayed on front end and at rear end along with serial number of the panel. Yellow base paint and 25mm high black digits are to be used for this purpose. The base paint should be encircled by a black strip. Naming shall be in the local as well as English language.

57 Cable Glands and Lugs

Cable glands shall be Double compression type, tinned/Nickel plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and of tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.

The cable glands shall be tested as per BS: 6121. The cable glands shall also be duly tested for dust proof and weather proof termination.

Cables lugs shall be tinned copper solder less crimping type conforming to IS: 8309 and 8394 suitable for aluminum or copper conductor (as applicable). The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

58 Cables Tags and Markers

Each cable and conduit run shall be tagged with numbers that appear in the cables and conduit schedule.

The tag shall be of aluminum with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI 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 Joint".

The marker shall project 150 mm above ground and shall be spaced at analysis interval 30 meters and at every change in direction. They shall also 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 and on each duct/ conduit entry. Cable tags shall be provided inside the switchgear, motor control centers, control and relay panels, etc., wherever required for cable identification, such as where a number of cables enter together through a gland plate.

The price of cable tags and markers shall be included in the installation rates for cables/ conduits quoted by the contractor.

Specific requirements for cabling for cabling, wiring, ferrules as covered in respective equipment section shall also be complied with.

CABLE GLANDS

Double compression type cable glands shall be provided by the Contractor for all power and control cables to provide dust and weather proof termination. Required number of packing glands to close unused openings in gland plates shall also be provided.

CABLE LUGS

Solderless crimping of terminals shall be done by using corrosion inhibitory compound. The cable lugs shall suit the type of terminals provided. Crimping tool used shall be of approved design and make.

Storage and handling of cable drums

Cable drums shall be unloaded, handled and stored in an approved manner. Rolling of drums shall be avoided as far as practicable. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication the drums may be rolled in the same direction it was rolled during taking up the cables.

CABLE SUPPORTS AND CABLE TRAY MOUNTING ARRANGEMENTS

Cable trenches in the control room are normally provided with embedded steel inserts on concrete floors/ walls. The Contractor shall secure supports by welding to these inserts or available building steel structures.

Insert plates will be provided at an interval of 600 mm wherever cables are to be supported without the use of cable trays, while at all other places these will be at an interval of 2000 mm.

CABLE TERMINATIONS 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.

The equipment will be generally provided with un-drilled 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.

The Contractor shall tag/ferrule the 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.

Control cables shall have stranded copper conductor. Bare portion of the solid conductors shall be tinned after removing the insulation and shall be terminated directly without using cable lugs.

All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.

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 with the approval of the Owner.

DIRECTLY BURIED CABLES

The Contractor shall construct the cable trenches required for directly buried cables. The scope of work and unit rates for construction of cable trenches for cables shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or concrete protective cover, back filling and reaming, supply and installation of route markers and joint markers. The Contractor/Supplier shall ascertain the soil conditions prevailing at site, before quoting the unit rates. Laying the cable and providing protective covering shall be as per approved drawing.

Installation of cables

Power and control cables shall be laid in separate tiers. The order of laying of various cables shall be as follows:

- Power cables on top tiers.
- Control, instrumentation and other service cables in bottom tiers.

Single core cable in trefoil formation shall be laid with a distance of three times the diameter of cables between trefoil center lines. All power cables 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. Trefoil clamps for single core cables shall be pressure die-cast aluminum (LM-6). Nylon-6 or fiber glass and shall include necessary fixing nuts, bolts, washer, etc. These are required at every 2 meter of cable run. Vertical and inclined cable runs shall be secured with 25 mm wide and 2 mm thick aluminum strip clamps at every 2 m. Horizontal runs in cable trays and trenches shall be secured using 4 mm nylon cord at every 2 m.

Cables shall not be bent below the minimum permissible limit. The minimum bending radius of power cables shall be 12D and that of control cables shall be 10D, where D is overall diameter of cable.

Where cables cross roads, drains and rail tracks, the cables shall be laid in reinforced spun concrete or steel pipes, buried at not less than one meter depth.

In each cable run some extra length shall be kept at a suitable point to enable one (for LT Cables) or two (for H.T. cables) straight through joints to be made, should 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.

Control cable terminations inside equipment enclosures shall have sufficient lengths so that switching 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.

Rollers shall be used at intervals of about 2.0 meters, while pulling cables.

All due care shall be taken during unreeling, laying and termination of cable to avoid damage due to twist, kink, sharp bends, etc.

Cable ends shall be kept sealed to prevent damage.

Inspection on receipt, unloading and handling of cables shall generally be in accordance with IS:1255 and other Indian Standard codes or practices.

Wherever cables pass through floor or through wall openings or other partitions, wall sleeves with bushes having a smooth curved internal surface so as not to damage the cables shall be supplied, installed and properly sealed at no extra charges.

The erection work shall be carried out in a neat workmanlike manner and the areas of work shall be cleaned of all scrap materials after the completion of work in each area every day. 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, such as cable numbers and a date on which laid, actual length and route, testing carried out, terminations carried out, along with the marked up copy of the cable schedule and interconnection drawing wherever the modifications are made.

In case the outer sheath of a cable is damaged during handling/ installation, the Contractor shall repair it at his own cost, and to the satisfaction of the Engineer-in- Charge. In case any other part of a cable is damaged, the same shall be replaced by a healthy cable, at no extra cost i.e. the Contractor shall not be paid for supply, 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 type, sleeve or paint.

59 Earth Knobs for LT Lines

1. SCOPE

This standard covers the requirements of knobs for supporting the neutral-cum-earth wire used for earthing of metal parts of supporting structures of overhead power lines with a nominal voltage upto 1000V (refer Construction Standard B-3 & B-4).

2. APPLICABLE STANDARDS

Except when they conflict with the specific requirements of this specification, the earth knobs shall conform to the latest version of IS:9511-1980.

3. MATERIALS

Earth knobs shall be made of cast iron.

4. GENERAL REQUIREMENTS

Earth knobs shall not have blow holes, shrinkage and other casting defects. The top and bottom flat portion of earth knob shall be smooth and plain.

5. SHAPE AND DIMENSIONS

The shape and dimensions of earth knob shall conform to Fig. 1.

6. ACCEPTANCE TESTS

The following acceptance tests shall be carried out atleast on one knob for every 1000 nos.

6.1 Electrical Resistance

6.1.1 The electrical resistance of the earth knob shall be measured using a Kelvin bridge. Adequate electrical contact shall be ensured against the two surfaces of the knob preferably by using brass washers, soldered to the leads going to the bridge circuit. The washers shall be of adequate size to ensure sufficient area of contact.

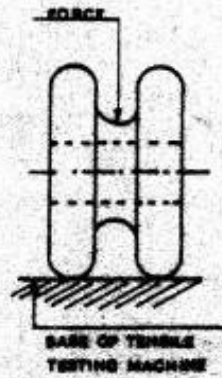
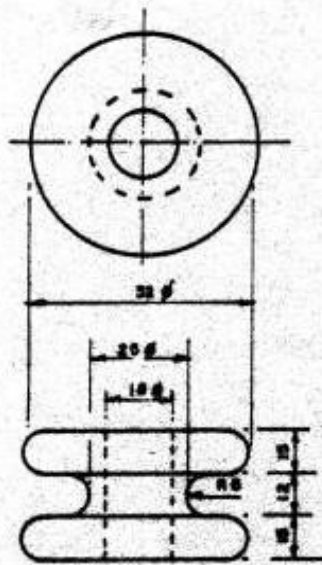
6.1.2 The electrical resistance of the earth knob, measured as given in 6.1.1 between the two flat portions, shall not exceed 200 m ohms.

6.2 Mechanical Strength

The breaking strength at the neck of the earth knob shall not be less than 11,500 kg. when force is applied in the direction shown in Fig. 2.

7. MARKING

Each earth knob shall be marked with the name of the manufacturer or his trade mark.



एल. टी. लाइनों के लिए अर्थनब
EARTH KNOB FOR LT. LINES

60 GI Wires

1. SCOPE

This specification covers details of solid G.I. Wires for use in rural distribution system.

2. APPLICABLE STANDARDS

Except when they conflict with the specific requirements of this specification, the G.I. wires shall comply with the provisions of IS:280-1978 and IS:7887-1975 or the latest version thereof.

3. APPLICATION & SIZES

G.I. wires covered in this Specification are intended for the following applications :

Application	Sizes (nominal dia)
Bearer wire for service	3.15mm (for single phase cables services) 4 mm (for three phase services)
Earthing of Transformers, poles & Fittings.	4 mm
Continuous Earthwire for. 11 KV lines	4 mm
Protective guarding at the crossing of over-head power lines with roads, railway tracts and telecommunication lines	3.15, 4 and 5 mm

4. MATERIAL

- 4.1 The wires shall be drawn from the wire rods conforming to IS:7887-1975 or the latest version thereof.
- 4.2 The requirements for chemical composition for the wires shall conform to IS:7887.
- 4.3 The wires shall be sound, free from split surface flaws, rough jagged and imperfect edges and other detrimental defects on the surface of the wires.

5. GALVANISING

The wires shall be galvanised with 'Heavy Coating' as per IS:4826-1979 or the latest version thereof.

6. GRADES

GI wires shall be classified into two grades based on their tensile strength :

Grade	Tensile Strength (MPa)
Annealed	300-550
Hard	550-900

7. TOLERANCE IN DIAMETER

The tolerance on nominal diameter at any section of wire shall not exceed (\pm)2.5%. Further, the maximum difference between the diameters at any two cross-sections of wires shall not exceed 2.5%.

8. TESTS

The following tests shall be carried out in accordance with IS:280-1978 or the latest version thereof as per sampling criteria stipulated therein :

- i) Dimensional check (dia) - refer clause 7 above.
- ii) Visual inspection regarding freedom from defects refer clause 4.3 above.
- iii) Tensile test
- iv) Wrapping test (for wire diameters smaller than 5mm)
- v) Bend test (for wire diameters 5mm only)
- vi) Coating test - refer clause 5 above
- vii) Chemical composition

9. PACKING

The wires shall be supplied in 50-70 kg. coils, each coil having single continuous length. Each coil of wire shall be suitably bound and fastened compactly and shall be protected by suitable wrapping.

10. MARKING

Each coil shall be provided with a label fixed firmly on the inner part of the coil bearing the following information :

- a) Manufacturer's name or trade mark
- b) Lot number and coil number
- c) Size
- d) Grade (Annealed or Hard)
- e) Mass
- f) Length
- g) ISI Certification mark, if any

61 Hot Dip Galvanised GS Solid Wire
 The hot dip galvanized MS Solid wire of sizes 5 mm, 4 mm and 3.15 mm diameters shall conform to the relevant ISS specification, briefed here below: -

1) MATERIAL

The Mild Steel wire shall have the chemical composition maximum sulfur - .055%, Phosphorus – 0.055%, Carbon 0.25%. Zinc shall conform to grade Zen 98 specified in IS 209-1966 & IS: 4826-1979 with up to date amendments.

2) ZINC COATING

Zinc coating shall be in accordance with IS: 4826-1979 (Col.4.2.1) for heavily coated hard quality.

3) GALVANISING

Galvanizing shall be as per IS 2629-1966, IS: 4826-1979 with up to date amendments.

4) UNIFORMITY OF ZINC COATING

Uniformity of Zinc coating shall be as per IS 2633-1972 (Col.4.2.1 to 4.2.3) with up to date amendments.

5) TENSILE PROPERTIES

The tensile strength of the wire after, galvanizing shall be between 55-95 Kg/Sq.mm (heavily coated Hard as per IS: 4826-1979 Tables-1) ensuring MS wire Mechanical properties as per IS-28-1972 8.1 to 8.3.

6) FREEDOM FROM DEFECTS

As per IS 2629-1966 (Cl.6.1) & 4826-1979 (Col.4.3) & with up to date amendments, be ensured.

7) TESTS

During the process of manufacture/ fabrication and finish all tests for chemical, mechanical, galvanizing as per IS-280-1979, IS: 1521-1972, IS1755-1961, IS: 6745-1972 & 4826-1979 be carried out. Test certificate towards, chemical composition (as per above) shall be submitted for each lot offered for inspection.

The following tests shall be conducted in presence of owner's representative.

1. Visual Physical inspection and measurement of specified dimensions.
2. Coating test as per IS-1755-1961, IS: 2629-1966, IS: 2633-1972, IS: 4826-1969 & 1979 – IS: 6745-1972.
3. Adhesion test as per IS: 1755-1961, IS: 2629-1966, IS: 2633-1972, IS: 4826-1969 & 1979 – IS: 6745-1972.
4. Tensile strength and breaking load and elongation determined as per IS 1521-1972 with up to date amendments.

8) PACKING

Packing shall be as per IS 280-1979 (Col.3.1) and each coil shall be between 50-100 Kg.

9) MARKING

As per IS: 280-1972 (Col.14.1 & 14.1.1) is required.

- 62 Material Properties and Other Technical Requirements for Heat Shrinkable Cable Terminations and Joints Suitable for XLPE Cables.
- 1) GENERAL: The term heat shrink refers to extruded or moulded polymeric materials which are cross linked to develop elastic memory and supplied in expanded or deformed size or shape.
 - 2) QUALIFYING EXPERIENCE: The kits should have satisfactory performance record in India in excess of 5 years supported with proof of customers having had satisfactory use of these kits in excess of 5 years.
 - 3) TYPE TEST REPORTS: The Joints and terminations should have been type tested and type test reports made available.
 - 4) KITS CONTENTS : The Kits should generally consist of:
 - (a) Heat shrinkable clear insulating tubes
 - (b) stress control tubing where necessary,
 - (c) Ferrule insulating tubing for joints,
 - (d) Conductive cable break outs for terminations, non tracking, erosion and weather resistant tubing both outer / inner
 - (e) non tracking erosions and weather resistant outdoor sheds in case of terminations
 - (f) high permittivity mastic wedge
 - (g) Insulating mastic.
 - (h) Aluminium crimping lugs of ISI specification.
 - (i) Tinned copper braids
 - (j) Wrap around mechanical protection for joints.
 - (k) Cleaning solvents, abrasive strips.
 - (l) Plumbing metal.
 - (m) Binding wire etc. adequate in quantity and dimensions to meet the service and test conditions.

The kit shall have installation instructions and shall be properly packed with shelf life of over 3 years.

63 4-in-1 & 6-in-1 DEEP DRAWN METAL METER BOX WITH MULTIPLE OUTGOING CONNECTOR (MOC) FOR SINGLE PHASE ENERGY METERS**1. SCOPE**

This specification covers the design, manufacture, testing, pre-dispatch inspection by purchaser and supply of outdoor type MS sheet, Deep Drawn Metal Meter Box from the manufacturers having satisfactory performance with Power Utilities in last 5 years. Metal Meter box shall be used for housing 4Nos. & 6Nos. single phase energy meters respectively of any make for electric connections of General categories.

2. CONSTRUCTIONAL AND TECHNICAL PARTICULARS:

- 2.1 Metal Meter Box (MMB) shall be corrosion free. It should be suitable for housing four single phase energy meters of any make. The MMB shall conform to attached drawings. The overall dimensions of MMB shall be 560x425x140mm (i.e. height x width x depth) for 4-in-1 Meter Box and 920x425x140mm (i.e. height x width x depth) for 6-in-1 Meter Box.
- 2.2 The Metal Meter Box (MMB) shall be made from 18 SWG CRCA MS sheet by Deepdrawn method. The base and cover of the MMB shall be individually in one piece without any welding joint. The fixing of the accessories like hinges, clamps, handle etc. shall be spot-welded. The cover of MMB shall be fixed with three tamper proof hinges welded inside and not visible from outside. The hinge pin diameter shall be 3mm. Hinges shall be made from 1.6mm MS sheet. The pins of hinges shall have head on top so that it does not fall down after wear & tear. The door of MMB shall open from right to left by a minimum of 90°. The collar of the door (cover) in closed position shall rest on the collar of the body (base) of MMB. The collar of the door shall overlap the collar of the body of MMB by 8mm. The collar of the body shall be provided with good quality rubber gasket lining of minimum 4mm thickness. Thickness of rubber lining shall be such that it provides proper sealing between the cover & base of MMB to avoid penetration of dust & ingress of water. Rubber lining should be fixed with good quality adhesive so that the same does not get removed on opening of the door. Three numbers 'U' shaped latch arrangement shall be provided to Seal the cover with base as shown in drawing. 2mm & 8mm diameter hole shall be provided in U-shaped latch for sealing wires & padlock. Holes provided for sealing & padlock should be aligned when latch is in closed position. Strips of U-latch shall be welded from inner side of the box. Complete U-latch arrangement shall be made from sheet thickness of 1.6mm and stainless steel rivet.
- 2.3 Viewing window openings of the size 90x100mm as indicated in the drawing shall be provided to facilitate taking of meter readings. Each Viewing window shall be provided with toughened glass of 5mm thickness. Glass shall have scratchproof logo on the right side top corner of the glass. Each glass shall be fixed inside the cover of MMB, with powder coated single piece drawn metal frame (Glass Holder) made of 20 SWG MS sheet fixed with min. four welded screws & nuts. The glass holder screws & nuts shall be inside the cover so that it cannot be opened from outside. Glass holder shall have rectangular cuttings as per details shown in drawing. The size of toughened glass shall be 110mm x 120mm so as to provide overlap of 10mm. The glass has to be fitted with a wrap around good quality rubber ring without joint having minimum depth of 8mm, so that it can with stand weather effect.
- 2.4 A handle of minimum 75mm length, 10mm width and 20 SWG sheet thickness should be provided for opening and closing of the cover at the place as shown in the drawing.
- 2.5 There shall be independent mounting arrangement for each meter as shown in the drawing. The meter mounting arrangement shall consist of two slotted strips & hanger bracket welded on the base of box as shown in drawing. The meter mounting arrangement should be raised from the base of Metal Meter Box (MMB) body by 15mm. Zinc plated adjustable strip shall be provided on meter mounting arrangement for fixing of the meters. Hanger bracket shall be provided with a screw of M4 threads and adjustable strip shall be provided with two nuts of M4 threads and 25mm long screws for fixing of the meters.
- 2.6 Four Nos. pole-mounting holes of 10mm diameter at the back of Metal Meter Box (MMB) shall be provided to fix the MMB on Poles. For fixing of MMB on poles, suitable clamps complete with nut, bolts & washers shall be provided with each box. For mounting of MMB on poles, 2 Nos. zinc plated / powder

- coated clamping strips shall be provided to fix the MMB with pole. Nuts & bolts shall be properly zinc plated.
- 2.7 Louvers for ventilation shall be provided on the sidewalls of the box as shown in drawing. 20SWG perforated sheet shall be welded from inside of the louvers suitable for IP-33 protection class.
- 2.8 Two holes for incoming cable (For Loop in and Loop out) shall be provided as shown in drawing. For outgoing cables 4Nos. holes for 4-in-1 Meter Box and 6Nos. holes for 6-in-1 Meter Box shall be provided as shown in the drawing. Cable holes shall be provided with superior quality rubber / plastic cable glands. Internal diameter of incoming gland shall be 30mm (minimum), and for outgoing gland shall be 20mm. Glands shall be made such that internal diameter of glands provided for cables should be closed with the film of minimum 1mm thickness. Cable will go through the cable glands by cutting the film of the glands.
- 2.9 Multiple Outgoing Connectors (MOC) for Phase and Neutral shall be provided at the top of the MMB as indicated in drawing. The Multiple Outgoing Connectors (MOC) shall be rated for minimum 300 Amp and 1100 Volts. Current carrying parts of MOC shall be protected & enclosed in a fire resistant insulated casing. The insulation shall be made of suitable material capable of durably withstanding the mechanical, electrical and thermal stresses to which it may be subjected in service. MOC shall be provided with the holes for incoming & outgoing cables. MOC shall be such that the external conductors inserted in the holes of MOC shall be connected by means of 2 Nos. screws which ensure that the necessary contact pressure corresponding to the current rating of MOC is maintained. Current carrying parts of Multiple Outgoing Connector including screws shall be at a safe distance from the outer edge of the insulation and shall not be accessible by hand / finger. Multiple Outgoing Connectors (MOC) used for Phase and Neutral shall have provision for fixing of one Nos. main incoming & one Nos. main outgoing cable and 4 Nos. outgoing for 4-in-1 and 6Nos. outgoing for 6-in-1 Meter Box. MOC shall be suitable for size of outgoing cable up to 10mm² and main incoming & main outgoing cable up to 25mm². Multiple Outgoing Connectors (MOC) shall be provided in Red color for Phase and black color for neutral. The Multiple Outgoing Connectors (MOC) shall be raised from the back side by minimum 25mm.
- 2.10 MMB shall be adequately protected against rust, water and corrosion both from inside and outside. The MMB shall be powder coated with Light Admiralty Grey colour (as per IS-5:1993 Colour No. 697).
- 2.11 Powder Coating: The surface of the MMB shall be properly pre-treated and cleaned in 7 tank process and shall be applied with a powder coating of 40 micron thickness on outer side and inside. The facility for 7-Tank Phosphating & powder coating shall be in house of the tenderer / manufacturer to ensure proper quality since these boxes are for outdoor applications.
- 2.12 Two earthing bolts of diameter 8mm and 25mm long shall be welded from inside of the box and shall be provided with 2 nuts & washer. Earth marking shall be duly embossed near the earth bolts. There shall be no powder coating on the earthing bolts.
- 2.13 All the screws, nuts and washers shall be properly zinc plated.
- 2.14 The tolerance permissible on the overall dimension of the Metal Meter Box (MMB) shall be (\pm) 3.5% and permissible tolerance on weight shall be -2%. Any weight on positive side will be acceptable. However, the tolerance for the fittings shall be (\pm) 3%. In case of an order, the actual weight of sample shall be mentioned for supplies.
- 2.15 Danger Marking shall be provided on the box in red colour.
- 2.16 Utility name and manufacturer name shall be provided on the door of meter box.
3. The box shall comply with the requirement of IP33. The box shall be fully type tested along with dimensions, as per the requirement of IS 13947 (Part-1):1993. The type test shall be carried out from the govt.-approved laboratories & shall be submitted along with the tender failing which Part-III of tender (Price Bid) of the firm shall not be opened. Government approved laboratories should be accredited by the National Board of Testing & Calibration Laboratories (NABL) of Govt. of India. The type test report shall not be older than 3 years.

4. **INSPECTION:**
The manufacturer / supplier shall give minimum 14 days advance notice about the readiness of material at his works. Representative of the Power Utility will inspect the material for conformity with specification before the same is accepted.
5. **TESTS:**
Following tests shall be performed on the box during inspection:
 - 5.1 **Visual Examination: -**

The MMB shall be inspected visually, externally and internally for proper Powder Coating layer, fitting of all the components in accordance with technical Specification.
 - 5.2 **Verification of dimensions: -**

Verification of dimensions, external / internal clearances will be carried out as per technical specifications.
 - 5.3 **Verification of fittings: -**

Components like insulated Multiple Outgoing Connectors, screws etc will be verified as per technical specification and usage requirement.
 - 5.4 **High voltage withstand test at 2.5KV: -**

The A.C. voltage of 2.5KV, 50HZ shall be applied for one minute as follows:
 - a) Between Phase & Neutral
 - b) Between Phase and earth screw
 - c) On the insulation of Multiple Outgoing Connector.
There shall not be any puncture or flash over during this test.
 - 5.5 **Current Carrying Capacity: -**

The Current of 300 AMP shall be applied for 30 minutes through high current source on each Multiple Outgoing Connector. There shall not be overheating of the Connectors during this test.
6. **PACKING:**
The Metal Meter Box (MMB) shall be suitably packed in 3 ply corrugated boxes in order to avoid damage in transit.
7. **PAST EXPERIENCE:**
The firm must have supplied the NIT quantity or similar item to any Power utility in any one financial year in last 5 years. Past performance of the manufacturer firm with Power utilities should be satisfactory both in quality and adhering to delivery schedule in last 5 years. Supporting documents shall be submitted along with the tender.
8. **Prototype & Drawings:-**
The manufacturer has to manufacturer the prototype Unit for each rating as per this specification before bulk manufacturing. The manufacturer should intimate the readiness of prototype to employer. The Project Manager will inspect the prototype for approval. The manufacturer should submit the final drawings in line with this specification and prototype to employer for approval before bulk manufacturing. The approval of prototype & drawings shall be a responsibility of manufacturer/Contractor. Tentative drawing of box is enclosed herewith.

20-in-1 Meter Pillar Box (MPB) for single phase meters

1. SCOPE:

This specification covers the design, manufacture, inspection, testing and supply of outdoor type M.S. sheet, Meter Pillar Box from the manufacturers having satisfactory performance with power utilities in last 5 years. Meter Pillar Box shall be used for housing Single Phase meters for electric connections of general category.

2. CONSTRUCTIONAL AND TECHNICAL PARTICULARS:

- 2.1 The meter pillar box shall conform to tender drawings. It should be suitable for housing 20 Nos. single phase energy meters of any make. The overall dimensions of the Meter Pillar Box shall be 1280mmx1115mmx200mm (i.e. height x width x depth) with suitable canopy at the top. A sliding bolt of 20mm width, 6mm thickness & 245mm length to be provided for extra locking as well as sealing arrangement to be provided as shown in Annexure-1& 8. Hole of 8mm shall be provided in the sliding bolt to provide the padlock. Other parts of the latch shall be made from 2mm thick MS sheet. The sliding bolt shall be duly powder coated. Suitable openings to drain out rain water, of minimum size be provided at bottom so that no reptile is able to enter pillar box.
- 2.2 Pillar box shall be fabricated from 18 SWG (1.2mm), M.S sheet by die-press method and having bottom frame made out of MS angle 40mmx40mmx5mm. The MS Angle Iron used should be manufactured by any 'BIS' approved manufacturer. The name of the manufacturer shall be marked on the angle iron and the document showing BIS approval of the manufacturer shall be shown to the inspecting officers and attached with the inspection report. Single piece of MS sheet be used for three side of box i.e. back, left and right side be of one piece. Top side of the same sheet must be bent at 90° from all three sides by 15mm and shall be welded at corners for strengthening of the box. For fabricating the box, maximum 4 Nos. of pieces should be used i.e. one piece for three sides, second piece for bottom side third & fourth piece for top side with canopy. In addition to this, left & right doors (as shown in Annexure 2 & 3) have to be fixed with hinges. All the welding joints should have 15mm overlapping. The meter pillar box shall have door (with left & right side partition) for facilitating access to meter reading from outside. Two holes of about 6mm diameter shall be provided on each side of upper canopy (as shown in drawing) for fixing cable spacers at site.
- 2.3 All the steel sections used in fabrication shall be carefully leveled and straightened before any work is done on them. No rough edges shall be permitted anywhere throughout the work. The material shall be capable to withstand mechanical, electrical and thermal stresses as well as the effects of humidity, which are likely to be encountered during its service. Welding shall be MIG welding or spot welding only. Welding work shall be done carefully so as to avoid over heated spots, cavities, porosity, burns and dents etc.
- 2.4 The hinge arrangement of the door shall consist of three-tamper proof inside hinges not visible from outside. Each door shall have minimum three hinges. One end of Hinges should be welded on inside of the door and other end should be fixed with Pillar Box by minimum three screws. Hinges arrangement shall be made from 16SWG (1.6 mm) M.S. Sheet. For extra strengthening of the doors, C-shaped channels shall be spot welded/ MIG welded from inside of the box (as shown in tender Drawing). Two no. such Channels shall be provided on the left door and one no. on the right door. The thickness of the sheet of channels shall be 1.2 mm. Viewing window opening of the size 90x100 mm as indicated in drawing (Drawing) shall be provided on the doors to view meter readings of Meters installed inside the Pillar Box. Viewing window shall be provided with toughened glass of 5mm thickness fixed from inside of the doors. Glass shall have scratchproof logo of utility of minimum 10mm height on the right side top corner of the glass. This glass shall be fixed from inside of the doors of pillar box, with single piece drawn metal frame with powder coating (Glass Holder) made of 20 SWG (0.9 mm) MS sheet fixed with min. four screws. Glass holder shall have rectangular cuttings as per details shown in Drawing. The size of toughened glass shall be 110x120mm so as to provide overlap of 10mm with viewing window. Glass has to be fitted with a wraparound rubber ring, in one piece, having minimum depth of 8 mm, made from good quality rubber so that it can withstand weather effect.

- 2.5 Door shall be provided with M.S. handle and locking arrangement (with one key) and suitable gasket, in 4 no. pieces (one piece for each side) with no gap at the joints, to make vermin proof as indicated in drawing (Drawing). Door shall be provided with three point locking arrangement. M.S locking rod of diameter 10mm (± 0.5 mm) with protrude of minimum 10mm at top & bottom, provided to prevent opening of the door in locked condition. Locking Patti should be provided from inside of door at the center, for locking purpose so that box gets locked from top, bottom & center in locked condition. The 3-point locking arrangement Patti should move inside the slot provided in the left & right door. Movement of locking Patti & locking rods should be linked with movement of outer handle. Locking rod shall lock the doors by sliding over the rollers provided on the top and bottom of the pillar box. Latch of suitable size, duly powder coated shall be provided on top and bottom on inside of the left door having utility name or logo. There should be a rubber/nylon washer in one piece, fixed with adhesive, between handle and the door to avoid penetration of rain water in Pillar Box through handle. One central lock with brass levers shall be provided inside the door. Key way shall be provided on the door for operating the lock from outside. Key way shall be provided with a cover. Locking arrangement shall be provided with Cover from inside. Keys provided shall be Master key type for ease of handling by utility staff. The handles provided should be of removable type.
- 2.6 Insulated Aluminium Bus bars for 3 Phases and Neutral shall be provided at the top of Pillar box as indicated in drawing. Three Nos. Aluminium bus bars of minimum 300 mm² with suitable length for R, Y and B phase and one Aluminium bus bar of 400mm² with suitable length shall be provided for neutral. Minimum clearance between each insulated bus bar shall be 60mm & end clearance from pillar box wall shall be minimum 75mm. These insulated bus bars shall be raised from the backside by minimum 25mm. Bus bars shall be protected & enclosed in a fire resistant insulated casing rated for 1100 V. The insulation shall be made of suitable material capable of durably withstanding the mechanical, electrical and thermal stresses to which it may be subjected in service. The insulated bus bars shall be provided with the holes for incoming & outgoing cables in such a way that the external conductors inserted in the holes of bus bars shall be connected by means of bolts/studs which ensure that the necessary contact pressure corresponding to the current rating of insulated bus bars is maintained. Aluminium bus bars including all live parts shall be at a safe distance from the outer edge of the insulation and shall not be accessible by hand. These insulated bus bars used for R-Y-B Phases and Neutral shall provide connections for 20 energy meters to be installed in the Pillar box. Each insulated bus bar shall have arrangement for fixing of 2Nos.main 4 Core XPLE cable of size up to 95mm² from the upper side of each bus bar by providing suitable arrangement/mechanism in such a manner that the main cable shall be connected from the upper side of bus bars and do not hang on the insulated bus bars. Each cable up to 95mm² shall be fixed with 2 Nos. M12 bolts / studs. Insulated bus bars shall be provided in Red, Yellow, Blue and Black color for R-Y-B Phases and neutral respectively.
- 2.7 There should be independent mounting arrangement for each meter and it should be raised from the back side of pillar box by 35mm. Each meter mounting arrangement shall be provided with the 6mm thick fire resistant insulating, hanger strip and adjustable strip as per drawings. Meter shall be fixed on these insulated strips. The supplier shall supply three mounting M.S. Screw, one screw with 4mm diameter for Hanger point and two Screws (M4 x 35mm) with nuts in the slots of each adjustable strip. The insulation provided should be fire resistant and sufficient gap should be provided so that the screws used for fixing the meters do not touch metal plate at the back or the metal strip.
- 2.8 For outgoing service cables, 20 Nos. holes with rubber cable glands of internal diameter 19mm shall be provided on both side walls of the pillar box (10 Nos. on each side wall). All cable glands shall have grooves of minimum 5mm depth for proper fixing with pillar box sheet. The glands shall be fixed with the central groove over the pillar box sheets, so that half of the gland is inside the pillar box with the other half outside the pillar box. The fire resistant insulation sheet shall be fixed firmly on inside the pillar box, on both sides for the outgoing service cables (each sheet having 10no. holes corresponding to the cable glands). The dia. of the holes in the fire resistant sheets shall be 20 mm. and the diameter of the holes in the pillar box for fixing of cable glands for outgoing service cables shall be 25mm.

The diameter of holes for main incoming and outgoing main cables shall be 60 mm with cable gland of internal diameter 45mm to be provided in the lower wall of the pillar box. All rubber cable glands shall be

properly fixed with suitable adhesive such that, the same does not get removed from Pillar box. Rubber glands shall be made such that internal diameter of glands provided for cables should be closed with the Rubber film of approximately 1mm thickness. Cable will go through the cable glands by piercing the rubber film of the glands. A fire resistant insulation sheet corresponding to the main incoming and outgoing main cables shall be firmly fixed on inside of the pillar box. The diameter of the holes in the insulation sheet shall be about 50mm. 3 Nos. Fire resistant perforated insulation sheets (with requisite undercuts for easy movement of outgoing cables from meters) shall be provided as vertical partition between each meter column for better heat dissipation.

- 2.9 Suitable cable clamps as shown in the drawing shall be provided in the pillar box to hold the main cables.
- 2.10 Louvers for ventilation shall be provided on the sidewalls of the pillar box, top of the front and back side below the canopy as shown in drawing. Louvers shall also be provided in the lower wall of the pillar box. 20SWG (0.9 mm) perforated sheet shall be welded from inside of the louvers.
- 2.11 Bolts of diameter 10 mm and 35 mm length with 2 Nos. plain washers and two no. nut are to be provided on both the sides for earthing the metallic body of the pillar box (Drawing). Earthing bolts is to be provided on the earth clamps welded on both sides of the meter pillar box. The earthing bolt should be provided from inside of the earth clamp. Earthing nut bolt & washer should be zinc plated. There should be no powder coating on top surface of earth clamp and earthing bolts. The thickness of the sheet of the earth clamp (as shown in Drawing) shall be 2mm.
- 2.12 40mmx40mmx5mm angle iron frame with 4 Nos. 750 mm length must be provided as legs of pillar box. The Angle Iron to be used for frame and the legs shall be manufactured by any 'BIS' approved manufacturer. The name of the manufacturer shall be marked on the angle iron and the document showing BIS approval of the manufacturer shall be shown to the inspecting officers and attached with the inspection report. Eight nos. (3 no. each on front & backside and one no. each on left & right sides) Mounting bolts of M10 should be welded on the top of base angle frame to hold the pillar box. Bolts shall be welded to angle frame such that it moves inside the mounting holes made at the bottom of the pillar box and is fixed from inside with nuts & washers. Angle frame should be interchangeable with all pillar boxes. The pillar box should fit on inside of the angle frame, on top of the legs. Further, the legs should be welded with overlap with the angle iron frame. Also there should be anchors of M.S. sheet of square shape with 4" sides of 2.5mm thickness, fixed on bottom of legs.
- 2.13 The tolerances permissible on various dimensions of the pillar box shall be $\pm 2\%$.
- 2.14 Rubber sealing/lining at least be 3mm thick shall be provided on 4 sides of the box in 4 no. pieces (one piece for each side) with no gap at the joints. to ensure proper closing of the outer door and to avoid ingress of water. It should be properly glued on the surface with the help of suitable adhesive so that the same does not get removed by itself on opening the door.
- 2.24 2.15 The pillar boxes (including Glass Holders) should be powder coated with light admiralty grey shade (Shade No-697 as per IS: 5:2007) suitable for outdoor use. The surface of the pillar boxes and Glass Holders shall be properly pre-treated and cleaned in 7 tank process and shall be applied with a powder coating of about 40 micron thickness on outer side and inside. The facility for 7-Tank Phosphating & powder coating shall be in house of the tenderer / MMB manufacturer to ensure proper quality.

3.0 WIRING OF PILLAR BOX:

For Internal wiring of Pillar Box, 'ISI' marked PVC insulated, unsheathed Copper cable of 10mm², shall be used. Copper cable shall have 140 strands of Copper wire with 0.3mm diameter. Red, Yellow & Blue colour wires shall be used for Phases R, Y, and B respectively. White or black colour wires shall be used for neutral connections. All technical parameters of the offered copper cable shall be as per IS: 694 and the tenderer shall mention in tender, all these technical parameters, including those not specified in the ISS. Each wire shall have pin lugs at meter end. Lugs should have compression joint with cable to establish a good electrical and mechanical contact. Lugs should be suitable for cable of 10mm² and should be made of Copper and coated with tin. Other end of each wire shall be fixed to Insulated bus

bars with 2 Nos. M6 bolt / stud duly zinc plated. Length of each wire shall be such that the Pin lug end of wire should be suitable for smallest and biggest meter. All the wires shall be properly dressed & tied together with cable nylon tie. The ends of cable should be provided with suitable cover to avoid short circuit in case of spare cables.

4.0 TESTING FACILITIES:

The tenderer must have the following minimum testing facilities in house: -

- i) High Voltage Tester.
- ii) High Current Source.
- iii) Megger
- iv) Powder Coating thickness Measuring instrument.
- v) Measuring instruments like Vernier, Micrometer, Measuring Tapes / Scales.
- vi) Facility for carrying out acceptance tests on copper cable as per IS: 694. In case a firm do not have this facility, the said tests on the copper cable shall be got carried out from Govt. / Independent test house/ works of the cable manufacturer, (subject to availability of the complete acceptance tests facilities) if a firm so desires.

5.0 SAMPLING PLAN:

One no sample per 100 nos pillar boxes of the offered lot shall be taken for carrying out pre-dispatch inspection by the inspecting officers.

6.0 MARKING:

Utility Name or Logo as shown in the drawing shall be embossed on the outer door and on the side opposite to the door on which door handle is fixed. Also manufacturers name should be embossed on the outer door with handle. Danger Notice as per Drawings should be printed in Red on outer door.

P.O. NO. & date and Sr. No. of MPB shall also be indelibly marked or embossed at a suitable place on the left door of MPBs, which should be of minimum 5mm height and clearly visible.

7.0 INSPECTION:

Each lot offered shall be inspected at the works of manufacturer by the inspecting officers of purchaser. The manufacturer shall give minimum 14 days' notice about readiness of material at his works for pre-dispatch inspection by the purchaser. The material shall be inspected for conformity with the specification before the same is accepted.

8.0 TESTS:

Following acceptance tests shall be carried out while inspecting lot of material offered.

a) Visual Examination:

The Meter Pillar box will be inspected visually, externally and internally for proper Powder Coating layer, fitting of all the components in accordance with technical Specification.

b) Verification of dimensions:

Verification of dimensions, external / internal clearances will be carried out as per technical specifications.

c) Verification of fittings:

Components like insulated bus bars, Lugs, Glass, Locks etc will be verified as per technical specification. Inspecting officers shall check that Angle Iron used for the angle iron frame & legs is manufactured by any 'BIS' approved manufacturer and record the same in inspection reports. A copy of ISI license of the angle iron shall be enclosed with inspection reports

- d) High voltage withstand test at 2.5KV:
The A.C. voltage of 2.5KV, 50HZ shall be applied for one minute as follows:
- i) Between live parts of each insulated bus bars.
 - ii) Between live part of each insulated bus bar and earthing bolts
 - iii) On insulation of bus bars.
 - iv) On PVC coating of PVC wires.
- There shall not be any puncture or flash over during this test.
- e) Current Carrying Capacity:
- i) The Current of 60Amp shall be applied for 30 minutes through high current source on the PVC cables. There shall not be overheating of the PVC cables during this test.
 - ii) The current of 300Amp shall be applied for 30 minutes through high current source on each insulated bus bar. There shall not be overheating of the insulated bus bar during this test.
- f) Earth Continuity Checking Test:
Earth Continuity shall be checked by Megger between two earthing terminals brought out on either side of Meter Pillar Box.
- g) From the lot offered by the firm for inspection, sample of PVC cable shall be tested for complete acceptance tests as per IS-694:1990, at the works of the firm (if facility available). In case the testing facilities are not available with the firm, the samples shall be got tested from any Govt./ Independent Test House, for which samples shall be sealed by inspecting officers, at the cost of firm. Out of the offered lot of Pillar Boxes, 2 no. samples of copper cable shall be taken from 2 no sample pillar boxes for testing, which shall be to supplier's account. One no sample shall be tested/ sealed for sending the same to test house. The second sample shall be retained as counter sample. The tenderers shall indicate whether they propose in house acceptance testing of cable or from test house. Alternatively, the acceptance tests on the samples of copper cable can also be got carried out by inspecting officers at works of the cable manufacturer, (subject to availability of the complete acceptance tests facilities) if a firm so desires.
- Inspecting officers shall check original documents regarding procurement of corresponding quality of ISI marked PVC copper cables for the offered lot of pillar boxes and attach an attested/signed photocopy of the said documents with each lot's inspection report. A copy of BIS license of the cable shall also be enclosed.
- 9.0 The box shall comply with the requirement of IP-33. The box shall be fully type tested for IP-33 with dimensions as per the requirement and IS 13947: 1993/other relevant standards, if any. The type test shall be carried out from the govt. approved laboratories. Government approved laboratories should be accredited by the National Board of Testing & Calibration Laboratories (NABL) of Govt. of India. The type test certificates must not have been issued earlier than three years from the original date of order.
- 10.0 PACKING:
Pillar Box shall be suitably wrapped to avoid damage in transit and handling. The Pillar boxes shall be suitably wrapped in 6mm to 8mm Expandable Poly Ethylene (EPE) foam and then shrink wrapped with Polythene Plastic sheet in order to avoid damage in transit and handling.
- 11.0 Prototype & Drawings:-
The manufacturer has to manufacturer the prototype Unit for each rating as per this specification before bulk manufacturing. The manufacturer should intimate the readiness of prototype to employer. The Project Manager will inspect the prototype for approval. The manufacturer should submit the final drawings in line with this specification and prototype to employer for approval before bulk manufacturing. The approval of prototype & drawings shall be a responsibility of manufacturer/Contractor. Tentative drawing of box is enclosed herewith.

STANDARD BIDDING DOCUMENT

(PARTIAL TURNKEY CONTRACT)

FOR

RURAL/URBAN ELECTRIFICATION WORKS OF **XXXX
(NAME OF DISTRICT) DISTRICT OF **XXXX** (NAME OF
STATE) UNDER DEENDAYAL UPADHYAYA GRAM
JYOTI YOJANA/INTEGRATED POWER DEVELOPMENT
SCHEME**

VOLUME-III

(TECHNICAL SPECIFICATONS & DRAWINGS)

Section-III : Technical Specifications for IPDS

SPECIFICATION No.:.....

DOCUMENT NO.:.....

VOLUME-III : SECTION – III
TECHNICAL SPECIFICATIONS
FOR IPDS

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A. TECHNICAL SPECIFICATION
OF
66/11 KV SUBSTATION

1) 66/11 KV POWER TRANSFORMER (15MVA/20MVA): To be customized by Utility

1. GENERAL

This specification covers the design, manufacture, assembly; shop testing, supply, delivery, installation works and field test of the Power Transformers complete with all accessories, fittings and auxiliary equipment for trouble free operation. The transformers shall be oil immersed and suitable for outdoor installation and shall comply with IEC 76/IS 2026.

2. DESIGN REQUIREMENTS

The transformers shall be connected to three phase 50 Hz system of 66 kV systems.

The transformer shall be installed outdoor. The transformer shall be oil immersed and designed for the cooling system as specified in Appendix-A.

The transformers shall be capable of operating continuously at its rated output without exceeding the temperature rise limits as specified in Appendix-A.

The transformer windings shall be designed to withstand short circuit stresses at its terminal with full voltage maintained behind it for a period as per IEC-76.

The transformer shall be capable of continuous operation at the rated output under the following conditions:

- a) The voltage varying $\pm 10\%$ of rated voltage.
- b) Frequency varying $\pm 5\%$ of the rated frequency.

The transformer shall be capable of delivering its rated output at any tap position.

The transformer shall be free from annoying hum and vibration when in operation even at 10% higher voltage over the rated voltage. The noise level shall be in accordance with respective IEC standards.

The transformer shall be designed and constructed so as not to cause any undesirable interference in radio or communication circuits.

The Transformer Secondary terminal shall be adequately designed for terminating two runs of 1CX800 sqmm cable (to be customized by utility) to it, with the help of appropriate size Outdoor Termination Kit. The cable shall be supported on a structure.

3. CONSTRUCTION FEATURES

3.1 Tank

The tank shall be of all welded construction and fabricated from sheet steel of adequate thickness. All seams shall be properly welded to withstand requisite impact during short circuit

without distortion. All welding shall be stress relieved.

Stiffener of structural steel for general rigidity shall reinforce the tank wall. The tank shall have sufficient strength to withstand without any deformation by mechanical shock during transportation and vacuum filling in the field.

The tank cover shall be bolted on the tank with weather proof, hot oil resistant, resilient gasket in between for complete oil tightness. If gasket is compressible metallic stops shall be provided to prevent over compression. Bushings, turrets, cover of access holes and other devices shall be designed to prevent any leakage of water into or oil from the tank. The tank cover shall also be provided with two (2) nos. grounding pads and connected separately to tank grounding pads.

The transformer tank shall be provided with sets suitable transporting arrangement

All heavy removable parts shall be provided with eye bolts for ease of handling and necessary lugs and shackles shall be provided to enable the whole transformer to be lifted by a crane or other means. Manholes of sufficient size shall be provided for access to leads, windings, bottom terminals of bushings and taps.

3.2 Core & Coils

The transformer may be of core or shell type. The core shall be built up with interleaved grade non-ageing, low loss, high permeability, grain-oriented, cold rolled silicon steel lamination properly treated for core material. The coils shall be manufactured from electrolytic copper of suitable grade. They should be properly insulated and stacked.

All insulating material shall be of proven design. Coils shall be so insulated that impulse and power frequency voltage stresses are at a minimum.

Insulating spacers and barriers shall suitably support coil assembly. Bracing and other insulations used in the assembly of the winding shall be arranged to ensure a free circulation of the oil and to reduce the hot spot of the winding.

All leads from the windings to the terminal board and bushings shall be rigidly supported to prevent injury from vibration or short circuit stresses. Guide tube shall be used where practicable.

The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer or under short circuit stresses.

3.3 Tappings

Off load / on-load taps as specified in Appendices shall be provided on the high voltage winding of the transformers.

The transformer shall be capable of operation at rated output at any tap position provided the primary voltage does not vary by more than $\pm 10\%$ of the rated voltage corresponding to the normal tap.

The winding, including the tapping arrangement, shall be designed to maintain the electromagnetic balance between H.V. and L.V. winding at all voltage ratios.

3.4 On Load Tap Changer (OLTC)

The continuous current rating of the tap changer shall be based on connected winding rating and

shall have liberal and ample margin. Lower rated tap changers connected in parallel are not acceptable.

The tap changing mechanism shall be located in an oil filled compartment separated from the main tank by a suitable oil tight barrier. The oil in OLTC compartment shall have its own separate oil preservation system complete with conservator, Buchholz relay/oil surge relay, breather, shut-off valves, oil level gauge, gas vent etc. However, one segregated compartment of the main conservator tank may be utilized for OLTC oil preservation.

3.5 Remote/Local Tap Operation

The on-load tap changing equipment shall have the provision for mechanical and electrical control from a local position. For local mechanical operation, the operating handle shall be brought outside the tank for operation from floor level with provision to lock the handle in each tap position.

In driving mechanism cubicle

- "RAISE-LOWER" control switch
- Means for manual operation when power supply is lost
- Tap change operation counter

The OLTC should be designed to be controlled from the remote. The remote OLTC panel with the switching and control devices shall be provided in the switchgear room.

3.6 Insulating Oil

The insulating oil shall conform to the latest revision of IS 335/IEC publication 296, properly inhibited for preventing of sludging.

The necessary first filling of oil shall be supplied for the transformer in non-returnable container suitable for outdoor storing. Ten percent (10%) excess oil shall also be provided to take wastage into account.

3.7 Oil Preservation System

Oil preservation shall be by a means of conservator tank or by a sealed tank system.

a) Conservator Tank System

- 1) The conservator tank shall be mounted on a bracket fixed on the tank.
- 2) The conservator tank shall be provided with two compartments, one for the main transformer tank while the other for the OLTC compartment. The partition barrier shall be provided so that OLTC oil shall not be mixed up with the transformer's oil under any circumstances.
- 3) One compartment shall be connected with the main transformer tank by pipes through double float Buchholz Relay (gas operated relay) with valves at both ends.
- 4) The other compartment shall be connected with the OLTC compartment by pipes through single float Buchholz Relay/Oil Surge Relay with valves at both ends.

- 5) Contact of the oil in the compartment for the main tank with atmosphere shall be prohibited by using a flexible urethane air cell. The cell shall be vented in to the atmosphere through a silica gel breather and shall inflate or deflate as oil volume changes.
- 6) Both compartments shall be provided with their own breather, filler cap and drain plug.
- 7) Each compartment of the conservator shall be provided with a dial type level indicator visible from the ground level and fitted with a low oil level alarm contact. Plain oil level gauge shall also be provided to each compartment.

3.8 Temperature Indicators

One set of winding temperature indicators shall be supplied and fitted locally so as to be readable at a standing height from ground level. Necessary current transformer and heating coil for obtaining thermal images of winding temperatures and a detector element shall be furnished and wired.

The above winding temperature indicator shall be provided with necessary contact to take care of the following:

- (a) Starting of cooling units with rise of temperature
- (b) Alarm on high temperature
- (c) Trip on higher temperature

One set of oil temperature indicator with maximum reading pointer and electrically separate sets of contacts for alarm and trip shall be mounted locally so as to be readable at a standing height from ground level

3.9 Buchholz relay (Gas operated relay) – (For conservator type of oil preservation)

The Buchholz relay shall be provided with two floats and two pairs of electrically separate contacts – one pair for alarm and the other pair for tripping.

3.10 Transformer Bushings

Transformer bushing at 11 kV side should be so designed to accommodate two no. 800 sq.mm. aluminium (1C) cable (utility to customize based on actual requirement and rating of transformer) with secondary inter phase clearance. All bushings shall conform to the requirements of the latest revisions of IEC publication 137.

The bushings shall be located so as to provide minimum electrical clearances between phase and ground as per relevant IS/IEC standards.

All bushings shall be porcelain type and shall be furnished complete with terminal connectors of adequate capacity. The porcelain used in bushings shall be homogeneous, nonporous, uniformly glazed to brown color and free blisters, burns and other defects.

Stresses due to expansion and contraction in any part of the bushing shall not lead to deterioration.

Bushings rated 66 kV and above shall be of the oil-filled condenser type with a central tube and

draw-in-conductor which shall be connected to the connector housed in the helmet of the bushings.

Liquid/oil-filled bushings shall be equipped with liquid level indicators and means for sampling and draining the liquid. The angle of inclination to vertical shall not exceed 30 deg. Oil in oil-filled bushings shall meet the requirements of the transformer oil standards specified.

3.11 Marshalling Box

A sheet, steel weatherproof marshalling box of IP-55 construction shall be provided. The box shall contain all auxiliary devices except those which must be located directly on the transformer. All terminal blocks for external cable connections shall be located in this box.

The marshalling box shall have the following but not limited to them:

- a) Load disconnect switch for incoming power supply for auxiliaries.
- b) AUTO-MANUAL selector switch and Local/Remote switch for OLTC
- c) Wiring and termination individually of the following alarm contacts for remote trip and alarm.
 - Buchholz relay alarm for main tank (For conservator type).
 - Buchholz/oil surge relay alarm for OLTC.
 - Winding temperature high alarm.
 - Oil temperature high alarm.
 - Tank oil level low alarm.
 - OLTC oil level low alarm.
 - Tap change incomplete alarm.
- d) Wiring and termination individually of the following trip contact for remote trip and trip alarm.
 - Winding temperature high trip.
 - Oil temperature high trip.
 - Buchholz relay trip or sudden gas and sudden oil pressure relay trip.
 - Pressure relief device.

Cubicle illumination lamp with door switch and space heater with thermostat and ON-OFF switch shall be provided.

3.12 11 kV Cable Termination

Adequate support structure with necessary cable support system shall be provided for

termination of two (2) 800 sq.mm. XLPE cable/phase on the 11 kV bushings (utility may customize based on actual requirement and rating of transformer). Adequate interphase barrier to be provided between the bushings. Suitable arrangement shall be provided for installation of 11kv surge arrester near the bushing termination.

3.13 Auxiliary Supply

All indications alarms and trip contacts provided shall be suitable for operation on a nominal 220V DC system for 66 kV Class Transformers.

Tap changing gear shall be suitable for operation of 430V, 3 phase, 4 wire, 50 Hz systems.

Cooling fans shall be rated at 430 V, 3 phase, 50 Hz.

The tap changing and cooler control supply voltage shall be 230V, Single phase 50 Hz.

3.14 Current Transformers

The scope includes the supply and installation of neutral current transformers and all necessary wiring to terminal blocks at the transformer-marshalling kiosk. The specification of requirements for current transformers shall be established and co-coordinated with the 66 kV bay CT and 11 kV switchgear CT.

Neutral current transformers are to be mounted inside the transformer and shall be easily accessible for testing.

3.15 Cooler Control Scheme

The bidder shall design and supply the required cooler control scheme with necessary fans and control gear. One no fan shall be provided as stand by.

4. TESTS

The following tests shall be performed

- i) Insulation resistance tests on bushings.
- ii) Insulation resistance test at 500V between core and core clamping structure.
- iii) Voltage withstand tests on insulating oil to BS:148.
- iv) Voltage ratio.
- v) Phase relationship/Vector Group.
- vi) Magnetisation characteristics of current transformers of winding temperature devices.
- vii) Calibration of winding temperature devices.
- viii) Tap selector and diverter switch alignment.
- ix) Calibration of automatic voltage control equipment.
- x) Proving tests as necessary on control schemes.

- xi) Proving tests of buchholz device by air injection.
 - xii) Impedance voltage at highest rated and lowest voltage tap.
 - xiii) Zero sequence impedance at rated voltage tap.
 - xiv) DC resistance at all voltage taps.
 - xv) Core balance test.
 - xvi) Tan delta-capacitance test on bushings (66kV).
 - xvii) Tan delta-capacitance test on transformer.
5. Losses at 75 deg Celsius at rated voltage shall be not higher than the values indicated below (IS2026 along with latest amendments if any):
- a) No load losses (Iron losses): 15 MVA- 10 kW, 20 MVA -14.5 kW
 - b) Full load (Copper losses + stray losses) losses: 15 MVA-56 kW, 20 MVA- 73 kW
6. TENDER EVALUATION & CAPITALIZATION OF TRANSFORMER LOSSES
- Conditions of contract at Volume-I may be referred for this.
The minimum loss indicated by any of the bidder will be taken as a base for computing any Liquidated damages for non-performance of the equipment and LD shall be levied as per GCC clause 24.1, 24.2 and corresponding clause 11 and 12 at SCC.
7. PERFORMANCE GUARANTEE
- The performance figures quoted on Technical Data Sheet shall be guaranteed within the tolerances permitted by standards IS 2026 & IEC 76 and will become a part of the successful Bidder's Contract.
8. DRAWINGS, DATA & MANUALS
- Submission of Drawings, Data & Manuals by the Bidder along with the tender Document and that after the award of contract for approval shall be as follows:
- a) The following drawings and details shall be furnished along with the Tender.
 - 1) Bidder's proposed typical general arrangement drawing showing constructional features of:
 - Tank including conservator, level gauge, etc.
 - Bushing configuration arrangement
 - Cable termination arrangement
 - Wheel base dimension and detail

- Head clearance required for detanking of coil assembly.
- 2) Test certificates of similar transformer as quoted.
- 3) Technical leaflets on accessories such as:
 - Buchholz relay, sudden gas pressure/oil pressure relay
 - Temperature indicators
 - Tap changer
 - High/Low voltage bushings

b) After Award of Contract

After award of contract, the successful Bidder shall submit the required number of copies of following data for approval.

- 1) Outline dimensional drawing showing the general arrangement, indicating the space required for:
 - Cable termination arrangement
 - Wheel base dimension & detail
- 2) Head clearance required for detanking of core and coil assembly.
- 3) Foundation plan and loading.
- 4) Transport/shipping dimension with net weight and weights of various parts.
- 5) Final calculation of impedance for each transformer.
- 6) Schematic flow diagram of cooling system showing the number of cooling units, etc.
- 7) Technical details along with control schematic and wiring diagram for marshalling box, remote tap changer control panel.
- 8) Short circuits withstand capacity design calculation.

Any other relevant data, drawing and information necessary for review of the items whether specifically mentioned or not, shall be furnished along with this information.

The general arrangement drawing, the schematic wiring diagram showing the control scheme, cable termination arrangement, location of terminal blocks, etc., shall be submitted for comment/approval. The Employer/Engineer will return these drawings after their review with their comments and/or approval. The review and comments will generally be made on the schematic diagram drawing and the configuration and the arrangement of the accessories fitted on the transformer. The Bidder on receipt of their returned drawings, with comments from the Employer/Engineer, shall prepare final wiring diagram. The outgoing terminals of the wiring diagram shall be specifically indicated for different functions, such as closing, tripping, alarm, indication, etc. The responsibility for correctness of the wiring diagram shall lie with the Bidder.

Employer/Engineer will only check the final schematic diagram after submission. If any modification, addition or alternation is considered necessary thereon to comply with the Employer/Engineer approved schematic drawing stated hereinabove, the said modification,

addition or alternation shall be carried out by the Bidder either in their works if it is before delivery or at site after delivery at no cost to the Employer.

9. NAMEPLATE

Each transformer shall be provided with a nameplate of weather resistant material fitted in a visible position showing but not limited to the following item:

- a) Kind of transformer
- b) Number of the specification
- c) Manufacturer's name
- d) Year of manufacture
- e) Manufacturer's serial number
- f) Number of phases and frequency
- g) Rated power
- h) Rated voltages and currents
- i) Connection symbol
- j) Impedance voltage at rated current
- k) Type of cooling
- l) Total weight
- m) Weight of insulating oil
- n) Class of insulation
- o) Temperature rise
- p) Connection diagram
- q) Insulation levels
- r) Weight of transportation and untanking
- s) Details regarding tapping's

10. TRANSPORTATION

The core and coils shall be completely dried before shipment and assembled with tank and with oil or dry nitrogen depending upon the size of the transformers. In order to facilitate handling and shipping, as many external accessories as practical, including bushings shall be removed and replaced by special shipping covers.

Bushings, radiators and other accessories which may be affected by moisture shall be packed in moisture proof containers.

CODES & STANDARDS (refer Volume III Section I Power Transformer Specification)

APPENDIX-A TECHNICAL PARTICULARS OF 66/11 KV TRANSFORMER

1	Rating ONAN		12.5 MVA, 15 MVA
	ONAF		20 MVA
2	Voltage Ratio		66/11.5 kV
3	Percentage impedance (at nominal Tap) voltage at 20 MVA and 75 deg. C		As per IS
4	Service		Outdoor
5	Type		Oil-immersed
6	Type of cooling		ONAN/ ONAF
7	Temperature rise above 50 deg. C ambient temperature		
	a)	In oil by thermometer	45 deg. C
	b)	In winding by resistance	55 deg. C
8	Number of phase and frequency		3 phase, 50 Hz
9	Maximum voltage		
	a)	Primary	72 kV
	b)	Secondary	12 kV
10	Rated voltage (line to line)		
	a)	Primary	66 kV
	b)	Secondary	11 kV
11	Insulation level of winding		
	a)	Basic impulse level as per IEC 76	

	-	Primary	325 kV
	-	Secondary	75 kV
b) Power frequency induced over voltage (1 min.)			
		- Primary	140 kV
		- Secondary	28 kV
12	Connection		
	a) Primary	Delta	
	b) Secondary	Star	
13	Vector group reference		
	Primary – Secondary	Dyn11	
14	Type of tap changer	On-load, full capacity	
15	Taps provided on	HV Winding	
16	Range of taps	-10 To 10%	
17	Number of taps	9	
18	Method of tap change control		
	Mechanical local	Yes	
	Electrical local	Yes	
	Electrical remote with "AUTO-MANUAL" selection	yes	
19	System grounding		
	a) Primary	Solidly grounded	
	b) Secondary	Solidly grounded	
20	System fault level	31.5 kA at 66 kV	
21	Neutral terminals		
	a) Primary	Yes	
22	Neutral CT		
	a) LV SIDE	2- CORE (One-PS, One – 5p20)	

Neutral CT Details

CT TYPE LV

5P20

PS

NEUTRAL CT

RATIO:1600/1

RATIO: 1600/1

V_k=800V

R_{ct}+2R_I<10

POWER TRANSFORMERS

APPENDIX-B : TRANSFORMER ACCESSORIES

The transformer furnished under this specification shall be equipped with the following:

- *1. Oil conservator with two compartments each with filler caps and drain plugs.
- *2. Two sets of silica gel breathers with connecting pipe and oil seal.
- *3. Air release plug.
- *4. Double float Buchholz Relay with electrically separate trip and alarm contacts for transformer tank.
- *5. Two Nos. of shut-off valves at both sides of each Buchholz Relay.
- **6. Sudden oil pressure relay with trip contact.
- **7. Sudden gas pressure relay with trip contact.
- **8. Pressure vacuum bleeder.
9. Mechanically operated self-resetting type pressure relief device with visible operation indicator and trip contact.
10. One (1) no. 150 mm Dial Magnetic oil level gauge with low level alarm contact (one for main tank and one for OLTC).
11. Direct Reading Plain oil level gauge-two (2) Nos.
12. 150 mm Dial oil Temperature indicator with maximum reading pointer and individually adjustable electrically separate sets of contact for alarm and trip.
13. 150 mm Dial Winding Temperature Indicator with individually adjustable electrically separate sets of contact for two stage cooler control, alarm and trip with detector element complete with heating coil, CT's etc.
14. Single float Buchholz Relay/Oil Surge Relay with alarm contact for OLTC.
15. Drain valve with threaded adaptor.
16. Sample valve (top and bottom)
17. Filter valves with threaded adaptor (top and bottom)
18. Manhole of sufficient size for access to the interior of the tank.

19. Cover lifting eyes.
20. Jacking pads, hauling and lifting lugs.
21. Bi-directional flanged wheels.
22. Skids.
23. Clamping device with nuts and bolts for clamping the transformer on foundation rails.
24. Ladder with safety device for access to the transformer to and Buchholz Relay.
25. Two (2) Nos. grounding pads each with two (2) Nos. tapped holes, bolts and washers for transformer tank, radiator bank and cable-end box grounding.
26. Rating plate and terminal marking plate.
27. Marshalling box for housing control equipment and terminal connections.
28. Cooling system complete with isolation valves and all necessary accessories.
29. HV and LV termination arrangement suitable for termination of cables.
30. Neutral bushing complete with connections.
31. One no PRV.

* For conservator type of oil preservation system.

** For sealed tank type of oil preservation system.

2. 66 kV CIRCUIT BREAKER (OUTDOOR TYPE)

1. GENERAL

66 kV Circuit Breakers shall be outdoor type, comprising three identical single pole units, complete in all respects with all fittings and wiring. The circuit breakers and accessories shall conform to IEC-62271-100 or equivalent Indian Standard.

2. DUTY REQUIREMENTS

- 2.1 Circuit breaker shall be suitable for 3 phase, 50 Hz, 66 kV System. The circuit breaker shall meet the duty requirement of any type of fault or fault location, when used on 66 kV effectively grounded or ungrounded systems and perform make and break operations as per the stipulated duty cycles satisfactorily.
- 2.2 The rated transient recovery voltage for terminal fault and short line faults shall be as per IEC:62271-100.
- 2.3 The circuit breakers shall be reasonably quiet in operation. Noise level in excess of 140 dB measured at base of the breaker would be unacceptable. Bidder shall indicate the noise level of breaker at distance of 50 to 150 m from base of the breaker.
- 2.4 The Bidder may note that total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage, pneumatic pressure and arc extinguishing medium pressure, etc.
- 2.5 While furnishing particulars regarding the D.C. component of the circuit breaker, the Bidder shall note that IEC-62271-100 requires that this value should correspond to the guaranteed minimum opening time under any condition of operation.
- 2.6 The critical current which gives the longest arc duration at lock out pressure of extinguishing medium and the duration shall be indicated.
- 2.7 All the duty requirements specified above shall be provided with the support of adequate test reports to be furnished along with the bid.

3. Principle Technical Parameters: - The SF6 gas Circuit Breakers covered in this specification shall meet the technical requirement listed hereunder.

1	Type of circuit breaker	Outdoor SF6 type
2	Rated frequency	50 Hz
3	Number of poles	Three (3)
4	Reclosing duty cycle	O - 0.3 Sec. - CO – 15 Sec.-CO
5	Rated short circuit breaking current at rated voltage	31.5 kA with percentage of DC component as per IEC56 corresponding to minimum opening time under operating conditions specified
6	Symmetrical interrupting Capability	31.5 kA rms
7	Short time current carrying Capability	31.5 kA rms for one (1) second
8	Rated normal current in amps.	800A (utility to customize based on actual requirement)
9	Total break (opening time)	60 m sec. (3 cycles)

10	Reclosing	Three phase high speed auto reclosing (as required)
11	Total closing time	100 ms
12	Trip and closing coil voltage	As per substation D.C. Voltage
13	Auxiliary contacts	As required plus 8NO and 8NC contacts per pole as spare. The contacts shall have continuous rating of 10A and breaking capacity of 2A with circuit time constant of minimum 20 millisecond at 220V DC (Typ.)
14	Temperature rise over Ambient	As per IEC:62271-100
15	Type of operating mechanism	Spring charging
16	Rated ambient temperature	50 deg. Centigrade
17	Seismic acceleration	0.3g horizontal
18	Rated voltage	66 kV (rms)
19	Rated one minute power frequency withstand voltage (Dry and Wet)	170 kV rms
20	Rated lightning impulse withstand voltage (1.2/50 Micro-Sec.)	325 kVp
21	No. of Terminals in common control cabinet	All contacts to be wired to common control cabinet with 24 extra terminal blocks.

4. CONSTRUCTIONAL FEATURES

4.1 All making and breaking contacts shall be sealed and free from atmospheric effect. In the event of leakage of extinguishing medium to a value, which cannot withstand the dielectric stresses specified in the open position, the contacts shall preferably self-close. Main contacts shall be first to close and the last to open and shall be easily accessible for inspection and replacement. If there are no separately mounted arcing contacts, then the main contacts shall be easily accessible for inspection and replacement. Main contacts shall have ample area and contact pressure for carrying the rated current under all conditions. The interrupter sectional drawing showing the following conditions shall be furnished for information with the bid:

- a) Close position
- b) Arc initiation position
- c) Full arcing position
- d) Arc extinction position
- e) Open position.

4.2 All the three poles of the breaker shall be linked together electrically.

4.3 Circuit breakers shall be provided with two (2) independent trip coils, suitable for trip circuit supervision. The trip circuit supervision relay would also be provided. Necessary terminals shall be provided in the central control cabinet of the circuit breaker.

5. SULPHUR HEXAFLORIDE (SF6) GAS CIRCUIT BREAKER

5.1 Circuit breakers shall be single pressure type.

- 5.2 Design and construction of the circuit breaker shall be such that there is minimum possibility of gas leakage and entry of moisture. There should not be any condensation of SF₆ gas on insulated surfaces of the circuit breaker.
- 5.3 In the interrupter assembly, there shall be absorbing product box to eliminate SF₆ decomposition products and moisture. The details and operating experience with such filters shall be brought out in additional information schedule.
- 5.4 Each pole shall form an enclosure filled with SF₆ gas independent of two other poles. Common monitoring of SF₆ gas can be provided for the three poles of circuit breaker having a common drive. The interconnecting pipes in this case shall be such that the SF₆ gas from one pole could be removed for maintenance purposes.
- 5.5 Material used in the construction of circuit breakers shall be such as fully compatible with SF₆.
- 5.6 The SF₆ gas density monitor shall be adequately temperature compensated to model the density changes due to variations in ambient temperature within the body of circuit breaker as a whole. It shall be possible to dismantle the monitor without removal of gas.
- 5.7 Sufficient SF₆ gas shall be supplied to fill all the circuit breakers installed plus an additional 10% of the quantity as spare.
- 6. OPERATING MECHANISM
- 6.1 Circuit breaker shall be operated by electrically spring charged mechanism.
- 6.2 The operating mechanism shall be anti-pumping and trip free (as per IEC definition) electrically and either mechanically or pneumatically under every method of closing. The mechanism of the breaker shall be such that the position of the breaker is maintained even after the leakage of operating media and/or gas.
- 6.3 The operating mechanism shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause trip or closing operation of the power operated closing devices. A mechanical indicator shall be provided to show open and close positions of breaker. It shall be located in a position where it will be visible to a man standing on the ground with the mechanism housing door closed. An operation counter shall also be provided.
- 6.4 Closing coil shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip coils shall operate correctly under all operating conditions of the circuit breaker upto the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage. If additional elements are introduced in the trip coil circuit their successful operation for similar applications of outdoor breaker shall be clearly brought out in the bid.
- 6.5 Working parts of the mechanism shall be of corrosion resisting material. Bearings requiring 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.
- 6.6 Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coil. Provision shall also be made for local electrical control. 'Local/remote' selector switches and closes & trip push buttons shall be provided in the breaker central control cabinet. Remote located push buttons and indicating lamps shall also be provided.
- 6.7 Operating mechanism and all accessories shall be in local control cabinet. A central control cabinet for the three poles of the breaker shall be provided along with supply of necessary tubing, cables, etc.
- 6.8 Provisions shall be made on breakers for attaching an operation analyser to perform speed tests after

installation at site to record contact travel against time and measure opening time.

- 6.9 The Bidder shall furnish curve supported by test data indicating the opening time under close-open operation with combined variation of trip coil and operating media along with the bid.

6.10 Spring Operated Mechanism

Spring operated mechanism shall be complete with motor, opening spring & closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit. Opening spring shall be supplied with limit switch for automatic charging and other necessary accessories.

As long as power is available to the motor, a continuous sequence of 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 compressing the closing spring.

Motor ratings shall be such that it requires not more than 30 seconds for fully charging the closing spring.

Closing action of the circuit breaker shall compress the opening spring ready for tripping.

When closing springs are discharged, after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.

The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.

6.11 Fittings and Accessories

- 6.11.1 Following is list of some of the major fittings and accessories to be furnished as integral part of the breakers. Number and exact location of these parts shall be indicated in the bid.

- 6.11.2 Control unit/Central control cabinet shall be complete with:

- a) Double compression type cable glands, lugs, ferrules, etc.
- b) Local/remote changeover switch
- c) Operation counter
- d) Fuses, as required
- e) Anti-pumping relay/contactors
- g) Rating and diagram plate in accordance with IEC including year of manufacture, etc.
- h) Gauges for SF₆ gas pressure.
- i) Gas density monitor with alarm and lockout contacts

7. FITTINGS AND ACCESSORIES

7.1 Hollow insulator columns

All routine tests shall be conducted on the insulators as per relevant IEC. In addition the following routine tests shall also be conducted on hollow column insulators:

- a. Ultrasonic test
- b. Pressure test
- c. Bending load test in 4 directions at 50% specified bending load.
- d. Bending load test in 4 directions at 100% specified Bending load as a sample test.
- e. Burst pressure test as a sample test.

7.2 Support Structures

The minimum height of equipment supports shall be 3050 mm. The height of center line shall be as given elsewhere in the specification.

7.3 Terminal connectors

Compression joint type terminal connectors suitable for single or twin ACSR panther/zebra/Moose conductor shall be supplied and they shall be suitable for both vertical and horizontal connections of the Transmission line conductor or station bus bar. Suitable terminal earth connectors (two Nos.) for earthing connections shall also be supplied. The drawings for these connectors shall be submitted.

The terminal connectors shall meet the following requirements:

- a) Terminal connectors shall be manufactured and tested as per IS:5561.
- b) All castings shall be free from blow holes, surface blisters, cracks and activities. All sharp edges & corners shall be blurred and rounded off.
- c) No part of a clamp shall be less than 10 mm thick.
- d) All ferrous parts shall be hot dip galvanised conforming to IS:2633.
- e) For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be cast integral with aluminium body.
- f) Flexible connectors shall be made from tinned copper/ aluminium sheets.
- g) All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- h) Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS:5561.

8. TESTS

8.1 Type Test

Each circuit breaker shall comply with the type test and shall be subjected to routine tests prescribed in latest edition of IEC-62271/IEC-60694/IS-13118.

Reports of all type tests as stipulated in IEC-62271, IEC-60694 or IS-13118 and line charging current and cable charging current and transformer charging & shunt capacitor switching current tests etc. as given below carried out by internationally recognized test laboratories shall be furnished. Supply from those original equipment manufacturers shall be accepted who are having type test certification for following test in past 5 years and the type and design of the breakers then intend to supply are exactly similar. The type test reports shall be produced in support of sub vender / vender of supply of breaker in quantity more than 25 the supplier shall conduct all following test free of charges in presence of Employer's representative.

In case some type tests are conducted at Manufacturer's own works, instead of at Govt. approved laboratory, the type test reports for same shall be accepted only if tenderer undertakes to conduct this type test free of charges in presence of Utility representative at time of inspection.

- i) Impulse withstand voltage test
- ii) Power frequency voltage withstand dry test on main circuit
- iii) Short circuit withstand capability test
- iv) Mechanical endurance test
- v) Temperature rise test
- vi) Radio interference voltage (RIV)
- vii) Measurement of the resistance of main circuit
- viii) Short time withstand current and peak withstand current test
- ix) Out of phase making & breaking test
- x) Shunt reactor current switching test
- xi) Dielectric test
- xii) IP-55 test on operating mechanism
- xiii) Seismic test
- xiv) Cable charging current switching test
- xv) Line charging current switching test
- xvi) Capacitor current switching test for isolated neutral capacitor banks.
- xviii) Degree of protection test on cubicles

8.2 Routine Tests

Routine tests as per IEC-60056 on the complete breaker/ pole along with its own operating mechanism and pole column shall be performed on all circuit breakers.

8.3 ACCEPTANCE TESTS:

The following acceptance tests as stipulated in the relevant ISS-13118 shall be carried out by the Manufacturer in presence of employer representative, unless dispensed with in writing by the employer.

- i) Power frequency voltage withstand dry test on main circuit
- ii) Voltage withstand test on control and auxiliary circuits
- iii) Measurement of resistance of the main circuit
- iv) Mechanical operating test
- v) Design and visual test
- vi) Tightness Test

In addition to above, speed curves for each breaker shall be obtained with the help of a suitable operation analyzer to determine the breaker contact movement during opening, closing, auto-re-closing and trip free operations under normal as well as limiting operating conditions (of control voltage) The tests shall show the speed of contacts directly at various stages of operation, travel of contacts, opening time, closing time, shortest time between separation and meeting of contacts at make-break operation and dynamic contact resistance measurement (DCRM) etc. Also, results obtained in type test analysis as stipulated in clause 8.1

shall be examined for acceptance before release of dispatch clearance for the lot.

9. COMPLETENESS OF EQUIPMENT:

Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment, shall be deemed to have been included in this specification.

10. PACKINGS:

All material shall be suitably packed for transport, direct to site and Manufacturer shall be responsible for all damages/losses due to improper packing. All boxes shall be marked with signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the Manufacturers.

3. 66KV ISOLATORS

1. GENERAL

The isolators and accessories shall conform in general to IEC-62271-102 except to the extent explicitly modified in specification.

Earth switches shall be provided on isolators wherever called for.

The isolators and earth switches shall be manually operated.

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

Isolators shall be gang-operated, double break or centre break.

2. DUTY REQUIREMENTS

Isolators and earth switches shall be capable of withstanding the dynamic and thermal effects of the maximum possible short circuit current of the system in their closed position. They shall be constructed such that they do not open under influence of short circuit current and wind pressure together. The earth switches wherever provided shall be constructional interlocked so that the earth switches can be operated only when the isolator is open and vice-versa.

In addition to the constructional interlock, isolator and earth switches shall have provision to prevent their electrical and manual operation unless the associated and other interlocking conditions are met.

Castel lock type interlock mechanism shall be provided in addition to normal mechanical interlock for-

- (a) Breaker and isolator closing
- (b) Isolator and earth switch closing.

The isolator shall be capable for making/breaking normal currents when no significant change in voltage occurs across the terminals of each pole of the isolator on account of making/breaking operation.

3. CONSTRUCTIONAL FEATURES

The isolators shall be provided with high pressure current carrying contacts on the hinge/jaw ends and all contact surfaces shall be silver plated Copper alloy. The contacts shall be accurately machined and self-aligned. They shall be easily replaceable and shall have minimum movable parts and adjustments.

The isolator shall be provided with a galvanized steel base provided with holes and designed for mounting on a lattice/pipe support structure. The base shall be rigid and self-supporting.

All metal parts shall be of non-rusting and non-corroding metal. Current carrying parts shall be from high conductivity electrolytic copper/aluminium. 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 alloy or equivalent. The live parts shall be designed to eliminate sharp joints, edges and other corona producing surfaces.

The isolators shall be so constructed that the switch blade will not fall to the closed position if the operating shaft gets disconnected. Isolators and earthing switches including their operating parts shall be such that they cannot be dislodged from their open or closed positions by gravity, wind pressure, vibrations shocks or accidental touching of the connecting rods of the operating

mechanism. The switch shall be designed such that no lubrication of any part is required except at very infrequent intervals.

The insulator of the isolator shall conform to the requirements stipulated in relevant IS. Pressure due to the contact shall not be transferred to the insulators after the main blades close. The insulators shall be so arranged that leakage current will pass to earth and not between terminals of the same pole or between phases.

4. CLAMPS AND CONNECTORS

The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.

The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.

Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.

All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.

They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.

Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.

Current rating and size of terminal/conductor for which connector is suitable shall be embossed/punched on each component.

5. EARTHING SWITCHES

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

6. OPERATING MECHANISM AND CONTROL

The Manufacturer shall offer manual isolators and earth switches having padlock arrangement on both 'ON' and 'OFF' positions.

Limit switches for control shall be fitted on the isolator/earth switch shaft, within the cabinet to sense the open and close positions of the isolators and earth switches.

It shall not be possible, after final adjustment has been made for any part of the mechanism to be displaced at any point in the travel sufficient enough to allow improper functioning of the isolator when the isolator is opened or closed at any speed.

Control cabinet/operating mech. Box shall conform to requirements stipulated in IS: 5039/IS 8623/IEC 439.

7. OPERATION

The design shall be such as to provide maximum reliability under all service conditions. All operating linkages carrying mechanical loads shall be designed for negligible deflection.

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

8. TESTS

In continuation to the requirements stipulated under Part-I the isolator along with operating mechanism shall conform to the type tests and shall be subjected to routine tests and acceptance tests in accordance with IEC- 62271-102. Minimum 50 nos. mechanical operations will be carried out on 1 (one) isolator assembled completely with all accessories as acceptance test. During final testing of isolator, closing/ opening of earth switch shall also be checked after isolator is fully open/close. Acceptance test shall be carried out with operating box.

The insulator shall conform to all the type tests as per IEC-60168. In addition to all type, routine and acceptance tests, as per IEC-60168, the following additional routine/ acceptance tests shall also be carried out:

- a) Bending load test in four directions at 50% min. bending load guaranteed in all insulators.
- b) Bending load test in four directions at 100% min. bending load guaranteed on sample insulators in a lot.
- c) Torsional test on sample insulator of a lot.

The type test reports shall not be older than FIVE years and shall be valid up to expiry of validity of offer. The above additional lists if not conducted earlier, shall be done under the subject project package at no extra cost.

9. Parameters

9.1. General (for General & 11 kV, refer Tech specification Volume III Section I)

9.2. 66 kV Class I isolators (to be customized by utility as per requirements and capacity)

a)	Rated voltage	72 kV (rms)
b)	Rated continuous current	Minimum 800 A at rated ambient temperature
c)	Rated Insulation levels	
i)	Rated one minute power frequency withstand voltage	i) 140 kV (rms) between live terminals and earth. ii) 162 kV rms across isolating distance
ii)	Rated lightning impulse withstand voltage	i) ±325 kVp between live terminals and earth ii) ±325 kV rms across isolating distance
d)	Phase to phase spacing	2000 mm

10. **COMPLETENESS OF EQUIPMENT:**
Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment, shall be deemed to have been included in this specification.

11. **PACKINGS:**
All material shall be suitably packed for transport, direct to site and Manufacturer shall be responsible for all damages/losses due to improper packing. All boxes shall be marked with signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the Manufacturers.

4. 66KV INSTRUMENT TRANSFORMERS (Utility to customize based on actual requirement)

1 CODES AND STANDARDS

- | | | |
|------|----------------------|---|
| i) | Current Transformers | IEC 60044, BS:3938, IS: 2705 |
| ii) | Voltage Transformers | IEC 60186, IEC 186A, IEC 60358, IS:3156 |
| iii) | Insulating Oil | IS:335 |

2 GENERAL REQUIREMENTS

The instrument transformers i.e. current and voltage transformers shall be single phase transformer units and shall be supplied with a common marshaling box for a set of three single phase units.

The instrument transformers shall be hermetically sealed units. The instrument transformers shall be provided with filling and drain plugs.

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

The insulators shall have cantilever strength of more than 600 kgf.

3 CURRENT TRANSFORMERS (CTs)

- 3.1. The CTs shall have single primary of either ring type or hair pin type or bar type.
- 3.2. In case of "Bar Primary" inverted type CTs, the following requirements shall be met.
- 3.3. The secondaries shall be totally encased in metallic shielding providing a uniform equipotential surface for even electric field distribution.
- 3.4. The lowest part of insulation assembly shall be properly secured to avoid any risk of damage due to transportation stresses.
- 3.5. The upper part of insulation assembly sealing on primary bar shall be properly secured to avoid any damage during transportation due to relative movement between insulation assembly and top dome.
- 3.6. The insulator shall be one piece without any metallic flange joint.
- 3.7. The CT shall be provided with oil sight glass.
- 3.8. The core lamination shall be of cold rolled grain oriented silicon steel or other equivalent alloys. The cores shall produce undistorted secondary current under transient conditions at all ratios with specified parameters.
- 3.9. Different ratios shall be achieved by secondary taps only, and primary reconnections shall not be accepted.
- 3.10. The guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

- 3.11. The instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CT/reactor is used, then all parameters specified shall be met treating auxiliary CTs/reactors as integral part of CT. The auxiliary CT/reactor shall preferably be in-built construction of the CT. In case it is separate, it shall be mounted in secondary terminal box.
- 3.12. The physical disposition of protection secondary cores shall be in the same order as given under CT requirement table(s) given below.
- 3.13. The CTs shall be suitable for high speed auto-reclosing.
- 3.14. The secondary terminals shall be terminated on stud type non-disconnecting terminal blocks inside the terminal box of degree of protection IP:55 at the bottom of CT.
- 3.15. The CTs shall be suitable for horizontal transportation.

4 VOLTAGE TRANSFORMERS (CVTs)

- 4.1. Voltage transformers shall be of capacitor voltage divider type with electromagnetic unit.
- 4.2. The CVTs shall be thermally and dielectrically safe when the secondary terminals are loaded with guaranteed thermal burdens.
- 4.3. The electro-magnetic unit (EMU) shall comprise of compensating reactor, intermediate transformer, and protective and damping devices. The oil level indicator of EMU with danger level marking shall be clearly visible to maintenance personnel standing on ground.
- 4.4. The secondaries shall be protected by HRC cartridge type fuses for all windings. In addition fuses shall also be provided for protection and metering windings for connection to fuse monitoring scheme. The secondary terminals shall be terminated on stud type non-disconnecting terminal blocks via the fuse inside the terminal box of degree of protection IP:55. The access to secondary terminals shall be without the danger of access to high voltage circuit.
- 4.5. The damping device shall be permanently connected to one of the secondary winding and shall be capable of suppressing ferro-resonance oscillations.
- 4.6. A protective surge arrester/spark gap shall preferably be provided to prevent break down of insulation by incoming surges and to limit abnormal rise of terminal voltage of shunt capacitor, tuning reactor, RF choke, etc. due to short circuit in transformer secondary. The details of this arrangement (or alternative arrangement) shall be furnished by Bidder for Employer's review.
- 4.7. The accuracy of metering core shall be maintained through the entire burden range upto 100VA on all three windings without any adjustments during operations.

5 MARSHALLING BOX (CT/PT MB)

Marshaling box shall conform to all requirements as given in technical specification for LT Switchgear & DB. The wiring diagram for the interconnection of three phase instrument transformer shall be pasted inside the box in such a manner so that it is visible and it does not deteriorate with time. Terminal blocks in the marshaling box shall have facility for star/delta formation, short circuiting and grounding of secondary terminals. The box shall have enough terminals to wire all control circuits plus 20 spare terminals.

6 PARAMETERS FOR CURRENT TRANSFORMERS
 (Utility to customize based on actual requirement)

a)	Rated primary current	800 A
b)	Rated dynamic current	80 kA (peak)
c)	One minute power frequency withstand voltage between secondary terminal and earth	5 kV
d)	Partial discharge level	10 Pico Coulombs max.
e)	Temperature rise	As per IEC 60044
f)	Type of insulation	Class A
g)	Number of cores	Five (5): Details are given in Table-I below.
h)	Rated frequency	50 Hz
i)	System neutral earthing	Effectively earthed
j)	Installation	Outdoor (up right)
k)	Seismic acceleration	0.3 g horizontal
l)	Rated short time thermal current	31.5 kA for 1 sec.
m)	Number of terminals in marshalling box	All terminals of control circuits wired upto marshalling box plus 10 terminals spare.
n)	Rated extended primary current	120% of rated primary current of 960A
o)	Rated system voltage (Um)	72.5 kV (rms)
p)	Rated insulation levels-	
i	1.2/50 micro-sec. impulse	±325 kVp
ii	One minute power frequency withstand voltage	140 kV rms

7 PARAMETERS FOR VOLTAGE TRANSFORMERS (66 kV CVTs)

a)	Rated frequency	50 Hz
b)	System neutral earthing	Effective earthed
c)	Installation	Outdoor
d)	Seismic acceleration	0.3 g horizontal

e)	System fault level	31.5 kA for 1 sec.
f)	Standard reference range of frequencies for which the accuracies are valid	96% to 102% for protection and 99% to 101% for measurement.
g)	High frequency capacitance for carrier frequency range	Within 80% to 150% of rated entire capacitance
h)	Equivalent resistance over entire carrier frequency range	Less than 40 ohms
i)	Stray capacitance and stray conductance of LV terminal over entire carrier frequency range	As per IEC:60358
j)	One minute power frequency withstand voltage -	
a)	Between LV (HF) terminal and earth	5 kV rms for exposed terminals or 2.5kV rms for terminals enclosed in a weather proof box.
b)	For secondary winding	2 kV rms
k)	Temp. rise over an ambient temp. of 50 deg. C	As per IEC 60186
l)	Number of terminals in control Cabinet	All terminals of control circuits wired upto marshalling box plus 5 terminals spare.
m)	Rated total burden	100 VA
n)	Partial discharge level	10 Pico Coulombs max.
o)	Number of cores	As per details given in table-II below.
p)	Rated system voltage	72.5 kV (rms)
q)	Rated insulation levels -	
i)	1.2 micro sec. impulse	±325 kV (peak)
ii)	One minute power frequency withstand voltage	140 kVp
r)	HF Capacitance	4400 pF (nominal)

The location of core shall be as per protection SLD.

8 TESTS

The current and voltage transformers shall conform to type tests and shall be subjected to routine tests in accordance with the relevant IS/IEC and shall also conform to the following additional type tests :

- i) Switching impulse withstand test.
- ii) Thermal withstand test i.e. application of rated voltage and rated current simultaneously by synthetic test circuit.
- iii) Seismic withstand test along with structure.
- iv) Thermal co-efficient test i.e. measurement of Tan-Delta as function of temperature (at ambient and between 80 deg. C and 90 deg. C) and voltage (at 0.3, 0.7, 1.0 and 1.1 Um).
- v) In addition to routine tests as per IEC/IS, measurement of partial discharge in continuation with power frequency withstand test required for 66 kV current transformer.

The type test reports shall not be older than FIVE years and shall be valid up to expiry of validity of offer. The above additional lists if not conducted earlier, shall be done under the subject project package at no extra cost.

- 9 COMPLETENESS OF EQUIPMENT:
Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment, shall be deemed to have been included in this specification.

- 10 PACKINGS:
All material shall be suitably packed for transport, direct to site and Manufacturer shall be responsible for all damages/losses due to improper packing. All boxes shall be marked with signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the Manufacturers.

5. 66KV SURGE ARRESTORS

1. GENERAL (for 11 kV, refer Tech specification Volume III Section I)

The surge arrestors shall conform in general to IEC-60099-4 and IS:3070, Part-3 except to the extent modified in the specification and shall be in accordance with requirements under Part-I, shall be of ZnO gapless type.

Arrestors shall be hermetically sealed units, self-supporting construction, suitable for mounting on lattice type support structures.

2. DUTY REQUIREMENTS

The Surge Arresters (SAs) shall be capable of discharging over-voltages occurring due to switching of unloaded transformers and long lines.

The reference current of SAs shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage. Values and calculations shall be furnished with offer.

The SAs shall be fully stabilised thermally to give a life expectancy of thirty (30) years under site conditions and take care of effect of direct solar radiation.

The SAs shall be suitable for circuit breaker duty cycle in the given system.

The SAs shall protect power transformers, circuit breakers, disconnecting switches, instrument transformers, etc. with insulation levels specified in this specification. The Bidder shall carry out the insulation coordination studies for deciding the rating and application of the SAs.

The SAs shall be capable of withstanding meteorological and short circuit forces under site conditions.

3. CONSTRUCTIONAL FEATURES

Each Surge Arrester (SA) shall be hermetically sealed single phase unit.

The nonlinear blocks shall be sintered metal oxide material. The SA construction shall be robust with excellent mechanical and electrical properties.

SAs shall have pressure relief devices and arc diverting ports suitable for preventing shattering of porcelain housing and to provide path for flow of rated fault currents in the event of SA failure.

The SA shall not fail due to porcelain contamination.

Seals shall be effectively maintained even when SA discharges rated lightning current.

Porcelain shall be so coordinated that external flashover will not occur due to application of any impulse or switching surge voltage upto maximum design value for SA.

The end fittings shall be non-magnetic and of corrosion proof material.

The Bidder shall furnish the following:

- a) V-I characteristics of the disc/block.
- b) Metalizing coating thickness for reduced resistance between adjacent discs along with procedure for checking the same.
- c) Details of thermal stability test for uniform distribution of current on individual discs.
- d) Detailed energy calculations to prove thermal capability of discs.

4. FITTINGS AND ACCESSORIES

Each SA shall be complete with insulating base for mounting on structure.

SAs shall be provided with grading and/or corona rings as required.

Self-contained discharge counters, suitably enclosed for outdoor use (IP:55 degree of protection) and requiring no auxiliary or battery supply shall be fitted with each SA along with necessary connections to SA and earth. Suitable leakage current meters shall also be supplied in the same enclosure. The reading of milli-ammeter and counter shall be visible through an inspection glass panel to a man standing on ground. A pressure relief vent/suitable provision shall be made to prevent pressure build up.

5. PARAMETERS

5.1 General

- a) System neutral earthing - Effectively earthed
- b) Installation - Outdoor
- c) Nominal discharge current - 10 kA of 8/20 microsec. wave
- d) Rated frequency - 50 Hz
- e) Long duration discharge class - 3
- f) Current for pressure relief test - 31.5 kA rms
- g) Prospective symmetrical fault current - 31.5 kA rms for 1 second
- h) Low current long duration test value (2000 micro sec.) - As per IEC
- i) Pressure relief class - Class A of Table VII of IS:3070 or equivalent IEC.
- j) Partial discharge at 1.05 MCOV (Continuous operating voltage) - Not more than 50 deg C.
- k) Siesmic acceleration - 0.3 g horizontal
- l) Reference ambient temp. - 50 deg. C

5.2 66 kV Class Surge Arrestor

a)	Rated system voltage	66KV
b)	Rated arrester voltage	60 KV
c)	Minimum discharge capability	8 kJ/kV or corresponding to minimum discharge characteristics given whichever is higher.
d)	Continuous Operating Voltage (COV) at 50 deg. C	49 kV rms
e)	Max. switching surge residual voltage (1 kA)	165 kVp maximum
f)	Maximum residual voltage at	
	i) 10kA nominal discharge current	180 kVp
	ii) 20kA nominal discharge current	As per IEC
g)	High current short duration test value (4/10 microsec. wave)	100 kVp
h)	Min. Total creepage distance	1850 mm
i)	One minute dry/wet power frequency withstand voltage of arrester housing	140 kV (rms)
j)	Impulse withstand voltage of arrester Housing with 1.2/50 micro sec. wave.	± 325 kVp
k)	RIV at 42 kV (rms)	Less than 1000 micro volts

6. COMPLETENESS OF EQUIPMENT:

Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment, shall be deemed to have been included in this specification.

7. PACKINGS:

All material shall be suitably packed for transport, direct to site and Manufacturer shall be responsible for all damages/losses due to improper packing. All boxes shall be marked with signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the Manufacturers.

6. 66 KV CABLE AND ACCESSORIES

1. SCOPE:

The scope under this section covers design, engineering, manufacture, testing, packing, supply of 66 KV, XLPE, insulated power cable for use with solidly grounded distribution systems. The XLPE cable and its accessories shall be complete with all fittings and components necessary for the satisfactory performance and ease of maintenance.

2. STANDARDS:

Unless otherwise specified, the cables shall conform, in all respects, to IEC-502, IEC-60840 and IS: 7098 (Part-III) / 1993 with latest amendment or latest edition for cross linked polyethylene insulated Thermoplastic High Density Polyethylene sheathed cable for working voltage of 66 KV.

3. CLIMATIC CONDITIONS:

The climatic conditions under which the cable shall operate satisfactorily are as follows:

- a) Maximum ambient temperature of air in shade °C : 50
- b) Minimum ambient temperature of air in shade °C : 4
- c) Maximum daily average ambient temperature °C : 40
- d) Maximum yearly average ambient temperature °C : 30
- e) Maximum relative humidity % : 95
- f) Max. soil temp. at cable depth °C : 40
- g) Max. soil thermal resistivity ohm-cm : 100-120 Deg C cm/watt

4. PRINCIPAL PARAMETERS:

4.1 66 KV (E) grade XLPE single core power cable of single length, with H.D. aluminium conductor, shielded with extruded semi-conducting layer, insulated with dry gas cured cross linked polyethylene (XLPE) insulation, insulation screened with extruded semi-conducting layer followed by semi-conducting non-woven water swellable tape, insulated core copper-wire, screened (suitable for 31.5KA for 1 sec) tapped with a combination of semi-conducting water swellable and poly aluminium laminated followed by black extruded Thermoplastic

HDPE (Poly-ethylene) inner sheath. Single H.D. aluminium wire armoured (suitable for 31.5KA for 1 sec) and graphite coating Thermoplastic HDPE outer sheathed overall cable, conforming to IEC-60840 for construction and also confirming to IS : 7098 (Part-III) / 1993 or any latest amendments thereof.

4.2 Outer sheathing should be designed to afford high degree of mechanical protection and should also be heat, oil chemicals and weather resistant. Common acid. Alkalis and saline solution should not have adverse effect on the Thermoplastic HDPE sheathing material used.

4.3 The cable should be suitable for laying in covered trenches and / or underground for outdoor.

4.4. CABLE PARAMETERS 66 KV (to be customized by utility as per requirements and capacity)

1	Voltage grade (Uo/U) KV	38/66
2	No. of cores	Single
3	Size (mm ²)	630

4	Nominal system voltage KV	66
5	Highest system voltage KV	72.5
6	System Frequency Hz	50
7	Variation in frequency	± 5 %
8	Fault level individually for	
	Conductor	59.22 KA / 1 Sec.
	Cu.screen	31.5 KA / 1 Sec.
	Armour	31.5 KA / 1 Sec.
9	Maximum allowable temperature, deg c	
	a) Design continuous operation at rated full load current, the max. temp. of conductor shall not exceed(deg c) :90	
	b) The conductor temperature after a short circuit for 1.0 sec. shall not exceed (deg c)	: 250
10	Basic insulation level.	
	(1.2 / 50 Micro second wave)	350 kVp
11	1-min. power frequency withstand voltage	140 kV
12	System earthing	Solidly grounded

5 GENERAL TECHNICAL REQUIREMENTS:

- 5.1 CONDUCTOR: The cable conductor shall be made from stranded H.D. aluminium to form compact circular shaped conductor having resistance within limits specified in IS: 8130 / 1984 and any amendment thereof. The conductor shall conform to IEC: 228 and the shape shall be compacted circular shaped.
- 5.2 CONDUCTOR SHIELD: The conductor having a semi-conducting screen shall ensure perfectly smooth profile and avoid stress concentration. The conductor screen shall be extruded in the same operation as the insulation; the semiconducting polymer shall be cross-linked.
- 5.3 INSULATION: The XLPE insulation should be suitable for specified 66KV system voltage. The manufacturing process shall ensure that insulations shall be free from voids. The insulation shall withstand mechanical and thermal stressed under steady state and transient operating conditions. The extrusion method should give very smooth interface between semi-conducting screen and insulation. The insulation of the cable shall be of high standard quality, generally conforming to IEC-60840 and I.S. 7098 part-III / 1993 (latest edition).
- 5.4 INSULATION SHIELD: To confine electrical field to the insulation, nonmagnetic semi-conducting shield shall be put over the insulation. The insulation shield shall be extruded in the same operation as the conductor shield and the insulation by triple extrusion process. The XLPE insulation shield should be bonded type. Metallic screening shall be provided. The metallic screen shall be of copper wire having fault current capacity (31.5 KA for 1-sec.)
 - 5.4 a) A semi-conducting non-woven water blocking tape shall be provided over the extruded semi conducting layer and over the copper wire metallic screen.
 - 5.4b) To avoid the ingress of moisture, poly-aluminium laminate tape shall be applied longitudinally with suitable overlap.

- 5.5 INNER-SHEATH: The sheath shall be suitable to withstand the site conditions and the desired temperature. It should be of adequate thickness, consistent quality and free from all defects. The sheath shall be extruded and of black Thermoplastic H.D.P.E. (Poly-ethylene).
- 5.6 ARMOUR: Single H.D. Aluminium wire armouring shall be provided. The dimension of H.D. Aluminium wire armouring shall be as per latest IS: 3975/19988. The armour shall be having fault current capacity (31.5 KA for 1- sec.)
- 5.7 OUTER SHEATH: Extruded Thermoplastic HDPE outer sheath conforming to IEC: 502/1983, shall be applied over armouring with suitable additives to prevent attack by rodents and termites. The outer sheath shall be coated with graphite throughout the length of cable.
- 5.8 CONSTRUCTION:
- 5.8.1 All materials used in the manufacture of cable shall be new unused and of finest quality. All materials should comply with the applicable provision of the tests of the specification. IS, IEC, CEA regulations, Indian Electricity Act and any other applicable statutory provisions rules and regulations.
- 5.9 CURRENT RATING: The cable will have current ratings and derating factors as per relevant standard IEC.
- 5.9.1 The one-second short circuit current rating values each for conductor, screen & armour shall be furnished and shall be subject to the purchaser's approval.
- 5.9.2 The current ratings shall be based on maximum conductor temperature of 90 deg. C with ambient site condition specified for continuous operation at the rated current.
- 5.10 OPERATION:
- 5.10.1 Cables shall be capable of satisfactory operation under a power supply system frequency variation of $\pm 5\%$ voltage variation of $\pm 10\%$ and combined frequency voltage variation shall be $+10\%$ & $- 15\%$.
- 5.10.2 Cable shall be suitable for laying in ducts or buried under ground.
- 5.10.3 Cable shall have heat and moisture resistance properties. These shall be of type and design with proven record on transmission network service.
- 5.11 IDENTIFICATION MARKING: Identification of cables shall be 'provided externally at three meters' intervals to identify as under.
- i) 'Name of manufacture'
 - ii) 'Per meter marking'
 - iii) 'Year of manufacture'
 - iv) 'Voltage grade' to be printed / embossed at the interval of one meter-length.
- The identification, by printing or embossing shall be done only on the outer sheath. Name of the purchaser shall also be embossed.
- 6.0 TESTS: (refer Tech specification Volume III Section I).

7. 66KV POST INSULATORS

1 GENERAL

The post insulators shall conform in general to latest IS:2544 and IEC-815.

2 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 shall be accepted. Height of post insulator shall be matched with the bus-bar and equipment line part elevation for required ground clearance.

The other requirements of insulator as given in technical specification of Auxiliary Items shall also be applicable.

3 TESTS

3.1 In accordance with the stipulations under part-I the post insulators shall conform to type tests and acceptance, sample and routine tests as per IS:2544, IEC-168 shall be carried out.

3.2 In addition to acceptance/sample/routine tests as per IS:2544, IEC-168, the following tests shall also be carried out.

- a) Ultrasonic tests on all cut shells as routine check.
- b) Visual examination and magnaflux test on all flanges prior to fixing.
- c) Check for uniformity of thickness and weight of zinc coating as a sample test from each lot of flanges prior to fixing.
- d) Bending load test shall be carried out at 50% minimum failing load in four directions as a routine test.
- e) Bending load in four directions at 100% minimum bending load guaranteed on samples as per clause-2.3 of IEC. Subsequently this post insulator shall not be used.
- f) Tests for deflection measurement at 20, 50, 70% of specified minimum failing load on sample.

3.3 The post insulator shall conform to following type tests as applicable according to voltage class:

- a) Switching Impulse withstand test (dry & wet)
- b) Lightning Impulse withstand test (dry)
- c) Power frequency withstand test (dry & wet)
- d) Test for deflection under load.
- e) Test for mechanical strength,

4 PARAMETERS

66 kV Class Bus Post Insulator		
a)	Type	Solid core type
b)	Voltage class (kV)	66 kV
c)	Dry and wet one minute power frequency withstand voltage (kV)	140 kV
d)	Dry impulse withstand positive and negative (kVp)	±325kv
e)	Max. radio interference voltage (pV) for any frequency between 0.5 MHz at voltage of 42 kV (rms) between phase to ground.	1000
f)	Total min. cantilever strength (Kg)	600
g)	Min. torsional moment (Kg m)	As per IEC-273
h)	Total height of insulator (mm)	As per Requirement
	i) Top p.c.d. (mm)	127
	ii) Bottom p.c.d. (mm)	127
i)	No. of bolts :	
	Top	4
	Bottom	8
j)	Diameter of bolt holes (mm)	
	Top	M16
	Bottom	Dia 18
k)	Pollution level as per IEC – 815	Class III, Heavy
l)	Min. total creepage distance (mm)	1850

5 COMPLETENESS OF EQUIPMENT:

Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment, shall be deemed to have been included in this specification.

6 PACKINGS:

All material shall be suitably packed for transport, direct to site and Manufacturer shall be responsible for all damages/losses due to improper packing. All boxes shall be marked with signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the Manufacturers.

8. LIGHTING

(refer Volume III Section I for specifications)

9. LT SWITCHGEAR & DBS

(refer Volume III Section I for specifications)

10. BATTERY & BATTERY CHARGER

(refer Volume III Section I for specifications)

11. CONTROL & PROTECTION SYSTEM FOR 66KV SUB-STATION

1 PREAMBLE

This specification is based on the understanding that the bidder shall supply and commission a completely integrated System for 66 kV Sub-station as-

1. Substation control system.
2. Substation protection system
3. Energy meters for 66 kV and 11 kV Switchgear

2 GENERAL REQUIREMENTS OF CONTROL SYSTEM

1. The Simplex panel shall be vertical and freestanding, floor mounted type with swinging door at the back of the panel.
2. The height and width of the panel shall be as per standard practices.
3. One panel should accommodate two bay controlling facilities.
4. Each bay control shall comprise of,
 - a. One wattmeter, one voltmeter with selector switch and one ammeter with selector switch, one varmeter.
 - b. One control switch having LED type red and green indication for breaker control.
 - c. Red /green LED type indication lamp for isolator indication.
 - d. Semaphore indicator for earth switch.
 - e. One synchronizing switch with key and sockets.
 - f. The bay control panel for transformer shall also include cut out for one no RWTI.
5. Annunciator with window type display shall be provided on each control panel for alarm annunciation. The display shall be of standard size and shall accommodate minimum two alarms simultaneously. The annunciator shall have accept, reset and test facilities.
6. The panel shall have the required control wiring. The wire shall be 1.5sqmm copper per connection. For CT connection only 2.5sqmm size cable per connection shall be used.
7. Necessary space heater, lighting arrangements shall be provided.
8. Independent transducer shall be provided for varmeter and wattmeter. One extra output

of 4-20ma shall be provided on the transducer for owner use. The accuracy of the transducer shall be 0.5%.

9. One of the panels should house the Check syn relay and Guard relay for synchronization. The synchronizing bus shall be of 2.5sqmm cable. The inter-panel wiring with necessary connection to check syn switch shall form the syn bus.
10. Bidder shall provide the syn scheme as per approval.

3 PANEL CONFIGURATION

As per Sub-Station requirement (to be specified by Employer)

4 GENERAL REQUIREMENTS OF RELAYS

- a. All relays and devices shall be of proven design and suitable make & type for the application satisfying the requirements specified elsewhere and shall be subject to the Employer's approval. Relays shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach and other characteristics to provide the required sensitivity to the satisfaction of the Employer.
- b. Relays shall be suitable for efficient and reliable operation of the protection scheme. The necessary auxiliary relays, trip relays, etc. required for complete scheme, interlocking, alarm, logging, etc. shall be provided. No control relay, which shall trip the circuit breaker when the relay is de-energized, shall be employed in the circuits.
- c. Relays shall be provided with self-reset contacts except for the trip lockout, which shall have contacts with a manual reset feature.
- d. Suitable measures shall be provided to ensure that transients present in CT & VT connections due to extraneous sources in the EHV system do not cause damage to relays. CT saturation shall not cause mal-operation of relays.
- e. Only DC/DC converters shall be provided in solid state devices/relays wherever necessary to provide a stable auxiliary supply for relay operation.
- f. DC batteries in protective relays necessary for relay operation shall not be acceptable. Equipment shall be protected against voltage spikes in the auxiliary DC supply.
- g. The testing and commissioning protocols for the protection systems offered shall be approved by the Employer before commissioning on site.

5 EHV LINE PROTECTION

Each 66 kV line shall be provided with the following protection:

- i) 3-zone non-switched static distance protection (21) proven for EHV D/C line protection application.
- ii) Non directional 3-ph over current (51)-(Definite Time).
- iii) Non directional earth fault (51N)- (Definite Time).
- iv) Autoreclosing relay.

- v) Check syn relay.

6 BUS COUPLER PROTECTION

- i) Non directional 3 ph over current (51)
- ii) Non-directional delayed earth fault (51N)- (Definite Time).

7 66/11 kV TRANSFORMER PROTECTIONS

- i) Static Biased differential protection. (87T) with 2nd harmonic resistant with high set. Unit.
- ii) High Impedance LV REF. (64)
- iii) HV Directional over current (67/50/51)
- iv) LV Back up Earth Fault (51N)

8 66 kV BUS PT

- i) Bus PT fuse failure relay.
- ii) 70% Bus under voltage relay.

9 PROTECTION PHILOSOPHY

- i) The 66kv line distance protection shall be set to cover the line length as per the parallel line distance protection philosophy.
- ii) The over current and earth fault relay provided on bus coupler and line shall be coordinated in such a way that for a bus fault on any of the bus the bus coupler shall open first. Then after some time delay the corresponding line shall be tripped. This time shall be less than zone-2 times setting of the remote end distance protection.
- iii) Fault between the 66/11 kV transformer and corresponding CT shall be cleared by the corresponding directional earth fault relay.
- iv) The distance relay offered by the bidder shall be suitable for 3-zone distance protection of 66kv and above line of length not more than 2 KM. The relay shall give reliable operation under all system contingencies. E/F element characteristics shall be reactive type to limit the mal operation and shall be reliable under high resistance fault.
- v) The distance relay located at the both end of transmission line shall operate independent of PLCC link.
- vi) The LBB trip command shall be extended to bus coupler and same bus breakers by appropriate isolators logic.

10 AUTO-RECLOSE AND SYNCHRONIZING CHECK

Auto-reclose (AR) and Synchronizing Check (SC) functionality shall be provided in a separate device. The interfacing between S/S Controller and Protection Units for achieving the AR function logic shall be achieved at Bay Level using communication LAN as well as standby hard-wired logic. The AR function shall meet the following criteria:

- Be of single shot type
- Have three phase reclosing facilities. It shall have a user-selectable option of three phase or non-auto reclosure mode.
- Incorporate a normal/delayed auto reclosure option with a time range of 1 to 60 s.
- Have a continuously variable three-phase and single-phase dead time of 0,1 to 5 s.
- Have a continuously variable reclaim time of 5 to 300 s.
- Incorporate the necessary auxiliary relays and timers to provide a comprehensive reclosing and synchronizing scheme.
- Have facilities for selecting check synchronizing or dead line charging features. The user shall have an option to change the required feature.

The built-in Synchronization Check feature shall determine the difference between the amplitudes, phase angles and frequencies of two voltage vectors. Checks shall be provided to detect a dead line or bus bar. The voltage difference, phase angle difference and slip frequency settings shall be adjustable.

11 66 kV CIRCUIT-BREAKER PROTECTION

Each circuit breaker in the 66 kV bay shall be provided with following protection functions:

- i) Local Breaker Back up Protection Function: LBB protection function shall be provided for each circuit breaker in the 66 kV Sub-Station with following logic.
 - Be three pole type having three single phase units
 - Shall operate for stuck breaker conditions
 - Have an operating/resetting time each of less than 15 ms.
 - The LBB function shall be initiated by external trip contacts from the Protection Units and after a set time delay shall energize the trip bus coupler.
 - Have a setting range of 5 to 80% of rated current
 - Have a continuous thermal withstand of 2 times rated current irrespective of the setting.
 - Have time delay feature with a continuously adjustable setting range of 0,1 to 1 s.

- Shall be an individual phase comprehensive scheme.
 - Shall not operate during the single-phase auto-reclosing period.
- ii) Trip Coil Supervision: A Trip Coil supervision function shall be provided for each lockout trip relay and each of the circuit-breaker trip coils. It shall incorporate both the pre-close and post-close supervision of trip coils and associated trip circuits. An audible alarm shall be given in the event of operation of trip coil supervision function. It shall have a time delay on drop-off of not less than 200ms.

12 ENERGY METERS

- a) Shall carry out measurement of active energy (both import and export) and reactive energy (both import and export) by 3 phase, 4 wire principle suitable for balanced/unbalanced 3 phase load.
- b) Shall have an accuracy of energy measurement of at least Class 0.5 for active energy and at least Class 1 for reactive energy according to IS 14697 and IEC 60687, and shall be connected to Class 0.5 CT cores and Class 0.5 VT windings.
- c) The active and reactive energy shall be directly computed in CT & VT primary ratings. The active energy shall be stored for each metering interval in two different registers as MWh (Export) and MWh (Import), along with a plus (+) sign for export and minus (-) sign for import. The reactive energy shall be stored for each metering interval in four different registers as MVARh (lag) when active export, MVARh (Lag) when active import, MVARh (lead) when active export, MVARh (Lead) when active import. In addition, two more registers shall be provided to record MVARH when system voltage is >103% and when system voltage is < 97%.
- d) Shall accumulate the net MWh and MVARh during each successive 15-minute block metering interval and store in the registers in non-volatile memory.
- e) Shall continuously integrate the energy readings of each register up to the previous metering interval.
- f) Each energy meter shall have a display unit. It shall display the net MWh and MVARh during the previous metering interval; peak MWh demand since the last demand reset; accumulated total MWh and MVARh; date and time; and instantaneous current and voltages on each phase.
- g) All the registers shall be stored in a non-volatile memory. Meter registers for each metering interval, as well as accumulated totals, shall be downloadable.
- h) At least last 40 days of data shall be stored before being over-written.
- i) Shall have a built in clock and calendar with an accuracy of less than 15 seconds per month drift without assistance of external time synchronizing pulse.
- j) Date/time shall be displayed on demand. Facility for synchronization of the clock by external signal shall be there.
- k) The voltage monitoring of all the three voltages shall be provided as well as alarm contact to indicate meter healthy status. The meter shall normally operate with power

drawn from the VT supplies. The burden of the meters shall be less than 2 VA.

- l) The power supply to the meter shall be healthy even with a single-phase VT supply. An automatic backup, in the event of non-availability of voltage in all the phases, shall be provided by a built in long life battery and shall not need replacement for at least 10 years with a continuous VT interruption of at least 2 years. Date and time of VT interruption and restoration shall be automatically stored in a non-volatile memory.
- m) Shall have an optical port as well as RS 485 port on the front of the meter for data collection from either a hand held meter reading instrument (MRI) having a display for energy readings (to be supplied by the bidder) or through modem to central data center. The MRI shall be complete with optical interface unit required.
- n) The meter shall be provided with signaling output on the front to test MWh and MVARh accuracy and calibration at site in-situ and test terminal blocks shall be provided for the same.

13 PANELS

All panels shall be free standing, simplex type, floor mounting type and completely metal enclosed. Cable entries shall be from the bottom. Panels shall be of IP 31 class or better.

Panels shall have removable gland plates with glands made of brass and shall be suitable for armoured cables.

Panels shall be painted. The colour of paint for exterior of the panel shall be as follows:

- | | | |
|----|----------------|---|
| a) | Ends | Powder coated smoke grey to shade : 692 of IS-5
(Semi Gloss) |
| b) | Front and Rear | -do- |
| c) | Interior | White |
| d) | Base | Black |

14 Earthing

- a) The panels shall be equipped with an earth bus of at least 50x6mm² galvanized steel flat bar or equivalent copper.
- b) Earth buses of adjoining panels shall be connected for continuity. The continuous earth bus so formed shall be connected to the main earth grid at one end only.
- c) All metallic cases of the mounted equipment shall be separately connected to the earth bus by 2.5mm² copper wire. No loops in the earth wiring shall be permitted.
- d) CT/VT neutral secondary shall only be earthed at the terminal block of the panel through links, such that the earthing of one group may be removed without disturbing others.

15 CONTROL CABLING PHILOSOPHY IN SUB-STATION

- a) Each secondary core of each phase CT/CVT shall be brought to the equipment marshalling box through independent cables.
- b) Each three phase secondary core of each CT/CVT shall be brought to the associated control/relay panel from the equipment marshalling box through independent cables.
- c) Single cores with at least 2.5mm² equivalent core cross-sectional area per connection shall be used for connection of all CT/CVT circuits.
- d) VT leads used for tariff metering shall have an equivalent core cross-sectional area of at least 2.5 mm² or equivalent per phase/neutral connection.
- e) Duplicate channels of protection shall have independent cables for tripping, DC supply, etc.
- f) For the following applications multiple cores with at least 2.5 mm² equivalent core cross-sectional area per connection shall be used:
 - i) DC supply to Bay Marshalling box
 - ii) DC supply to circuit-breaker cubicle
 - iii) DC looping for closing and tripping circuits of circuit-breaker
- g) Spare cores shall be provided as per following norms:

Up to 3-core cable	-	Nil
5 Core Cable	-	Min. 1 core
7 to 14 core cables	-	Min. 2 cores
More than 14 core	-	Min. 3 cores
- h) For various field input from the breaker, transformer etc. for alarm, at least 1.5mm² equivalent cross section area per connection shall be used.

16 FACTORY ACCEPTANCE TESTS (FAT)

All equipment furnished under this specification shall be subject to test by authorized quality assurance personnel of the bidder and Employer's representatives during manufacture, erection and on completion. The approval of the Employer or passing such inspections or tests will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specifications when erected or fails to give complete satisfaction in service. The detailed requirement of operational and pre-FAT tests as well as FAT test (Integrated Test) is given in this Section.

The FAT shall be mutually agreed upon and approved by Employer during detailed engineering.

17 Operational and Pre-FAT Tests

- a) The authorized quality assurance personnel of the manufacturer shall conduct all tests as per the requirements and fully satisfy themselves regarding completeness of hardware, software and full compliance with specification requirements by all equipment/sub-systems and the system as a whole before sending notification for FAT to the Employer. Bidder shall maintain accurate records for all pre-FAT tests which shall be properly documented and duly certified documents shall be furnished to Employer at least two weeks prior to FAT tests, while giving inspection call.
- b) Each individual item of equipment/sub-system furnished by the Bidder as well as the complete system as per this specification shall be inspected and tested by the Bidder in his works for full compliance with specification requirements, completeness, proper assembly, proper operation, cleanliness and state of physical condition as applicable.
- c) The Bidder shall conduct a point by point wiring continuity check to every input and output and verify that the wiring connections agree with the documentation.
- d) The pre-FAT report shall be in the format of FAT procedure as approved by the Employer. It shall be accompanied by a very detailed report, in a log form, of the performance of all pre-FAT Tests. These records shall list not only the successfully completed tests, but shall detail all system, test and component failures.
- e) Bidder shall send notification regarding readiness for FAT and indicate the proposed date for commencement of FAT to enable the Employer to depute representatives for participating in these tests. The notification shall be sent to the Employer not less than one month prior to commencement of the FAT along with the copies of documents covering pre-FAT results.
- f) The Bidder shall ensure that all hardware required for fully implementing the system as per requirements of this specification is available and the adequacy of hardware, system configuration, etc., is fully established during the pre-FAT Tests conducted by the Bidder. In case any deficiencies in hardware is noticed by the Bidder during the pre-FAT Tests, the Bidder shall make good all such deficiencies and re-conduct the required tests to fully satisfy himself regarding completeness of the system and full compliance with specification requirements before sending notification to the Employer regarding FAT Tests.

18 SITE / COMMISSIONING TESTS

Site tests shall include all tests to be carried out at site upon receipt of equipment. It shall include but not be limited to testing calibration, configurations and pre-commissioning trials, startup tests, trial operation and performance and guarantee tests. The Bidder shall be responsible for all site / commissioning tests.

The Bidder shall maintain all tests, calibration records in Employer approved formats, and these shall be countersigned by authorized quality assurance personnel of the Bidder supervising these works.

The Bidder shall maintain master checklists to ensure that all tests and calibration for all equipment/devices furnished under these specifications are satisfactorily completed under the supervision of the authorized quality assurance personnel of the Bidder.

The site / commissioning tests shall be categorized under following categories:

- a) Startup tests
- b) Calibration and configuration checks
- c) Pre-commissioning tests
- d) Trial Operation
- e) Availability Tests

19 Point-to-point testing shall include:

- Verification of all status indications by operating the plant
- Verification of event / alarm indications by simulating alarm conditions
- Verification of all analogue indications by injection testing.
- Verification of control and protection logic.

20 System Hand-over and Final Acceptance

The system will be handed-over to the Employer for commercial operation after the site / commissioning tests have been completed to the satisfaction of the Employer. A hand-over certificate will be issued by the Employer. The Bidder will still be responsible for the Availability Tests.

Final acceptance of the system by the Employer will take place after the Availability Tests have been done to the satisfaction of the Employer.

21 TYPE TEST REQUIREMENTS

Test reports for following type tests shall be submitted for all relays.

A. Insulation Tests:

S.No.	Description	Standard
1.	Dielectric Withstand Tests	IEC 60255-5 2 kV rms for 1 minute between all case terminals connected together and the case earth. 2 kV rms for 1 minute between all terminals of independent circuits with terminals on each independent circuit connected together. ANSI/IEEE C37.90-1989 1 kV rms for 1 minute across the open contacts of the watchdog relays. 1 kV rms for 1 minute across open contacts of changeover output relays. 1.5kV rms for 1 minute across open contacts of normally open output relays.
2.	High Voltage Impulse Test, class III III	IEC 60255-5 5 kV peak; 1.2/50 psec; 0.5 J; 3 positive and 3 negative shots at intervals of 5 sec

B. Electrical Environment Tests:

1.	DC Supply Interruption	IEC 60255-11 The unit will withstand a 20ms interruption in the auxiliary supply, in its quiescent state, without de-energizing.
2.	AC Ripple on DC supply	IEC 60255-11 The unit will withstand a 12% ac ripple on the dc supply.
3.	AC voltage dips and short Interruptions	IEC 61000-4-11 20ms interruptions/dips.
4.	High Frequency Disturbance	IEC 60255-22-1, class III At 1MHz, for 2s with 200 ohms source impedance: 2.5 kV peak; 1 MHz; T = 15 psec; 400 shots/sec; duration 2 sec between independent circuits and independent circuits and case earth. 1.0kV peak across terminals of the same circuit.
5.	Fast Transient Disturbance	IEC 60255-22-4, class IV 4kV, 2.5kHz applied directly to auxiliary supply 4kV, 2.5kHz applied to all inputs.
6.	Surge Withstand Capability	IEEE/ANSI C37.90.1 (1989) 4kV fast transient and 2.5kV oscillatory applied directly across each output contact, optically isolated input and power supply circuit
7.	Radiated Immunity	C37.90.2: 1995 25MHz to 1000MHz, zero and 100% square wave modulated. Field strength of 35V/m.
8.	Electrostatic Discharge	IEC 60255-22-2 Class 4 15kV discharge in air to user interface, display and exposed metal work. IEC 60255-22-2 Class 3 8kV discharge in air to all communication ports. 6kV point contact discharge to any part of the front of the product.
9.	Surge Immunity	IEC 61000-4-5: 1995 Level 4 4kV peak, 1.2/50ms between all groups and case earth. 2kV peak, 1.2/50ms between terminals of each group.
10.	Capacitor Discharge	No change of state or any operation shall occur when a capacitor of capacitance shown below, charged to $1.5 \times V_n$ volts, is connected between any combination of terminals and any combination of terminals and ground. Master trip circuits – 10pF Other protection & control circuits – 2pF

C. EMC Tests:

Sl. No.	Description	Standard
1.	Radio-Frequency Electromagnetic Field, Non-Modulated	IEC 60255-22-2, class III 10 V/m; 27 MHz to 500 MHz
2.	Radio-Frequency Electromagnetic Field, Amplitude Modulated	ENV 50140, class III 10 V/m; 80 MHz to 1000 MHz; 80% AM; 1 kHz
3.	Radio-Frequency Electromagnetic Field, Pulse Modulated	ENV 50140/ENV 50204 10 V/m; 900 MHz; repetition frequency 200 Hz; duty cycle 50 %
4.	Disturbances Induced by Radio Frequency fields, Amplitude Modulated	ENV 50141, class III
5.	Power Frequency Magnetic Field	EN 61000-4-8, class IV 30 A/m continuous; 300 A/m for 3 sec; 50Hz
6.	Interference Voltage, Aux. Voltage	EN 50081- 150 kHz to 30 MHz
7.	Interference Field Strength	EN 50081- 30 MHz to 1000 MHz

D. Atmospheric Environment Tests:

Sl. No.	Description	Standard
1.	Temperature	IEC 60255-6 Operating -4°C to +55°C Storage and transit -4°C to +70°C IEC 60068-2-1 for Cold IEC 60068-2-2 for Dry heat
2.	Humidity	IEC 60068-2-3 56 days at 93% RH and +40°C

E. Mechanical Stress Tests:

Sl. No.	Description	Standard
1.	Vibration (during Operation and Transportation)	IEC 255-21-1; IEC 68-2-6 Response Class 2 Endurance Class 2
2.	Shock (during Operation and Transportation)	IEC 255-21-2, class 1, IEC 68-2-27 Shock response Class 2 Shock withstand Class 1 Bump Class 1
3.	Seismic Vibration (during Operation)	IEC 60255-21-3 Class 2
4.	Continuous Shock (during Transportation)	IEC 255-21-2, class 1, IEC 68-2-27

22 SETTINGS

Fault levels will be provided to the Bidder by the Employer. The Bidder shall, based on this information, compile a complete and detailed report for the setting of the protection elements on all the protection equipment, to the approval of the Employer. Any additional information required to complete this exercise shall be timeously requested by the Bidder.

The bidder shall provide the Employer with a philosophy document clearly setting out the philosophy the bidder will use in determining setting levels. Each setting will have a brief description of the specific function or element. The setting calculation and formula will also be shown on the document. All relevant system parameters, line data, transformer data additionally used for calculating the setting will appear in the setting document. The bidder will conduct system studies in determining fault levels on different locations. These study results will also form part of the setting document. Any additional information required to complete this exercise shall be timeously requested by the Bidder.

The setting document will be presented and discussed with the Employer prior to final issue of the document. The final accepted setting document should be made available to the Employer in PDF format.

It is the Bidder's responsibility to configure each protection relay to provide the protection and control facilities required. A full set of relay configuration and setting files shall be included in the design and documentation submissions. The bidder will issue three sets of setting documents once accepted by the client and consultant.

23 COMPLETENESS OF EQUIPMENT:

Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment, shall be deemed to have been included in this specification.

24 PACKINGS:

All material shall be suitably packed for transport, direct to site and Manufacturer shall be responsible for all damages/losses due to improper packing. All boxes shall be marked with signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the Manufacturers.

12. SWITCHYARD AUXILIARY ITEMS

1. ACSR CONDUCTOR

a)	Code and standard	IS 398 (Part-II)
b)	Name	ACSR Equivalent to 261.5 sq.mm. area conductor/Panther
c)	Overall diameter	21.00 mm
d)	Weight	974 kg/km
e)	Ultimate tensile strength	89.67 kN minimum
f)	Strands and wire diameter of	
-	Aluminium	30/3.00 mm
-	Steel	7/3.00 mm

2. CLAMPS AND CONNECTORS

- 2.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.
- 2.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.
- 2.3 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.
- 2.4 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.
- 2.5 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.
- 2.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.
- 2.7 Current rating and size of terminal/conductor for which connector is suitable shall be embossed/punched on each component.

3. INSULATOR STRING HARDWARE

3.1 The insulator hardware shall be of bolted type and shall be of forged steel except for insulator cap, which can be of malleable cast iron. It shall also generally meet the requirements of clamps and connectors as specified above.

3.2 In one span, Tension string assembly at one end shall be supplied with suitable turn buckle.

3.3 Disc Insulator

The disc insulator shall meet the following parameters:

- | | | | |
|----|-----------------------------------|---|--|
| a) | Type | : | Antifog type insulator |
| b) | Size of insulator | : | 255x145 |
| c) | Electro mechanical strength | : | 120kN |
| d) | Leakage distance (mm) | : | 430mm minimum or as required to meet the total creepage. |
| e) | Power frequency withstand voltage | : | 85 kV (dry), 50kV (wet) |

4. EARTHING CONDUCTOR

4.1 The main conductor buried in earth shall be 40mm dia rod for main and auxiliary mat. The earthing conductors over the ground shall be of 75x12 mm GS flat. The earthing leads for columns and auxiliary structures, cable trenches shall be of 75x12 mm GS flat. The earthing of the lighting fixtures shall be carried out by 16 SWG wire.

4.2 All conductors above the ground level shall be galvanised steel.

4.3 Earthwire for Lightning Protection

- | | | | |
|----|----------------------------|---|-----------------------------|
| a) | Number of strands | : | 7 of steel |
| b) | Strand diameter | : | 3.15 mm |
| c) | Overall diameter | : | 9.45 mm |
| d) | Weight | : | 431.80 kg/km approx. |
| e) | Ultimate tensile strength | : | 68.4 kN minimum |
| f) | Total cross-sectional area | : | 54.55 sq.mm. |
| g) | Calculated DC resistance | : | 3.375 ohms/km at 20 deg. C. |

- | | | |
|----|---------------------------------|---|
| h) | Direction of lay of outer layer | Right hand |
| i) | Protective coating for storage | Boiled linseed oil to avoid wet storage stains (white rust) |

4.4 Cable Support Structures & Accessories

4.4.1 The Bidder shall fabricate and install mounting arrangements for the support and installation of all the cables on angles in trenches. These mounting structures/cable racks shall be fabricated from structural steel members (channels, angles and flats) of the required size.

4.4.2 Cable supports shall be painted after installation. The painting shall be in conformity with stipulated in Volume-III, Section-I. All welding works inclusive of the consumables required for fabrication and installation shall be in the scope of the Bidder.

5. BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS, AND DISC INSULATORS

5.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC:137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5284. The support insulators shall be manufactured and tested as per IS:2544/IEC 168/IEC 273. The insulators shall also conform to IEC 815 as applicable.

5.2 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

5.3 Porcelain used shall be homogenous, 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. Hollow porcelain should be in one integral piece in green & fired stage.

5.4 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burns and other similar defects.

5.5 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 when operating at normal rated voltage.

5.6 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.

5.7 Bidder shall make available data on all the essential features of design including the method of assembly of shells and metal 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.

5.8 Post type insulators shall consist of a porcelain part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.

5.9 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way

be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

- 5.10 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued, porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.
- 5.11 Bushings, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/ sample test in accordance with relevant standards.
- 5.12 Insulator shall meet requirement of IEC - 815 as applicable, having alternate long & short sheds.
- 6. CABINETS, BOXES, KIOSKS AND PANELS, ETC.
- 6.1 All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, etc. shall generally conform to IS:5039, IS:8623 and IEC:439 as applicable.
- 6.2 They shall be of painted sheet steel or aluminium. The thickness of sheet steel shall be 2mm cold rolled or 2.5mm hot rolled. The thickness of aluminium shall be 3mm and shall provide rigidity. Top of the boxes shall be sloped towards rear of the box. The paint shall be of grey RAL 9002 on the outside and glossy white inside. However, the junction and switch boxes shall be of hot dip galvanised sheet steel of 1.6mm thickness.
- 6.3 The cabinets/boxes/kiosks/panels shall be free standing or wall mounting or pedestal mounting type. They shall have hinged doors with padlocking arrangement. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets.
- 6.4 The degree of protection of all the outdoor boxes shall not be less than IP 55 as per IS 2147.
- 6.5 The cable entry shall be from bottom, for which removable gasketed cable gland plates shall be provided.
- 6.6 Suitable 240V, single phase, 50Hz ac heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10deg. above the ambient.
- 6.7 The size of enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/kiosk/panel shall be provided with a 15A, 240V ac, 2 pole, 3 pin industrial grade receptacle with switch. For incoming supply, MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be of rotary switch type.
- 6.8 Each cabinet/box/kiosk/panel shall be provided with two earthing pads to receive 75mmx12mm GS flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire. The cabinets / boxes / kiosks / panels shall also be provided with danger plate, and internal wiring diagram pasted on inside of the door. The front label shall be on a 3mm thick plastic plate with white letters engraved on black background.
- 7. BAY MARSHALLING BOX
- 7.1 Three no. bay MBs shall be provided located at a convenient location to receive and distribute cables one marshalling box should be used for requirement of two bays. It shall meet all the requirements as specified for cabinets/boxes above.

- 7.2 It shall have three separate distinct compartments for following purposes:
- To receive two incoming 415V, three phase, AC supplies controlled by 25A four pole MCBs, and to distribute five (5) three phase ac supplies controlled by 8A four pole MCBs.
 - 80 nos. terminal blocks in vertical formation for interlocking facility.
8. TERMINAL BLOCKS
- 8.1 They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4.
- 8.2 The terminal blocks shall be of 650V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.
- 8.3 The terminals shall be provided with marking tags for wiring identification.
- 8.4 The terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall also be provided with short circuiting and earthing facilities.
9. WIRING
- 9.1 All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows :
- Wherever the cable size is specified that has to be used, otherwise,
- a. All circuits except PT/CT circuits 1.5 sq.mm
 - b. PT/CT circuits 2.5 sq. mm.
- 9.2 All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.
- 9.3 Wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires shall not fall off when the wires and shall not fall off when the wire is disconnected from terminal blocks.
- 9.4 All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrules purposes.
- 9.5 All terminals including spare terminals of auxiliary equipment shall be wired upto terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be wired out. Interpole cabling for all equipment's shall be carried out by the Bidder.
10. CABLE GLANDS AND LUGS
- 10.1 Cable glands shall be Double compression type, tinned/Nicked plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and

oxidation. Rubber components used in cable glands shall be neoprene and off tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.

10.2 The cable glands shall be tested as per BS:6121. The cable glands shall also be duly tested for dust proof and weather proof termination.

10.3 Cables lugs shall be tinned copper solder less crimping type conforming to IS:8309 and 8394 suitable for aluminum or copper conductor (as applicable). The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

11. CONDUITS, PIPES AND ACCESSORIES

11.1 The 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 reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.

11.2 Rigid conduits shall be flow-coat metal conduits of Nagarjuna Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/ pipes shall be of a reputed make.

11.3 Flexible conduits shall be heat-resistant lead coated steel, water-leak, fire and rust proof, and be of PLICA make or equivalent.

12. AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

- a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/visual defects/temperature rise test.
- b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/visual examination
- c) Heat run test on contacts
- d) IR/HV test, etc.

13. TYPE TESTS

All equipment with their terminal connectors, control cabinets, main protective relays, etc. as well as insulators, insulator strings with hardwares, clamps and connectors, marshalling boxes, etc., shall conform to type tests and shall be subjected to routine and acceptance tests in accordance with the requirements stipulated under respective equipment sections.

14. COMPLETENESS OF EQUIPMENT:

Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment, shall be deemed to have been included in this specification.

15. PACKINGS:

All material shall be suitably packed for transport, direct to site and Manufacturer shall be responsible for all damages/losses due to improper packing. All boxes shall be marked with signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the Manufacturers.

13. 11 KV SWITCHGEAR

1. GENERAL

This section of specification covers the design, manufacture, assembly, shop testing/inspection before dispatch, packing, forwarding, transportation to site, insurance (during transit, storage and erection), storage, erection, supervision, site testing and commissioning of 11 kV, 3 phase 50 Hz air insulated metal clad indoor switchgear unit with horizontal draw out circuit breaker at 66/11 kV Substation.

The scope of supply shall also include necessary special tools and plants required for erection, maintenance.

The switchgear panel should be complete in all respects with insulators, bimetallic connectors, interrupting chamber (vacuum circuit breaker), operating mechanisms control cabinet, interlocks, auxiliary switches indicating devices, supporting structures, accessories, etc., described herein and briefly listed in the schedule of requirements. The spares/attachments which are necessary for the smooth functioning of the equipment and specifically are not mentioned here shall be assumed to be included the scope of supply.

2. STANDARDS

2.1 The circuit Breaker shall confirm to the latest revision with amendment available of relevant standards, rules, and code. Some of which are listed herein for ready reference.

Sl. No.	IS	IEC	Item
1.	IS-13118 (1991)	IEC-56	Specification of High Voltage AC Circuit Breaker
	IS-12729	IEC-694	Common clauses for high voltages switchgear and control gear standards
2.	IS-2705 (1992)		Current Transformer
3.	IS-3156 (1992)		Voltage Transformer
4.	IS-3231 (1987)		Relays
5.	IS-1248		Ammeter & Voltmeter
6.	IS-375		Arrangement of Breaker Busbars main connection and auxiliary wiring
7.	CBIP REPORT NO.-88 (JULY) 1996	IEC-687	Static Energy Meter
8.	IS-3072		Installation and maintenance of switchgear
9.	IS : 9135		Guide for testing of circuit breakers with respect to out of phase switching
10.		IEC : 60	High voltage testing technique
11.	IEC-17A Study Group Dec. 1981		Sealing of interrupters/breakers
12.	IS-3427		Metal enclosed Switchgear and Control gear
13.	IS-1554	IEC-227	PVC insulated cables upto and including 1000 volts
14.	IS : 5		Colors for ready mixed paints and enamels

15.		IEC : 529	Degree of protection
16.	IS : 996	IEC-34	Single phase Small AC and universal electrical motors
17.	IS : 2629, 2633	Iso : 1460	Hot dip galvanising

2.2 Equipment conforming to other international standards will also be considered if they ensure performance and constructional feature equivalent or superior to the standard listed above. Bidder shall clearly indicate the standard as adopted.

3. SERVICE CONDITIONS

3.1 Climatic Conditions

The breakers and accessories to be supplied against this specification shall be suitable for satisfactory continuous operation under the tropical conditions.

4. CONFIGURATIONS OF DIFFERENT TYPE OF PANELS (to be customized by utility as per capacity and requirement)

TYPE	RATING	NO.
Incomer	1600A	2
Bus Coupler	1600A	1
Bus PT	$11000/\sqrt{3}/110/\sqrt{3}$	2
11 kV Feeder		
• CAPACITOR FEEDER	• 800A, SUITABLE FOR 2500 KVAR CAPACITOR CHARGING DUTY.	• 4
• NORMAL FEEDER	• 800A	• 12

5. CONSTRUCTION

5.1 The 11 kV HT Switch board shall be totally enclosed dust and vermin proof, sheet metal clad, floor mounted, free standing, indoor type and shall house circuit breakers, busbars, control equipments, cable termination, current transformers, potential transformers, instruments, relays and other accessories. All HT panels shall be with fully draw out type breaker carriages, compartmentalized design with cold rolled sheet steel (thickness 2.0 mm for non load bearing and 3.0mm for load bearing parts) and with IP-4X class of enclosure. The Circuit Breaker compartment, Busbar compartment, Cable compartment and LT compartment shall have its own pressure relief flaps/vents with a view to release pressure which would develop in the unlikely event of fault. The vents shall not allow entry of vermin in any case. Bus bar, metering, circuit breaker chamber, cables and cable box chamber should have proper access for maintenance, proper interlocks should be provided. All instruments shall be non-draw out type and safe guard in every respect from damages and provided with mechanical indicator of connection and disconnection position. The switchgear shall be completed with all necessary wiring fuses, auxiliary contacts terminal boards etc.

5.2 For each of the incoming and outgoing cubicles, the cable connection, HT bus bars and all low voltage control devices shall be housed in separate enclosures. These enclosures shall be necessarily isolated from that for main circuit breaker chamber to offer better safety and protection of working personnel. All doors other than cable chamber shall be of hinged and

lockable type with Neoprene gaskets at all joints and the cable chamber shall be fixed with nuts and bolts. Additional wire mesh guards and gaskets shall be provided for cable chamber.

- 5.3 The arcing contacts and bus bar should be rated for 25ka for 1s Bus bars shall be capable of connecting one switchgear panel to other through proper insulated arrangement, which does not decrease the insulation strength of the bus bar at the point of connection between two panels. The panels shall be modular in design.
- 5.4 The breakers should be able to be drawn out in horizontal position at ground level [with vertical/horizontal isolation] when breaker is drawn out in horizontal position none of the live components inside the 11 KV switchgear panel should be accessible. The safety shutters shall be robust and shall automatically cover the live components when the breaker is drawn out. The switchgear shall have complete interlocking arrangements at the fully inserted and fully drawn out and test positions. Withdrawal of the breaker should not be possible in ON position, it should not be possible to close the circuit breaker in service unless the entire auxiliary and control circuit are connected.
- 5.5 Breaker should have three distinct positions inside the cubical; i.e. service, test and isolated.
- 5.6 The switchboard shall be suitable to handle full rated capacity in the naturally ventilated atmosphere and it shall be able to control and contain the high short circuit energy under internal arc conditions and ensure safety of the operating personnel in case of faults.
- 5.7 The cubicle door can be fully shut with breaker in 'ISOLATED' position to stop ingress of dust and vermin. All switching operations shall be performed with the door closed.
- 5.8 The VT/Relay compartments shall have degree of protective not less than IP52 in accordance with IS:13947. However remaining compartments can have IP 4X type sealing. All louvers if provided shall have very fine Brass or GI mesh screen.
- 5.9 Safety shutters complying with IEC-60298 shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the truck is moved to ISOLATED position. The shutters shall move automatically, through a linkage with the movement of the truck. Preferably it shall however, be possible to open the shutters of busbar side and cable side individually against spring pressure for testing purpose after defeating the interlock with truck movement deliberately. It shall also be possible to padlock shutters individually. In case, insulating shutters are provided, these shall meet the requirements of Clause 3.102.1 Note -2 of IEC-60298 and necessary tests are per IEC -60298 Clause 5.103.1 shall be carried out. A clearly visible warning label "Isolate elsewhere before earthing" shall be provided on the shutters of incoming and tie connections which could be energized from other end.
- 5.10 The switchboard shall have the facility of extension on both sides. Adopter panels and dummy panels required to meet the various busbar arrangement, cable / busduct termination and layouts shall be included in Bidder's scope of work.
- 5.11 Bus duct inter connection is also includes in the Bidder Scope of Work. The interconnection shall be top entry type with required enclosure and bus duct site. Adequate support shall be provided for this inter-connection by higher from roof.

6. BUS BARS AND CONNECTORS AND INSULATORS

- 6.1 Bus bars and all other electrical connection between various components shall be made of high conductive aluminum alloy of rectangular cross sections. The bus bars shall be able to carry the rated current of 1600 Amp continuously without excessive heating and for adequately meeting the thermal and dynamic stresses in the case of short circuit in the system up to full SC rating specified.
- 6.2 All bus bars connections shall be firmly and rigidly mounted on suitable insulators to withstand

short circuit stresses and vibrations.

- 6.3 Adequate clearance between 11 KV point and earth and between phases shall be provided to ensure safety as per provision in the relevant Indian standard specification/CEA regulations and the same shall be capable of withstanding the specified high voltage tests as per IS-13118/IEC-56 and amendment thereof.
- 6.4 Sharp edges and bends either in the bus bars or bus bar connections shall be avoided as far as possible. Wherever such bends or edges are un-avoidable, suitable compound or any other insulation shall be supplied to prevent local ionization and consequent flashover.
- 6.5 Busbar cross-section shall be uniform throughout the length of switchgear. Busbars and other high voltage connection shall be sufficiently corona free at maximum working voltage.

Busbar insulators shall be of arc and track resistant high strength, non-hygroscopic, non-combustible type and shall be suitable to withstand stresses due to over-voltages, and short circuit current. Busbar shall be supported on the insulators such that the conductor expansion and contraction are allowed without straining the insulators. In case of organic insulator partial discharge shall be limited to 100 pico coulomb at rated capacity.

7. CIRCUIT BREAKER

- 7.1 HT circuit breakers envisaged in the specification shall be designed to control and protect the power system. The circuit breaker shall conform to IS 13118: 1991, IS 3427: 1969, IEC 298, IEC : 694 and IEC publication 56.
- 7.2 All circuit breakers shall be of horizontal isolation & horizontal draw out type construction having easy manufacturing facility with separate lockable doors over their compartment. The circuit breakers shall be fitted with necessary safety mechanical interlocks.
- 7.3 The moving carriage of circuit breaker shall be provided with earthing contacts continuously so that the breaker remains positively earthed in "service" position and during withdrawal operation up to "test" position. The breaker shall have anti pumping features.
- 7.4 All circuit breakers shall have three operational positions such as "Service", "Test" and "Isolated" position with positive indication for each position. All circuit breakers of identical rating shall be physically & electrically interchangeable.
- 7.5 The HT breaker shall be provided with motor operated, spring charged independent closing mechanism. The mechanism shall have one geared motor which will automatically recharge the mechanism as soon as breaker is closed. These breakers shall have electrical and mechanical trip free features and an emergency mechanical push to trip the same. All the features of the equipment shall ensure complete safety of the operation and shall be complete with approved safety devices to protect against potential hazards to operating personnel or to the equipment around. The breakers shall also have facilities for manual operation during emergency and servicing. Mechanism shall be simple, rugged and reliable with minimum number of linkages. No damage to parts shall take place in case of any inadvertent attempt for wrong operation.
- 7.6 All HT breakers shall be provided with at least 8 potential free Aux. contacts to be used for interlocking / signaling purposes. Contact arrangement may be 4 NO + 4 NC and these shall be rated for 220 VDC, 6 Amp.
- 7.7 The circuit breakers shall be capable of rapid & smooth interruption of current under all conditions completely suppressing all undesirable phenomenon even under most severe & persistent short circuit condition or when interrupting small leading or lagging reactive current.
- 7.8 The circuit breaker and panel should be completely type tested for 25 KA for 1 sec. and Test

Certificate from independent authority should be submitted along with the Tender.

- 7.9 Facilities to check contact erosion shall be provided particularly.
- 7.10 Comprehensive interlocking system to prevent any dangerous or inadvertent operation shall be provided. Isolation of circuit breaker from bus bar or insertion into bus bar shall only be possible when the breaker is in the open position.
- 7.11 Vacuum interrupter should have an expected life of 30000 operations at rated current and should be capable for operating more than 100 times at rated short circuit current.
- 7.12 The switchgear should be designed for 2500 KVAR charging duty.
- 7.13 Mechanical indicators shall be provided on the breaker trucks to indicate OPEN / CLOSED conditions of the circuit breaker, and CHARGED/DISCHARGED conditions of the closing spring. An operation counter shall also be provided. These may be visible without opening the breaker compartment door.

8. Control and Interlocks

The circuit breaker will normally be controlled from local panels through closing and trip coils.

Facilities shall be provided for mechanical tripping of the breaker and for manual charging of the stored energy mechanism for a complete duty cycle, in an emergency. These facilities shall be accessible only after opening the compartment door.

Each panel shall have two separate limit switches, one for the Service position and the other for Isolated position. Each of these limit switches shall have at least four (4) contacts which shall close in the respective positions.

Auxiliary Contacts of breaker / contactor may be mounted in the fixed portion or in the withdrawable truck as per the standard practice of the manufacturer, and shall be directly operated by the breaker / contactor operating mechanism.

Circuit breaker shall be provided with inter pole barriers of insulating materials. The use of inflammable materials like Hylam shall not be acceptable.

9. PROTECTION RELAYS

- 9.1 All the switchgears shall be provided with protective relays designed to disconnect faulty circuit with speed and discrimination and shall conform to IS-3231 (1987) or latest revision thereof regarding accuracy and other feature. Composite relay unit having S/C, O/C, E/F etc. shall be preferred.
- 9.2 All protective & auxiliary relays shall be in dust & vermin proof enclosure, flush mounted on front side of metering compartment and shall be draw out type.
- 9.3 Insulation of relays should withstand 2.5 KV AC (rms) at 50 Hz for one second between all circuits and the case and between all circuits not intended to be connected together as per IS – 3231 : 1965.
- 9.4 Relays should be able to withstand Impulse and High Frequency Disturbance as per IS 8686: 1977.
- 9.5 All relays and timers shall be rated for control supply voltage as mentioned elsewhere and shall be capable of satisfactory continuous operation between 75-110% of the rated voltage.

- 9.6 Bidder shall furnish in their offers the details of Relays (make, type, range etc.) considered by them for each feeder in a tabular form together with descriptive literature of the Relays offered.
- a) All relays shall be draw out type confirming to all requirements as per IS:3231 and shall be suitable for operation from CT secondaries as required. All static relays shall confirm to IS :8686 .
 - b) The protective relays, except for lock-out relays shall have self - reset contacts, and shall be suitable for efficient and reliable operation of the protective schemes
 - c) All timers shall be either electromagnetic or static type.
 - d) All relays & timers shall be designed for satisfactory performance under specified tropical and humid conditions.
 - e) The bidder shall include in his bid a list of installations where the relays offered are in trouble free operation.
 - f) The relays and timer shall operate under extreme conditions of control voltage variation.
 - g) They shall not have any inbuilt batteries, and shall operate on available DC supply. They shall be provided with hand-reset operation indicators (flags) or LEDs with pushbuttons for resetting and for analysing the cause of breaker operation.
 - h) Shall have built-in test facilities, or can be provided with necessary test blocks and test switches. One testing plug shall be provided for each switchboard.
 - i) The auto reclose logic shall be generated from local panel. The logic shall be, with the tripping of the feeder breaker under faults after a time delay of 1000 ms. closing command shall be given to particular breaker. If the breaker close/trips then no further closing command shall be issued. However this shall not be used for, I/C, B/C and capacitor feeder.
 - j) Over voltage relay provided on bus PT shall be used as a backup.
 - k) The over voltage trip logic shall be extended only to capacitor feeder.
 - l) The protection relay should have potential free contacts as per the protection logic requirement.
 - m) Reverse blocking principle for the feeders with incomer shall be provided.
 - n) Intertripping of incomer with upstream breaker shall be provided.
 - o) Automatic power factor control relay shall be provided one in each section for switching on the capacitor
 - p) All equipment shall have necessary protections. However, following minimum protections shall be provided.

FEEDER TYPE	Differential (87T)	REF (64R)	Over Current (50)	Over Current DMT(51)	Earth Fault (51N)	Under Voltage (27)	Over Voltage (59)	Fuse Failure
Incomer	Yes	Yes	Yes	Yes	Yes	-	-	-
Bus Coupler	-	-	-	Yes	Yes	-	-	-
Capacitor feeder	-	-	Yes	Yes	Yes	-	-	-
Normal feeder	-	-	Yes	Yes	Yes	-	-	-
Bus PT	-	-	-	-	-	Yes	Yes	Yes

q) The capacitor protection scheme shall be designed for the capacitor configuration given elsewhere.

10. CURRENT TRANSFORMERS

10.1 Two core CTs shall be employed for measuring instruments and automatic tripping of circuit breakers on overload, Earth Fault and short circuit protection. CT can be mounted on cable side of breakers with easy accessibility. Class of accuracy and burden for protection CT shall be 5P10 and for metering CT the same shall be class 0.5. The VA burden of the CTs shall be min. 25% more than the calculated value. However, the min. VA burden of CTs shall be 20 VA. CT shall conform to IS : 2705 (Parts 1-4) 1992 with its latest amendments.

However bidder shall furnish the actual VA ratings calculation required for the CT considering the relays and meters provide, for employer approval.

10.2 All the CT's shall be cast resin insulated, Bar primary/Wound secondary type. All secondary connections shall be brought out through conduits to terminal blocks having provision of shorting links.

10.3 Ratio of the CT's shall be as indicated in the protection SLD.

10.4 Short time rating of CTs shall be 25 KA for 1 second. CTs shall be double core and dual ratio. Saturation factor for metering core shall not exceed 2.5.

10.5 The designed accuracy should be available even at the lowest ratios and all CTs shall withstand fault current corresponding to 25KA for 1 sec.

10.6 The secondary terminal of the current transformers shall be such that effective and firm wire terminations are possible. Shorting links of adequate capacity shall be provided at the terminal blocks for sorting of the leads from secondary terminals of current transformers. The secondary terminal of the CTs shall be earthed at one point.

10.7 The secondary winding resistance of CTs shall be as low as possible but not greater than 0.2 Ohms per 100 turns.

11. POTENTIAL TRANSFORMERS (PT)

TWO (2) Nos. single phase units of $((11/\sqrt{3}) \text{ kV}/(110/\sqrt{3})\text{V})$ PTs shall be mounted on incoming panels. HRC fuse protection of adequate rating shall be provided on HT and LT side of PT. Accuracy class of PT shall be 0.5. The primary and secondary of these PTs shall be "Star" connected and used for, all protection and measuring purposes onboard viz. line volt meters,

energy meters etc. PTs shall conform to IS:3156 (Parts 1-4):1992 with its latest amendments.

Potential transformers shall be cast resin, draw out type. PT changeover scheme shall be provided in the switchboard.

All PT should have suitable current limited fuse both at primary and secondary.

12. CABLE GLANDS AND CLAMPING ARRANGMENT FOR HOLDING SUITABLE CABLE BOXES

12.1 Two nos, brass-wiping glands for each incomer and one no. Brass wiping gland for each outgoing panel of adequate dimension for XLPE cable of 3 crores up to 400 sq. mm size (to be customized by utility) shall be supplied along with panels. For bus coupler no cable glands should be provided.

12.2 Suitable cable boxes as per requirement of cable shall be arranged by the bidder. The panel shall however provide a flat of size 50x6 mm² with suitable clamp made of 50x6 mm² flat along with Nuts Bolts and Washers for holding the cable boxes. The flat should be fitted at a suitable height with allotted arrangement for adjustment of height from 300mm to 500mm at site. The clamp and flat shall have suitable stud type arrangement for earthing cable and cable box.

12.3 All control cable/wire entries shall be by means of suitable cable glands, such glands shall be of brass and tinned.

13. AUXILIARY/CONTROL WIRING

All the secondary wiring in the panel shall have high quality PVC insulation and the same shall have conductor size of not less than 2.5 mm² of copper. Colors of the secondary/auxiliary wiring should confirm to IS 375/1963 and latest amendment thereof if any. All wiring shall be neatly run and group of wiring shall be securely fixed by clips so that wiring can be checked without necessity of removing the clamps. Wiring between fixed and moving portion of the panel shall be run in flexible tubes and the same shall be so mounted to avoid any damage to them due to mechanical movements. Ferrules with number shall be provided on both end of the wiring.

14. STATIC ENERGY METERS

14.1 Scope

This specification covers design, engineering, manufacture, inspection, testing at manufacturers works including type testing before dispatch, supply and delivery of three phase 4 wire tri-vector export with "Time of the Day" register, load profile data record "MD" register suitable for both unbalanced and balanced load.

14.2 Applicable Standards

Sl. No.	Standards	Description
1.	IS : 14697	Specification for AC Static Transformer operated Watt Hour & VAR-Hour meters, classes 0.2 S & 0.5 S
2.	IEC : 60687	AC Static Watt-Hour Meters for Active Energy (classes 0.2 S & 0.5 S)
3.	IS: 15959 (including amendment 2)	Data Exchange for Electricity Meter Reading, Tariff and Load Control – Companion Specification
4.	IEC : 62056-21 (Latest Version)	Data exchange for Meter Reading and Direct Local Data Exchange
	IEC : 61000-4-5 (2001-04)	For Electro Magnetic Compatibility – Testing and Measurement techniques, Surge immunity test
6.	IEC : 61358	Criteria for selection for tests LIKE Acceptance, Inspection.
7.	ANSI/IPC-A-610	Workmanship standard for Acceptability of Electronic Assemblies (A standard developed by Institute for Interconnecting and packaging Circuits).

14.3 General Requirements

14.3.1 Electrical Specifications

Class of Accuracy	: 0.5 S
Supply Voltage	: Suitable for operation from 110 Volts/63.5 Volts Ph-Ph/Ph-N, PT Secondary
Frequency	: 50 Hz +/- 5%
Power Factor	: 0.5 Lag – Unity-0.8 Lead
Basic Current Ib	: 1A
Maximum continuous Current	: 20 Ib
Minimum starting current	: As per IS 4697
Impulse withstand Voltage (1.2/50m Sec):	-

- 14.4 Guarantee Period
- The offered meters shall be guaranteed for normal operation for at least 5 years from the date of receipt at site without any repair whatsoever.
- 14.5 Design and Constructional Features
- 14.5.1 Location & Mounting
- The Energy meters shall be supplied suitable for indoor installation. Enclosure shall have IP-51 protection. All the feeder meters to be suitable for mounting on Simplex type Vertical Panel with rear door, Energy Meter flush mounted and clearly visible, with disconnecting type TBs, fully wired.
- 14.5.2 Design
- Meter shall be designed with application specific integrated circuit (asic) or micro controller; shall have no moving part; electronic components shall be assembled on printed circuit board using surface mounting technology; factory calibration using high accuracy (0.1 class) software based test bench.
- All components used shall be approved by reputed testing authority at national level or other international recognized testing authority.
- 14.5.3 Manufacturing Process, Assembly and Testing
- Meters shall be manufactured using latest and 'state of the art' technology and methods prevalent in electronics industry.
- All inward flow of major components and sub assembly parts (CT, PT, RTCs/Crystal, LCDs, LEDs, power circuit electronic components etc.) shall have batch and source identification.
- Multilayer 'PCB' assembly with 'PTH' (Plated through Hole) using surface mounted component shall have adequate track clearance for power circuits. SMT component shall be assembled using automatic 'pick-and-place' machines with in process 7 stages, Reflow Soldering oven, for stabilized setting of the components on 'PCB'.
- For soldered PCBs, cleaning and washing of cards, after wave soldering process is to be carried out as a standard practice.
- Assembly line of the manufacturing system shall have provision for testing of sub-assembled cards.
- Manual placing of components and soldering, to be minimized to items, which cannot be handled by automatic machine.
- Handling of 'PCB' with ICs/C-MOS components, to be restricted to bare minimum and precautions to prevent 'ESD' failure to be provided.
- Complete assembled and soldered PCB should undergo functional testing using computerized Automatic Test Equipment.
- Fully assembled and finished meter shall undergo 'burn-in' test process for 24 Hours at 55 degree Celsius (Max. temperature to not exceed 60 degree Celsius) under base current (Ib) load condition.

Test points should be provided to check the performance of each block/stage of the meter circuitry.

Testing at intermediate and final stage to be carried out with testing instruments, duly calibrated with reference standard, with traceability of source and date.

14.5.4 Displays

Displays tested shall be suitable for temperature withstand of 60⁰ C;

7+1 digits (with ± indication), parameter identifier, backlit Liquid Crystal Display (LCD) of minimum 10 mm height, wide viewing angle. Auto display cycling push button required with persistence time of 12 Seconds.

Sequence of display of various instantaneous electrical parameters shall be as desired by Employer at the time of order.

Normal display shall be Active energy value, on release of push button, at any of the display parameter during scrolling.

14.5.5 Calibration of Meter

Meters shall be factory calibrated using high accuracy test bench. Energy Meter shall have test output device, accessible from the front, and capable of being monitored with suitable testing equipment while in operation at site. Resolution of the device shall enable the starting current test in less than 10 minutes. Accuracy of test bench at works shall be as per the guidelines provided in IS: 14697.

14.5.6 Self-Diagnostic Features

The meter shall have self-diagnostic features to check its circuits for any malfunctioning. The bidder shall furnish the details of the self-diagnostic features.

14.5.7 Construction

a) Meter Case and Cover

i) To ensure high reliability, long trouble free life, safety against electric shock, spread of fire and effects of excessive temperature, the meter casing and cover shall be made of high quality industrial grade polycarbonate material having adequate strength, which is unbreakable, corrosion resistant & inert to chemicals, flame retardant, immune to ultra violet radiation and meet UV ageing test as per relevant ASTM standards.

ii) The bidder shall indicate hardness, melting temperature and tensile yield strength of the material and necessary test certificate of the same shall be furnished.

iii) The polycarbonate material used shall conform to IS: 11731 (FH-1 category) besides meeting the test requirement of heat deflection test as per ISO: 75 and glow wire test as per the relevant Standard.

iv) The meter shall be provided with adequate shielding to withstand external magnetic influence from all directions as per latest amendments of CBIP 88 report.

v) Meter cover shall be continuously ultra sonically welded with meter base from all sides. Suitable locking arrangement shall be provided between the base and cover of the meter.

14.5.8 Sealing Arrangement

Two sealing screws shall be provided for proper fixing of the meter cover so that access to the

working part shall not be possible without breaking the seal.

14.5.9 Terminal Block and Cover

The terminal block shall have adequate insulating properties and mechanical strength. The terminal block shall be made from best quality non-hygroscopic, flame retardant polycarbonate material (capable of passing the flammability tests give in IS: 11731) with nickel-plated brass studs for connecting terminals.

The terminal block is to be enclosed in a metallic housing of steel plate of sufficient thickness to cover its back and sides and provide enough strength for the purpose of tightening of screws. Clamping screws should be provided inside the terminal cover and should have metallic sleeve moulded within the block to avoid damage during tightening of the screws.

The terminals in the terminal block shall be of long socket type suitable for connection of cables with aluminium conductors along with suitable lugs (lugs to be provided by the supplier) having cross sectional area, with adequate length. Double screw arrangement shall be provided to achieve adequate termination. All terminals and connecting screws and washers shall be of tinned / nickel plated brass material.

The terminal cover shall be transparent with minimum thickness 2.5 mm and the material shall be same as that of meter case. It shall be of extended type and accommodate, in addition to the terminal block, a suitable length of external cable along with its insulation.

14.5.10 Name Plate and Marking

Every meter shall have a nameplate clearly visible and indelible and distinctly marked in accordance with IS: 13779 (latest version). The following information shall appear on a nameplate preferably placed within the meter.

1. Manufacturer's name & trade-mark and place of manufacture.
2. Serial number and year of manufacture.
3. Designation of type.
4. Number of phases and number of wires for which the meter is suitable.
5. Guarantee period.
6. Employer's name & meter number.
7. Principal unit in which the meter records.
8. Reference voltage & frequency in Hz.
9. Basic current and rated maximum current.
10. Meter constant (pulse rate of testing signal).
11. Class index.
12. Project Name.

14.6 Fixing Arrangement

Every meter shall have three fixing holes one at the top and two at the bottom. The fixing holes shall be properly matched for mounting inside the meter compartment as per the drawing, and this specification.

14.7 Operational Requirements

14.7.1 Performance under Influence Quantities

As per IS 14697.

Accuracy for measurement & display of instantaneous quantities shall conform to IS14697.

14.7.2 Additional Technical Features

- a) Output Device
 - i) Energy Meter shall have test output, accessible from the front, and be capable of being monitored with suitable testing equipment while in operation at site.
 - ii) Operation indicator must be visible from the front.
 - iii) Test output device shall be provided in the form of LED/LCD.

Resolution of the test output device shall be sufficient to enable the starting current test in less than 10 minutes. Nameplate shall indicate the 'impulse/ Unit' with appropriate resolution.

- b) Cumulative Energy Register

Meter should have provision for automatic recording of cumulative kWh & MD KW at say 24.00 hours on the last day of the month for each of the past six calendar months and same to be stored in the register/memory.

- c) Temperature Conditions

As per Is 14697;

Meter to perform satisfactorily under Non-Air Conditioned environment in HT sub-station with Indoor switchgear in some of the locations.

14.7.3 Real Time Internal Clock (RTC) of Energy Meter

RTC shall be pre-programmed for 30 Years Day/date without any necessity for correction. Maximum drift shall not exceed +/- 300 Seconds per year.

Time & date setting shall only be possible through one of the following:

Common Meter Reading Instrument (CMRI) or Meter testing work bench and this shall need password enabling for Consumer meter;

14.7.4 Clock Day/Date Synchronisation

Synchronisation of Energy Meter 'RTC' Time/Date shall be possible thro' password/Key code enabled command from remote server or sub station 'PC' as per the arrangement. Master Clock reference shall be obtained from Main server or local 'PC'. However the master clock, Main server and Local PC is not in scope of supply.

Synchronisation shall be carried only if the 'RTC' drift is within ± 10 minutes.

Error log to be recorder by the system S/W if the 'RTC' time is out of range.

14.7.5 Quantities to be Measured & Displayed

As per Appendix G of IS 14697.

- a) TOD 'time slot register' wise export & Import (when asked) of kWh & kVARh, kVAh energy;
- b) Maximum kVA or kW demand with elapsed time.
- c) Instantaneous kW, kVA, PHASE WISE kW & kVA, OVERALL pf, MD reset count, frequency, time & date, RTC battery health;

In addition, present status of abnormality shall also be possible to be displayed.

Tamper details shall be stored in internal memory for retrieval by authorized personnel through either of the following:

- i) Common Meter Reading Instrument (CMRI) ii) AMR and this shall need password enabling.

14.7.6 Demand Integration Period (DIP)

- i) Energy Meter shall continuously monitor and calculate the average maximum demand for each demand interval time of 30 minutes and maximum of these in a calendar month shall be stored along with date and time when it occurred;
- ii) It shall however be possible to change the demand integration period (DIP), from 30 to 15 minutes at site, with proper security;
- iii) The Maximum demand of past six months shall be stored in the memory with date and time.
- iv) It shall be also possible to retrieve this data through communication port and MRI.
- v) Media copy of software for downloading of meter data through MRI on to a PC shall be provided on a compact disc. This shall be suitable to window-based operating system. Installation and commissioning manual for the same shall also be provided.

14.7.7 Time of Day (TOD) Registers

6 different TOD energy registers as per clause G-8 of IS 14697 are required. Time block settings shall be advised to the supplier at least 4 weeks before commencing delivery. Change of time period for TOD metering shall be with password enabling from CMRI or from base computer.

14.7.8 Load Survey Data Registers

Storage in Non volatile memory for 40 days, 30 minute demand of any of the flow parameters of kW, kVA, kVAR (or Pf), Average of 3 voltages and phase currents shall be provided.

14.7.9 Indications

- i) Meter healthy indicator must be visible from the front.
- ii) Test output device shall be provided in the form of LED/LCD.
- iii) Energy Meter shall have test output, accessible from the front, and be capable of being monitored with suitable testing equipment while in operation at site.

- iv) Resolution of the test output device shall be sufficient to enable the starting current test in less than 10 minutes. Nameplate shall indicate the 'impulse/ Unit' in appropriate resolution.

14.7.10 Communication Facilities & Standards

For data communication, the data structure adopted within the energy meter shall be on an internationally acceptable method. The data structure/coding details shall be furnished to the Employer. However minimum shall be provided.

- a) Local communication port: Energy meter shall have a galvanically isolated optical communication port as per IEC 62056-21 or any other internationally accepted port in front of the meter for data transfer to or from a hand held data Collection Device (Common Meter Reading Instrument 'CMRI' - conforming to CBIP technical report-111) with proper security and without error.
- b) Meter shall be provided with 'RS 485' port. 'RS485' communication port shall be suitable for interfacing multiple Energy Meters. It shall be possible to download stored meter data, on polling basis with the aid of a software schedule by addressing one meter at a time and downloading the stored data into the sub-station data logger/Central data center computer.
- c) Energy Meter shall operate on industry standard 'MODBUS' protocol and shall be individually addressable

14.7.11 Tamper & Fraud Monitoring and Recording

Meters shall at least be immune to tampers elaborated in IS 14697, ANNEX G-10.

All types of tampers for which meter is made immune, shall be listed by the bidder. These tampers records need not be recorded or stored in the meter memory. Further, compliance to these are to be demonstrated by the bidder during acceptance test by successful bidder.

The meter should have anti tamper features. These shall at least include:

- i) Phase Sequence Reversal: Meter should work accurately irrespective of phase Sequence of supply.
- ii) Bypassing of Current Coil: Meter must have capability to record bypassing (shunting) of current coil(s) of one or any two phases with date, time and duration with normalisation time. Meter should not record tamper if load currents are unbalanced within specified limits permissible in the system.
- iii) Current reversal in current coil: The meter shall register energy consumption correctly in forward direction irrespective of the direction of current in the current coil/Coils with date and time of first occurrence and last restoration along with total number of such occurrences for all phases during the above period.
- iv) Missing potential: Meter shall be capable of detecting and recording occurrences of missing potential (One phase or two phases) and its restoration which can happen due to intentional/accidental disconnection of potential leads with date and time along with total number of such occurrences for all phases during the above period. This recording of tampering shall not be done when meter is without any load i.e. Current in all phases is Zero.

- v) Error recording shall include current unbalance beyond 30% in the phases, RTC clock correction failures (when drift is beyond specified value etc);
- vi) Missing Neutral: Meter shall continue to record accurately even if the neutral of potential supply gets disconnected.

14.7.12 Accuracy

In case any drift is noticed in the accuracy of the meter, which is beyond the permissible limits, the concerned meter shall be with-drawn from service and Bidder shall supply a new meter without any extra cost as a replacement (with in one month of receipt from Employer), during the guarantee period.

14.8 Inspection, Testing and Despatch

14.8.1 Type Tests

The meter offered should have successfully passed all type tests described in the IS 14697 and IEC 61000 4-5 Type test certificate shall be submitted along with the offer and the same shall not be more than 36 months old on the date of opening tender. Make & type of major components used in the type-tested meter shall be indicated in the type test certificates.

14.8.2 Acceptance and Routine Tests

Criteria for selection for such tests and performance requirements shall be as per IS 14697, IEC 61358.

14.8.3 Quality Assurance Plan

The bidder (manufacturer) shall have a comprehensive quality assurance program at all stages of manufacture for ensuring products giving reliable, trouble free performance. The bidders (manufacturers) quality assurance plan shall be submitted along with bid document, which would be reviewed in detail by the Employer in case of award and accepted with modifications, as felt necessary. A sampler manufacturing quality plan document is enclosed in this specification.

The bidder's quality assurance programme shall generally cover the following:

- i) Bidder organization structure for the management and implementation of the proposed quality assurance programme.
- ii) Quality System Manual.
- iii) Design Control System.
- iv) Documentation Control System.
- v) The procedure for purchase of materials, parts, components, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- vi) System for process controls and fabrication and assembly controls.
- vii) Inspection and test procedure both for manufacture and field activities.
- viii) Control of calibration and testing of measuring /testing equipments.
- ix) System for Quality Audits.
- x) System for handling storage and delivery.

The Bidder shall accordingly furnish along with the bid

- i) A comprehensive quality assurance plan which is in practice (for both product & process).

- ii) A detailed list of bought out items with name of the manufacturer and details about in coming quality control.
- iii) Quality assurance plan of bidders' collaborators in case of foreign collaborators.

Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedure of the bidders' quality management & control activities. The bidders shall provide all necessary assistance to enable the Employer to carry out such audit & surveillance.

14.9 Manufacturing and Testing Facilities

14.9.1 The following Manufacturing and testing facilities shall be available.

The factory shall be completely dust proof.

The testing rooms shall be temperature and humidity controlled as per relevant Standards.

The testing and calibrating equipment should be automatic and all test equipment shall have their valid calibration certificates

Power supplies used in testing equipment shall be distortion free with sinusoidal waveforms and maintaining constant voltage current and frequency as per the relevant Standards.

14.9.2 During the manufacturing of the meters following minimum checks shall be carried out.

- a. Meter frame dimension tolerance shall be minimum.
- b. The pressure coil shall be made totally encapsulated and care shall be taken to avoid ingress of dust and moisture inside the coil.
- c. The assembly of parts shall be done with the help of jigs and fixtures so that human errors are eliminated.
- d. The meters shall be batch tested on automatic, computerized test bench and the results shall be printed directly without any human errors.
- e. The current coil shall be made with the help of jigs and fixtures.
- f. The potential coil shall be made with automatic computerized machine.

14.9.3 Mounting and Fixing Arrangement Drawings/Data Sheet

Manufacturer shall ensure following technical points:

- i) Meter shall be mounted on the switchgear by providing suitable cutouts, and shall be connected to suitable CT/PT.
- ii) RS 485 Bus shall be formed by connecting the RS 485 port of all the meters in the switchgear. The external interphase point for this shall be provided in the Bus PT panel.

14.10 INSTRUMENTS AND METERS

Indicating instruments shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 deg. scales, shall conform to IS : 1248 and shall have an accuracy class of 1.5 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

Instruments shall have white dials with black numerals and lettering. Black knife edged pointer with parallax free details will be preferred.

Instruments and meters shall be factory calibrated to directly read the primary circuit quantities. Means shall be provided for zero adjustment without dismantling the instruments.

14.11 NAME PLATE AND DIAGRAM PLATES

All equipment shall have weather proof and non corrosive metal plates fixed in suitable position with full particulars engraved thereon with white letters against black background.

The firm shall affix a name plate on each Switchgear panel having following information:

- a. Manufacturer's name and trade mark.
- b. Unique No.
- c. Type of Panel.
- d. CT Ratio.
- e. Rated Voltage.
- f. Rated Insulation Level
- g. Rated Frequency
- h. Rated Normal Current
- i. Rated Short Circuit Breaking Current.
- j. Weight
11. Specification No.
12. Order No. and Date
13. Year of supply.

15. PAINTING

All metallic surface [except enameled and bright parts] exposed to weather shall be given suitable primer coat and two coats of first quality paint of approved color. The supplier shall also supply adequate quantities of paints, Varnish etc. for use of finished cost and for use of patching up any scratches received during transport, handling erection testing and commissioning.

Instead of above proper powder coating after proper pre-treatment is acceptable and in that case earlier condition will not applicable.

16. TESTS

The design of circuit breaker shall be proven through all the routine and type tests in accordance with IS 13118: 1991/IEC 56 and any amendment thereof. Photocopy of all the test reports must

be enclosed with the tender. Type test report earlier than 5 year from the date of tender opening shall not be acceptable.

17. Technical Parameters (to be customized by utility as per capacity and requirement)

17.1 11 kV Circuit Breakers

Sl. No.	DESCRIPTION	VALUES
i)	Rate Voltage (kV rms)	: 11 kV
ii)	Rated frequency (Hz)	: 50
iii)	System neutral earthing	: Solidly grounded system
iv)	Type of arc quenching medium	: Vacuum
v)	Rated normal current at site conditions (Amps)	: 1600 Amp for I/C breaker and Bus Coupler and 800 Amp for Outgoing feeders
vi)	Number of poles	: 3
vii)	Installation	: Indoor type
viii)	Temperature rise	: As per IEC 56 (Table-4) Page-19
ix)	Rated short circuit	
	a) Interrupting capacity at 11 kV	: 25 kA
	b) The percentage DC components	: As per IEC 56 & (Ref. Page 51, 21 of IEC)
	c) Minimum number of Short Circuit operation the Circuit Breaker can withstand	: 100
x)	Rated short circuit making capacity	: 62.5 KA
xi)	First pole to clear factor	: 1.5
xii)	Rated short time current carrying capacity	: 25 kA
xiii)	Rated duration of short circuit	: 1 Seconds
xiv)	Total break time for any current upto the rated breaking current with limiting condition of operating and quenching media pressure (ms)	: As per IS/IEC
xv)	Closing time (rms)	: As per IS/IEC
xvi)	Standard value of rated transient recovery voltage for terminal fault	: As per IEC-56
xvii)	Standard value of rated line Characteristics for short line	:

	faults	
	RRRV	: KV/ms=0.214
	Surge	: Factor K=1.6 A
	Peak	
	Factor	
	Impedance	: Z (ohms) = 450
xviii)	Rated operating	:
	a) Duty cycle	: O-0.3 Second-CO-3 Minutes-CO
	b) Auto reclosing	: Suitable for three phase Auto reclosing duty
xix)	Rated insulation level under heavy pollution condition 1.2/50 micro second lightening Impulse withstand voltage (kV peak) to earth	: 75 kV
xx)	Power frequency withstand voltage kV (rms) to earth (kV rms)	: 28 kV
xxi)	Rated characteristic for out of Phase breaking	:
	a) Out of phase breaking capacity	: 25% of rated breaking capacity
	b) Standard values of transient recovery	: As per IEC-56
	c) Operating mechanism	: Spring operated, Anti pumping and Trip free mechanism
	d) Power available for operating mechanism	: Three phase 415 Volts 50 C/S or single phase 50 C/S 240 Volts
xxii)	a) Rated supply voltage of closing and operating devices and auxiliary circuits	: 1) 220 VDC 2) 240 Volts AC 50 C/S single phase 3) 415 Volts 50 Hz three phase
	b) Permissible voltage variation	: 1) In case of DC Power supply voltage variation shall be between 85% to 110% of normal voltage. 2) In case of AC power supply voltage variation shall be of the normal voltage as per IS-15% to +10%
	c) Permissible frequency	: $\pm 3\%$ from normal 50 Hz as per IS : 2026 Part-I 1977 para 4.4
	d) Combined variation of frequency and voltage	: $\pm 15\%$
xxiii)	Number of auxiliary contacts	: 10 NO and 10 NC on each pole Continuous current rating 10 Amps, DC

xxiv)	Number of coils	: 1 (One) trip coils and 1 close coil with anti-pumping arrangement
xxv)	Rated terminal load	: 100 kg. Static. The breaker shall be designed to withstand the rated terminal load, wind, load, earthquake load and short circuit forces.

18. COMPLETENESS OF EQUIPMENT:

Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment, shall be deemed to have been included in this specification.

19. PACKINGS:

All material shall be suitably packed for transport, direct to site and Manufacturer shall be responsible for all damages/losses due to improper packing. All boxes shall be marked with signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the Manufacturers.

14. 11KV CAPACITOR BANK

1. GENERAL

The manufacturer with 2.5 MVAR, 11 kV class capacitors offered, should have designed, manufactured, type tested as per relevant IEC/IS, supplied in the last three years for system voltage of 11 kV or higher.

This specification covers the basic requirements in respect of Capacitor Banks with internal/external fuse, mounting racks, supporting structure complete in all respect along with series reactors.

2. STANDARDS

The Shunt Capacitor Bank and associated equipment shall conform to the latest additions of the following standards except to the extent explicitly modified in the specification and shall also be in accordance with requirements specified in this specification.

- | | | |
|-------------------|---|------------------|
| a) Capacitor | : | IS : 13925 |
| b) Series Reactor | : | IS : 5553 |
| c) Internal Fuse | : | IEC 593/IS 12672 |
| d) External Fuse | : | IEC 549/IS 9402 |

3. GENERAL ARRANGEMENT OF CAPACITOR BANKS

- a) The Capacitor Bank shall be of outdoor type suitable for operation in the climatic conditions as given in this specification and mounted on steel racks and structure with suitable insulators as required to be supplied by the bidder.
- b) The bidder shall furnish details of connections between the Capacitor units and groups together with layout diagram showing the basic arrangement of banks complete with dimensions.

4. DESIGN CRITERIA REQUIREMENT AND CONSTRUCTIONAL DETAILS OF CAPACITOR

- i) Each bank shall be made up by two groups of star connected banks each star connected bank shall be unearthed, with a floating neutral, but interconnected by a Neutral Protective Current Transformer (NCT) of suitable ratio to operate protective relays. The NCT secondary current shall be 1A and its ratio decided by design to meet with the protection requirements specified.
- ii) The protective scheme shall be either by two step current relay arranged as follows:

If the failure of one or more units causes an over voltage of less than 10% tolerable on the other remaining healthy units, then the unbalance current shall cause in the first step to sound an alarm. But if more than the above number of units fails causing a voltage rise of more than 10% the unbalance current shall cause to trip and isolate the capacitor bank instantaneously.
- iii) The per phase and individual star group rating shall be built up by series – parallel combination of individual units so as to achieve the desired bank rating. The individual capacity ratings shall be as per IS: 2834.
- iv) All parallel units in one series group shall preferably be arranged in different tiers that is one series group shall be duly insulated from one another by post insulators adequate to withstand the voltage that may be impressed and shall be sufficient to withstand even in case of total failure of all the parallel units in a series group. The complete assembly shall also be duly insulated from the earth potential by supporting post insulators.

- v) Although the tolerances in the output rating of each individual unit shall be as per IS:2834 yet it shall be ensured that in a completely assembled bank, the departures from the nominal rating and within the specified tolerances values shall not cause nuisance alarm or tripping since such alarm or tripping shall be to meet only with the protective requirements specified.
- vi) The tolerances in the output ratings shall not cause departures in the line currents by that value specified in IS: 2834. Besides it shall also be ensured that these unsymmetrical currents shall not cause unsymmetrical voltage rises, whether for short periods or during prolonged operation.
- vii) Individual units shall be designed to meet with the requirements of the permissible overloads as specified as per IS: 2834. Each unit shall also be provided with internal discharge devices complying with the requirements of the IS.
- viii) The voltage rating of the NCT shall be decided by the Bidder by taking into consideration the voltage impressed on the NCT due to:
 - a) Voltage due to failure of one or more parallel units in a series bank.
 - b) Voltage impressed on the NCT when all the parallel units in one series bank fail simultaneously. The bidders shall furnish along with the bid design calculations for the same.

5. CAPACITOR UNITS

- a) Each capacitor unit in the Bank shall be self-contained outdoor type having 2 bushing suitably rating for series/parallel connections with other units to form the capacitor bank of rated capacity at 50 Hz. The bushing shall be of porcelain and shall be joined to the case by soldering or welding.
- b) The capacitor unit shall be manufactured Hazy Polypropylene as dielectric using non PCB impregnation shall be carried out under high degree of vacuum and the unit shall be of totally sealed type.
- c) Each capacitor unit shall be provided with a internal discharge resistor designed to drain the phase voltage of the bank to 50 V or less within 5 minutes after disconnection from the supply.
- d) Each capacitor unit shall be suitable for continuous operation at least 1.3 times the rated current at rated voltage and frequency. This over current factor shall include the combined effect of presence of harmonics and over-voltage up to 1.1 times rated voltage.
- e) The container of capacitor unit shall be of stainless steel or CRCA steel painted within suitable anti-rust primer and two finishing coats of paint as per manufacturers' standard practice. The container shall be made from sheet steel of suitable thickness designed to allow for expansion and contraction due to all ambient and loading conditions expected during the life of the unit.
- f) In case of externally fused capacitors the rating of unit shall so chosen that failure of 2 units in a particular series group shall not cause over-voltage exceeding 10% on the other healthy unit in that same series group. Calculations on above showing the justification of the unit size shall be furnished by the bidder along with the offer.
- g) The design of the internally fused capacitor unit shall be such that it shall permit up to 40% element failure in series group without passing more than 10% over voltage on

the other healthy units.

- h) Each capacitor unit shall be mounted so that it can be easily removed from the racks and replaced without removing other units, de-assembling any portion of the rack.
- i) Protective fuses: the capacitor units shall be provided with either internal or external fuses as per standard practice of the manufacturer.

A. Capacitor units with internal fuses

The internal fuses shall conform to IEC:593/IS:12672 and the Bidder shall furnish type test certificates for compliance with IEC/IS. The design of the internal fuse shall be same that residues from fuse operation(s) shall not cause deterioration of the impregnating fluid. The fuse assembly shall be distinct and separate from element packs and so constructed that operation of a fuse indoor worst condition does not affect the other healthy elements. The fuses shall not melt or deteriorate when subjected to inrush currents, which occur during the life of the bank. The design of the fuse shall be such that it shall isolate only the faulty element and the operation of the fuse shall not affect the other healthy elements.

B. Capacitor units with external fuses

The external fuses shall be of current limiting (HRC) type. The fuse system shall in any event be designed to ensure that the energy released into a faulty capacitor unit is less than the value that will cause rupture or bursting of the container. The fuses shall conform to IEC: 549/IS: 9402 and Bidder shall furnish type test certificate for compliance with IEC/IS. The characteristics of the fuse shall be such that it shall isolate the faulty unit only and prevent it from mechanical destruction due to internal faults. The capacitor unit together with external fuses shall be arranged in the bank by providing adequate clearance between the body of the capacitor units of a phase and the line terminal or the common bus for the units of the other phases to obviate the possibility of occurrence of bird faults. The fuse shall isolate the faulty capacitor unit only and the healthy capacitor units shall not be affected in any way by the isolation of faulty unit. The fuses shall not melt or deteriorate when subject to inrush currents which occur during the life of the bank. The external distance between two metal ends of the fuse shall comply with specified creepage distance (i.e. the length of the insulating part of the fuse shall be such that the specified creepage distance is achieved). The selection of fuse to be done in such a manner that characteristic of fuse shall match suitably with over current withstand characteristic of associated capacitor unit.

The capacitor bank and protection shall be such that failure of one unit (i.e. one external fuse operation) does not cause tripping of the bank. The bidder shall furnish detailed calculations in evidence of above along with the Bid.

Metalised Polypropylene Type, self-healing design capacitor with internal safety design is also acceptable. Bidder shall explain the features and properties of the capacitor offered to meet the requirement described above. These shall have discharge resistance provided internally to eliminate stress in case of de-energisation.

6. MOUNTING RACKS

- a) The mounting racks shall be hot dip galvanized steel sections. Each end of the rack shall have provision to receive incoming line connection.
- b) The racks shall be complete with rack insulators, foundation bolts or any other hardware etc. for assembly into complete bank.
- c) The height of the racks of capacitor banks shall be such that for making electrical connections with other equipment, proper electrical clearances are maintained.
- d) The capacitor bank along with its mounting racks and series reactor and null CT shall be suitable for installation on the plinth and the enclosure shall be suitably fenced and interlocked as per safety requirements.

7. TESTS

- a) Type Tests – The equipment shall comply with the requirements of type test as per IS: 2834 and copies of these type test reports should be submitted along with offer. The capacitor offered must have been also endurance tested as per IEC: 871-2/IS: 13925 and copies of reports submitted along with offer. The capacitors under the type tested as per relevant IS/IEC.
- b) Acceptance and routine tests – The equipment shall comply with all routine and acceptance tests as per IS – 2834. Sampling to be done as per Appendix-E, IS-2834.

8. SERIES REACTORS

- a) The series reactor of small size (as required) shall be used in the Capacitor banks for limiting the inrush current. The series reactor shall be outdoor type 50 Hz, air-cooled air core type and suitable for operation in climatic conditions specified.
- b) Series reactors shall be capable of withstanding the specified short circuit currents.
- c) The percentage series reactance shall preferably be 0.2%. However, the value of series reactance shall be decided during detailed engineering. The Bidder shall furnish calculations justifying the value selected.
- d) The series reactors shall conform to type tests and shall be subjected to routine tests as per IS.

9. TECHNICAL PARAMETERS OF CAPACITORS AND SERIES REACTORS

The capacitor units and series reactors and other equipments/materials covered in this specification shall meet the technical requirements listed hereunder:

Capacitor Units (to be customized by utility)

S.No.	ITEM	SPECIFICATION
a)	Nominal System Voltage (kV)	11
b)	MVAR Capacity required at nominal system voltage (MVAR)	2.5
c)	Rated voltage of this capacitor bank (kV)	12
d)	Protection of Capacitor units	Internal / External fuses
e)	Type of connection	Double Star
f)	Unit Size	Option of the manufacturer to chose the appropriate unit size and rating
g)	Power loss (tan delta including loss in the fuse)	Not to exceed 0.2 Watt per applicable standards.
h)	Permissible overloads	Max. permissible Overloads with reference to voltage current and reactive output shall conform to Applicable standards.
i)	Type of grounding	Ungrounded
j)	Type of discharge	Internally through Resistor provided within the capacitor unit
k)	Capacity to receive inrush current	Not less than 100 times rated current
l)	Temperature category	The capacitors shall be suitable for maximum ambient temperature of 50 deg. C adequate care should be taken to protect the capacitors from direct sun radiations on account of Outdoor installations.

10. SERIES REACTORS

S.No.	ITEM	SPECIFICATION
a)	Rated Voltage (kV)	12
b)	Type	Air core
c)	Rating of series reactors	0.2% of Capacitor bank rating to be connected on neutral end
d)	Insulation levels Impulse withstand voltage(KVp)	75
e)	Short time withstand capacity and duration	16 times of 130% rated current of capacitor bank for 3 seconds
f)	Linear characteristic	Upto 1.5 pu
g)	Continuous rating	130% of rated current of capacitor bank

11. COMPLETENESS OF EQUIPMENT:

Any fittings, accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary for the satisfactory operation of the equipment, shall be deemed to have been included in this specification.

12. PACKINGS:

All material shall be suitably packed for transport, direct to site and Manufacturer shall be responsible for all damages/losses due to improper packing. All boxes shall be marked with signs indicating the up and down sides of the boxes along with the unpacking instructions, if considered necessary by the Manufacturers.

15. OUTDOOR NON SEALED TYPE THREE PHASE 11 KV/433V STATION TRANSFORMERS

(refer Volume III Section I for Tech Specification)

16. ACSR CONDUCTOR

(refer Volume III Section I for Tech Specification)

17. CIVIL & STRUCTURAL WORKS

1. GENERAL REQUIREMENTS

1.1 This chapter includes the technical requirements for 66 kV Sub-station, including associated design and preparation of all civil & structural drawings and execution of all associated civil works. This Chapter deals mainly with technical specifications for the design, supervision and construction of complete civil & structural works Complete under the scope of this contract.

1.2 The specifications are intended for general description of work, quality and workmanship. The specifications are not however exhaustive to cover minute details and the work shall be executed according to relevant latest Indian Standards/IRC specifications. In the absence of the above, the work shall be executed according to the best prevailing practices in the trade, recommendations of relevant American or British Standards or to the instructions of Engineer. The IS standards/IRC specifications to be followed are mentioned in the technical specifications attached hereto. They shall be latest edition/version of the same issued 15 days prior to the date of opening of this tender. The Bidder is expected to get himself clarified on any doubts about the specifications etc. before bidding, and the discussions recorded in writing with the Employer in respect of interpretation of any portion of this document.

The Bidder shall take all necessary precautions to protect all the existing equipments, structures, facilities & buildings etc. from damage. In case any damage occurs due to the activities of the Bidder on account of negligence, ignorance, accidental or any other reason whatsoever, the damage shall be made good by the Bidder at his own cost to the satisfaction of the Engineer. The Bidder shall also take all necessary safety measures, at his own cost, to avoid any harm / injury to his workers and staff from the equipment & facilities of the power station.

During the progress of work, the Engineer will exercise supervision of the work to ensure that the technical provisions of the contract are being followed and the work is being executed accurately and properly. However, such supervision shall in no way relieve the Bidder of the responsibility for executing the work in accordance with the specifications.

Before submitting the bid, the Bidder shall inspect and examine the site and its surroundings and shall satisfy himself as to the nature of the ground and subsoil, the availability of materials necessary for completion of the work, means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his offer. No extra claim consequent on any misunderstanding or otherwise shall be allowed.

2. LAYOUT AND LEVELS

The layout and levels of all structures etc. shall be made by the Bidder at his own cost from the general grid of the plot and bench marks given by the Engineer. The Bidder shall give all help in instruments, material and men to the Engineer, at no extra cost, for checking the detailed layout & correctness of the layout and levels. However the Bidder shall be solely responsible for their correctness.

3. CODES AND STANDARDS

All standards, specifications, acts and code of practice shall be followed. In case of conflict between this specification and those (IS standards, codes etc.) referred to here - in, the former shall prevail.

4. SUBMISSIONS

The following documents shall be submitted by the Bidder for approval of the Employer, prior to commencement of fabrication and erection / construction. This list is not exhaustive but indicative only. Final list of drawings shall be prepared with successful bidder during detail engineering.

- i) Detailed Survey of the Area
- ii) Geotechnical Investigation to decide type of foundation of different structures
- iii) GA drawing showing Co-ordinates of various Gantry structures and facilities.
- iv) Drawing showing underground facilities with co-ordinates of all facilities such as Gantry foundation, equipment foundation, R.C.C cable trench, cable ducts, drains, sumps, pits, culverts, other foundations etc.
- v) Proposed erection/construction scheme for various structural and civil works envisaged as per design requirement.
- vi) Foundation design & drawing for Gantry structure & Lighting Mast.
- vii) Foundation design & drawing for equipment supports, their control cubicles, bus post supports and bay marshalling kiosks
- viii) Details of RCC cable and pipe trenches with necessary precast RCC removable covers with lifting facility, sump pits, back-filling, cable tray supports,
- ix) Design calculation, General arrangement drawings & detailed erection / construction drawings including R/F drawings for sub-station control room building.
- x) Design & drawing of roads and complete drainage system within Sub-Station including crossings.
- xi) Site preparation, soil sterilization / antiweed treatment including gravel filling, but excluding major leveling.
- xii) Complete fencing along with gate for the Sub-Station
- xiii) Structural steel fabrication drawings and Reinforcement bar bending schedules for reference.
- xiv) Electronic soft copy of all the approved drawings/calculations in Cat-II/Cat-I.

5. SUB-STATION CONTROL ROOM BUILDINGS GENERAL REQUIREMENTS

5.1 General

The scope includes the design, engineering and construction including antitermite treatment of Buildings including sanitary, water supply, electrification etc. The building shall be of RCC framed structure of concrete grade M25. The Sub-Station control room shall include rooms as specified below:

Sl. No.	Facility
i.	66kv control/relay and 11 kV Switchgear room
ii.	LT Switchgear Room
iii.	Charger Room
iv.	Battery Room
v.	Store/Record Room
vi.	Miscellaneous

An open space of 1200 mm minimum shall be provided on the periphery of the rows of panel and equipment generally in order to allow easy operator movement and access as well as maintenance.

The building shall be aesthetically designed keeping in view the surrounding land scapes, proper architecture shall be used to design the exterior look and finish. The architectural drawing shall, be submitted for employers approval.

5.2 Design

- a) The buildings shall be designed:
- i) To the requirements of the national building code of India, and the standards quoted there in.
 - ii) To adequately suit the requirements of the equipment and apparatus contained in the buildings and in all respects to be compatible with the intended use and occupancy.
 - iii) With a functional space arrangement.
 - iv) The building shall have framed super structure.
 - v) The building shall have minimum one brick thick wall cladding on exterior face. To allow for easy access to equipment and maintenance of the equipment. Wherever required, fire retarding materials for walls, ceilings and doors, which would prevent supporting or spreading of fire.
 - vi) With materials preventing dust accumulation.
- Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.
- b) Individual members of the building frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion etc.
 - c) Permissible stresses for different load combinations shall be taken as per relevant is codes.

- d) The building lighting shall be designed in accordance with the requirements of relevant section.
- e) The building auxiliary services like air conditioning and ventilation systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements specified in relevant section or elsewhere in this specification.
- f) Underdeck insulation shall be provided as per technical specification.

5.3 Design Loads

Building structures shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, crane load, wind loads, seismic loads, and temperature loads.

Dead loads shall include the weight of structures complete with finishes, fixtures and partitions and should be taken as per IS: 1875.

Super-imposed loads in different areas shall include live loads, minor equipment load, cable trays, small pipe racks / hangers and erection, operation and maintenance loads. Equipment's loads shall constitute, if applicable, all load of equipments to be supported on the building frame.

For crane loads an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to provisions of IS : 875 (latest revision). The longitudinal crane surge shall be 5% of the static wheel load. The wind loads shall be computed as per standards, seismic forces shall be considered as specified in this specification. Response spectrum method shall be used for seismic analysis using at least first five modes of vibration for temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for the purpose shall be taken as the difference between the mean of daily minimum ambient temperature during the coldest month of the year and mean of daily max. Ambient temperature during the hottest month of the year.

The structure shall be designed to withstand stresses due to 50% of the total temperature variation. Wind and seismic forces shall not be considered to act simultaneously. Floors/slabs shall be designed to carry loads imposed by equipment, cables piping travel of maintenance trucks and equipment and other loads associated with building. Floors shall be designed for live loads as per relevant IS. Cable and piping loads not less than 5 KN/Sq.m hanging from the underside, shall also be considered additionally for floors where these loads are expected. In addition, beams shall be designed for incidental point loads of 20 KN to be applied at any point along the beams. The loads shall be subject to purchaser's approval.

5.4 Submission

The following documents are to be submitted for review and approval to the Employer prior to commencement of fabrication and erection/construction:

1. Schematic equipment layout
2. Detailed architectural drawings required for execution i.e. Detail floor plans, all elevation, section, stair case detail, toilet detail, finish schedule, colour scheme (both internal and external), door and window details, fixing details for doors and windows, false ceiling etc. Architectural facia and projection, miscellaneous architectural details,

coping, flashing, khurras. Water proofing, fillet, surface drain around control room building, rain water down comers, sanitary, plumbing etc. and other details as per requirement.

3. Design intent document giving basis of design shall cover all aspects, parameters, assumption, references, structural idealization/ mathematical model, loading faces, loading combination, analysis and design of control room building shall be furnished and got approved before commencement of detailed engineering.
4. Structural analysis, design calculation and drawings for foundations / substructure and superstructure of building, facilities, services etc.
5. Analysis, design calculation and drawings for all underground facilities with coordinates and invert levels like buried pipes, buried cables, trenches, ducts, sewer drains, sumps, manholes, water supply and overhead water tank etc.
6. Copy of all tests / studies / investigation carried out by bidder as per scope.
7. All other designs, calculations, details, drawings or any other submission as indicated elsewhere in this specification and required by Employer time to time after award.

6. DESIGN PARAMETERS FOR SUB-STATION STRUCTURES

Gantry structure, which consist of open web towers connected by girders. These shall be made of structural steel conforming to IS: 2062 Grade and duly galvanized conforming to IS: 2629. All joints shall be bolted connections. Nuts shall conform to I.S 1363(Part 3):1992 of property class 5 .Butt splice is used for splicing the main members and splice shall be located away from the node point. IS: 802 - 1977 "Code of practice for use of structural steel in overhead transmission line towers" shall be followed for design of structural supports. Wind pressure (for zone 4) up to height of 30 m above existing ground level shall be considered as per IS:802,Part 1(1977) for design of structures. Height & type of towers shall be established based on electrical requirements. All structures of outgoing & incoming feeders shall be designed for angular deviation of ± 30 -degree angle of deviation of line in horizontal plane and ± 20 degree deviation in vertical plane is considered and the resulting worst combination of forces shall be considered for design. For all out going & incoming feeders, the conductor span shall be taken as 250 m for design purpose. The specified clearances are to be achieved considering wind pressure and structure height etc.

6.1 Loading Conditions

Towers and girders shall be designed for the following loading conditions:

- a. Transverse load due to wind.
- b. Longitudinal load due to unbalanced tension in conductor.
- c. Transverse load due to deviation of conductor.
- d. Torsion load due to unbalanced vertical and horizontal forces.

- e. Short circuit forces including 'snatch' in case of bundled conductor.
- f. Temperature stress.
- g. Earthquake forces as per IS: 1893.

The occurrence of earthquake and maximum wind pressure is unlikely to take place at the same time. The structure shall be designed for either of the two. However, temperature stresses can be ignored, as these towers are freestanding structure in open space.

Load Combinations and Factor of Safety

Simultaneous application of following loads shall be considered for the design of Sub-Station structure:

- a) Normal condition
 - 1. Wind load on bus bars, shield wires, insulator strings, electrical equipment, structural members etc.
 - 2. Unbalanced load due to conductor/wire tension.
 - 3. Dead load of wires/conductors, insulator, electrical equipment and structural members.
 - 4. Load due to angle of deviation of the approach span.
 - 5. Torsion loads due to unbalanced vertical & horizontal forces.
- b) Abnormal conditions
 - 1. Short-circuit forces
 - 2. Seismic forces

Note:

- 1) Earthquake forces shall not be combined with wind forces.
- 2) Direction of wind shall be assumed such as to produce maximum stresses in any member for the combination of wind load with conductor tensions. The wind acting perpendicular and parallel to bus conductor and shield wire shall be considered separately.
- 3) The conductor tension shall be assumed as acting on only one side of the gantry for the analysis and design of Sub-Station gantries.

6.2 Factor of Safety

The factor of safety for the design of members for Sub-Station structures shall be considered as 2.0 for normal conditions & 1.5 for Abnormal Conditions

6.3 Minimum Thickness of Members & Galvanizing Thickness

All steel work used in construction of gantry structure should be galvanized and minimum section thickness should not be less than 4 mm. Weight of zinc coating shall be at least 0.610 kg/m² & foundation bolts shall have heavier zinc coating at least 0.80 kg/m²

6.4 Special Design Consideration for Lightning Masts

Diagonal wind condition shall be considered for lightning masts. Provision of IS: 875(Part-III)-1987 shall apply for inclined wind condition.

6.5 Design Consideration for Equipment Support

The supporting structure for B.P.I., LA, CVT, CT & Isolator equipment's shall be comprised of lattice structural steel conforming to IS 2026 and shall be designed as per IS: 802.

7. SUB-STATION SURFACING

Entire area of sub-station shall be provided with broken stone filling which shall consist of 50 mm thick stone metal filling of 25 mm stone aggregate on the top and 75 mm thick filling of 20 mm stone aggregate below. Each layer shall be compacted by using half ton roller with 4-5 passes and suitable water sprinkling. Before laying the broken stone fill, the top layer of the soil shall be treated for anti-weed considering the type of weeds found in the vicinity. The antiweed – soil sterilization details such as manufacturer's name, their specification, test certificate, etc. shall be furnished for Purchaser's approval. Any modification if required in the proposed antiweed treatment chemical shall have to be done by the Bidder at no extra cost to the Employer.

8. SUB-STATION TRENCHES

Cable trenches shall be provided for routing of cables from control room to equipments through a common marshalling box for each 66 kV bays. Each cable trench shall cater to two bays on either side. The cable trench shall be of adequate size. The trenches located within sub-station shall project at least 150 mm above the finished formation level so that no storm water shall enter into the trench. The bottom of trench shall be provided with a longitudinal slope of 1:500. The downstream end of cable trenches shall be connected through pipe drains to the nearby RCC manholes (to convey water from trenches) of storm water drainage system. The precast covers shall not be more than 150 mm in width and shall not be more than 50 kg. Lifting hooks shall be provided in the precast covers. Trenches shall be given a slope of 1:50 in the direction perpendicular to the run of the trenches. PVC water stop shall be provided at all expansion joints of all trenches. Angle of size 50x50x6 mm (minimum) with lugs shall be provided in the edges of RCC cable trenches supporting cover, edges of manhole supporting, supporting edges of precast RCC cover and any other place where breakage of corners of concrete is expected. Section drawings of main and secondary trenches attached can be seen for reference.

9. SUB-STATION DRAINAGE SYSTEM

Open storm water drains shall be provided on both sides of the road and shall be designed to drain the road services as well as all the free and covered areas, etc. Open RCC rectangular section shall be provided for all drains. The thickness of side wall and bottom slab of RCC drains shall be minimum 100 mm or as per design consideration whichever is higher. RCC box/precast RCC pipe culvert shall be provided for road and rail crossing.

10. SUB-STATION ROAD

Roads inside the area shall be of rigid reinforced concrete pavement (3.75m wide) along with 1.0 m wide shoulder on either side. The base and sub base of the road shall be of water bound macadam. Finished top of road shall be 300 mm above the surrounding ground level. There shall be as per the approved drawing of sub-station (area) General Layout Plan.

11. DESIGN CONSIDERATION FOR FOUNDATION

Detail design of foundation shall be as per IS: 4091 "code of practice for design and construction for transmission line tower and poles". The F.O.S. for foundation shall be 10% more than factor of safety for supporting structure i.e. 2.2 for normal condition and 1.65 for abnormal condition

12. SEISMIC LOADS

All structures shall be designed for seismic forces adopting the site specific seismic information.

13. WIND LOAD

All structures shall be designed for wind forces in accordance with the IS: 875 (Part -3) and as specified in this document.

14. INCREASE IN PERMISSIBLE STRESSES

The increase in permissible stress of materials and soil bearing pressure for different load combinations under wind, seismic and temperature loads shall be as per relevant IS Codes.

15. FENCING OF SUB-STATION (LIVE PART) AREA

The fence shall be of M.S. wire mesh welded intervals and kept under tension which in turn is attached to the fence post with security nuts and bolts. These wire mesh shall be parted with 2 coats red oxide paint and then with green colour enamel paint.

All nuts, bolts, fasteners, clamping strips, clamps, clips, etc. shall be hot dip galvanised.

All fence posts shall be 65x65x6 MS angles spaced at 2.5mC/C. All straining posts shall be 65x65x6 ms angles. All corner posts will have two stay posts and every tenth post will have

transverse stay post suitable RCC foundations for the post and stays shall be provided based on the prevailing soil conditions.

Toe walls either of brick masonry with bricks of class designation 50 with minimum crushing strength 50 Kg / M² or of hollow concrete block masonry shall be provided between the fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 thick PCC coping (1 : 2 : 4) and shall extend minimum 300 below formation level. Toe wall shall be plastered with cement sand mortar (1 : 6) on both sides and shall be painted with coats of texture cement paint (Sandtex matt or equivalent) of approved colour & make. Toe wall shall be provided with weep holes at appropriate spacings.

16. M.S. GATE

M.S. Gate of 3.0 M wide x 2.6 M height shall be provided to provide access through the fencing to the sub-station. It shall be made in two leaf, with locking arrangements. The gate shall be made with outer frame of 50 NB (Medium) M. S. Pipe, vertical & horizontal runners with 40x6 M.S. flat and weld mesh of opening size 50 x 25 mm and nominal size of mesh 4 mm dia. Hinges, al-drops and other accessories shall be provided for effective working of the gate.

17. MATERIALS AND GRADE OF CONCRETE

17.1 Concrete

- a. Minimum grade of structural concrete shall be M25 conforming to IS:456.
- b. Blinding concrete below foundations, cable trenches, shall be PCC of minimum grade M-7.5,
- c. Blinding concrete under brick foundations shall be minimum 150mm thick in PCC of minimum grade M-10.

17.2 Cement

Cement shall be ordinary Portland cement conforming to IS:269, Portland slag cement conforming to IS:455, Fly ash based pozzolona cement conforming to IS:1489 (Part-I), or Portland pozzolona cement conforming to IS 1489 (Part-II). For miscellaneous concrete works, Fly ash based Portland pozzolona cement or Blast slag cement may be used as per the specifications if directed by the Project Manager. Ordinary Portland cement conforming to IS 269 shall be used for all structures requiring grade of concrete M – 25 or above. Supply of all types of cement shall be in Bidder's scope.

17.3 Reinforcement Steel

HYSD bars (Fe 415) conforming to IS:1786 shall be used for all structures. Supply of reinforcement steel shall be in bidder's scope.

17.4 Structural Steel

Structural steel shall be of tested quality and shall be of mild steel of Grade 'A' up to 20 mm thickness and of Grade 'B' with normalised steel for thickness above 20 mm and shall conform to IS : 2062. Chequered plates shall conform to IS : 3502 and MS pipes for handrail shall conform to medium grade of IS : 1161.

All gratings shall be electroforged type. Minimum thickness of the grating shall be 40mm. The opening size shall not be more than 30mm x 100mm. The minimum thickness of the main bearing bar shall be 3mm. All gratings located inside the building shall be sand blasted and provided with two coats of suitable primer and two coats of finish paint (black colour) as per approved painting system. All gratings located outside the building shall be hot double dip galvanised at the rate of 610 gms / Sq.M. Supply of all structural steel shall be in Bidder's scope.

The Bidder shall keep sufficient stock of cement & steel at site at any point of time when the work is in progress (excluding what has been already incorporated in the works) so that any shortage, disruption / delay in availability of these materials during procurement will not affect the progress of work at site. The minimum quantity of such materials in stock at site shall not be less than the Requirement of one (1) month in case of Cement and Requirement of two (2) Consecutive months in case of Steel.

18. GEOTECHNICAL INVESTIGATION & FOUNDATION SYSTEM

Details pertaining to Geotechnical Investigation and Foundation system are specified at ANNEXURE-I to this Section.

19. TESTS FOR MATERIAL / WORKMANSHIP

All tests required for various bought out items, materials, quality of workmanship or any other tests as desired by Project Manager and as specified in technical specification shall be carried out by the Bidder at his own cost in the presence of the authorized representative of the Engineer.

The quality assurance check lists are given at the end of respective chapters / sections of these specifications. The Bidder shall submit comprehensive Quality Assurance plan for all materials, equipment, workmanship, services etc. and get it approved from the Engineer. This shall include setting up a test laboratory at site. However, such check list shall in no way limit the liability and responsibility of the Bidder in regard to quality of workmanship as detailed out in the specifications.

20. DRAWINGS

The successful Bidder shall first submit the structural design calculations along with general arrangement drawings for approval. After the approval of the design calculations by the Employer, detailed construction drawings shall be prepared and submitted for Employer's approval along with revised design calculations, if required, within 15 days. Required number of sets of design calculations, drawings and documents shall be submitted by the Bidder. All documents including design calculations shall be prepared in MS office and all drawings shall be drafted using AutoCAD (latest version). During every submission one soft copy of the document shall also be submitted. When final approval is obtained from the Employer the Bidder shall submit all the documents in TWO sets of CD ROM (One + One Back - up) together with minimum three sets of distribution prints well documented and page controlled with details of Employer's approval marked thereon. Approval of drawings / documents shall not relieve the Bidder of the responsibility regarding the adequacy of design and correctness of drawings.

21. ALTERATION IN SPECIFICATION AND DESIGN

The Project Manager shall have the power to make any alteration and omissions from, additions to or substitution for, the original specifications, drawings, designs and instructions that may appear to him to be necessary during the progress of the work, and the Bidder shall carry out the work in accordance with any instruction which may be given to him in writing signed by the Project Manager and such alterations, omissions, additions or substitutions shall not invalidate the contract and any altered, added or substituted work which the Bidder may be directed to do in the manner above specified as part of the work shall be carried out by the Bidder on the same conditions in all respects on which the Bidder agreed to do the original contract work. The time for completion of work shall be altered in the proportion that the altered, added or substituted work bears to the original contract work, and the certificate of the Project Manager shall be conclusive as to such proportion.

The rates for the altered items of work shall be worked out on the following basis and necessary alternations in the total amount shall be made on that basis:

- (a.) The rates to be reimbursed or recovered shall be taken as same as those given in CPWD-DSR (latest) for those items for which the rates are available in CPWD - DSR (latest). However, the premium as officially declared by CPWD's official circulars, at the time of carrying out these works, the same shall also be applicable.
- (b.) Rates for the items not covered under CPWD - DSR (latest) shall be derived from the rates of similar items of CPWD schedule of rates. However, the premium as officially declared by CPWD on the above DSR rates if existing or prevalent through CPWD's official circulars, at the time of carrying out these works, the same shall be applicable.
- (c.) In the event there is no similar class of work specified in the CPWD - DSR

(latest) the Bidder shall work on a rate for such an item on the basis of the prevalent market rates for materials / men / machines and submit the same together with the detailed analysis to the Project Manager within 7 days. The Project Manager shall thereafter review the correctness and then conduct necessary negotiations with the Bidder to arrive at a mutually agreeable rate. Engineer's decision in regard to rates of such items shall be final and binding on the Bidder.

In case of conflict between this chapter and other Chapters of Technical Specifications, provisions given in this chapter shall govern.

CIVIL & STRUCTURAL WORKS					
FINISHING SCHEDULE					
Sl. No.	Location	Internal Walls	External Walls	Ceiling	Flooring
1.	Substation Bldg.	Acrylic emulsion Paint	Stone cladding	-	-
2.	Switchgear Room, ACDB+DCDB Room	Acrylic emulsion paint	-	-	
3.	Battery Room	Acid resistant tiles up to 2.1 M.	-	Acid resistant Paint	25 mm Acid resistant tiles
		Acid resistant paint above 2.1			
		M upto ceiling			
4.	Entrance, Lobby, Corridor etc.	Oil bound distemper over pop	-	Oil bound distemper	Kota Stone
5.	Toilets	Glazing tiles 2.1 m high	-	White Wash	Anti skid ceramic tiles

ANNEXURE-I (GEO TECHNICAL INVESTIGATION)

1.0 GEOTECHNICAL INVESTIGATION

- 1.01 The Contractor shall perform a detailed soil investigation when specified under Scope of Work 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 report to the effect will be submitted by the Contractor for Owner's specific approval giving details regarding data proposed to be utilized for civil structures design.
- 1.02 The Contractor should visit the site to ascertain the soil parameters before submitting the bid. The may assess the topography requiring cutting and filling operations including slope stability and protection measures (if slopes encountered). Any variation in soil data shall not constitute a valid reason for any additional cost & shall not affect the terms & condition of the Contract. Tests must be conducted under all the critical locations i.e. Control Room Building. Tower locations, transformer etc.

2.0 SCOPE OF WORK

This specification covers all the work required for detailed soil investigation and preparation of a detailed report. The work shall include mobilization 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 Owner.

All the work shall be carried out as per latest edition of the corresponding Indian Standard Codes.

2.01 Bore Holes (by standard punctuation test)

Drilling of bore holes of 150 mm dia. in accordance with the provisions of IS: 1892 at the rate of minimum two number of bore holes to 10 m depth or to refusal which ever occur earlier for the new bay or extension of existing substation. (By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration). However, for a new substation, minimum three bore-holes shall be done to find out the geological profile of the area. If any unconformity encountered then more bore holes shall be drilled with the approval of Engineer-in-charge for the new projects. However in case deep pile foundations are envisaged the depths have to be regulated as per code provisions. In cases where rock is encountered, coring in one borehole per bay shall be carried out to 1.5 M in bedrock and continuous core recovery is achieved. Performing Standard Penetration Tests at approximately 1.5 m interval in the borehole starting from 1.5 m below ground level onwards and at every change of stratum. The disturbed samples from the standard penetrometer shall also be collected for necessary tests.

Collecting undisturbed samples of 100/75 mm diameter 450 mm long from the boreholes at intervals of 2.5 m and every change of stratum starting from 1.0 m below ground level onwards in clayey strata.

The depth of Water table shall be recorded in each borehole. 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-charge.

2.02 Electrical Resistivity Test

This test shall be conducted to determine the Electrical resistivity of soil required for designing safe 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 IS: 3043. The test shall be conducted using Wagner's four electrode method as specified in IS: 1892, Appendix-B2. 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 0.5 m upto a distance of 10.0 m.

2.03 Water Sample

Representative samples of ground water shall be taken when ground water is first encountered before the addition of water to aid drilling of boreholes. The samples shall be of sufficient quantity for chemical analysis to be carried out and shall be stored in airtight containers.

2.04 Back Filling of Bore Holes

On completion of each hole, the Contractor shall backfill all bore holes as directed by the Owner. The backfill material can be the excavated material and shall be compacted properly.

2.05 Laboratory Test

1. The laboratory tests shall be carried out progressively during the field work after sufficient numbers of samples have 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.
2. 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 IS Codes. The following laboratory tests shall be carried out
 - a) Visual and Engineering Classification
 - b) Liquid limit, plastic limit and shrinkage limit for soils.
 - c) Natural moisture content, bulk density and specific gravity.
 - d) Grain size distribution.
 - e) Swell pressure and free swell index determination.
 - f) California bearing ratio.
 - g) Consolidated undrained 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) Rock quality designation (RQD), RMR in case of rock is Encountered

2.06 Test Results and Reports

- 2.06.01 The Contractor shall submit the detailed report in two (2) copies wherein information regarding the geological detail of the site, summarised observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. Initially the report shall be submitted by the Contractor in draft form and after the draft report is approved, the final report in two (2) copies shall be submitted. The test data shall bear the signatures of the Investigation Agency, Vendor and also site representative of Utility.
- 2.06.02 The report shall include but not limited to the following:
 - a) A plan showing the locations of the exploration work i.e. bore holes, dynamic cone penetration tests 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 summarised 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.

2.07 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 Owner. 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. Slope stability characteristics and landslide history of the area shall be specifically highlighted. Remedial measures to be adopted shall also be given.
- 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 shall be provided.
- d) Recommendations regarding slope of excavations and dewatering schemes, if required. Required protection measures for slope stability for cut & fill slopes of switchyard and approach road with stone pitching/retaining walls shall be clearly spelt out. Calculation shall also be provided for stability adequacy.
- 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. shall be given. In the latter case detailed specification of any special treatment required including specification or materials to be used, construction method, equipment 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.

18. INSTALLATION

1. EARTHING

The earthing shall be done in accordance with requirements. Earthing of panels shall be done in line with the requirements given in respective equipment section of this specification.

2. CIVIL WORKS

The civil works shall be done in accordance with requirements stipulated under Section-17 of this specification.

3. STRUCTURAL STEEL WORKS

The structural steel works shall be done in accordance with requirements stipulated under Section-17 of this specification.

4. BAY EQUIPMENT

4.1 The disposition of equipment to be supplied is shown in enclosed single line diagrams and layout drawings.

4.2 The Bidder shall prepare layout drawings and submit the same for approval of the EMPLOYER. The approval of drg. shall not absolve Bidder from his responsibility regarding designing & engineering of Sub-Station and Bidder shall be fully responsible for all works covered in the scope of this specification.

5. LIGHTNING PROTECTION

Detailed drawings shall be submitted for approved locations on Sub-Station towers provision of lightning rod electrode at suitable Location.

5.1 Lightning protection System down conductors shall not be connected to other conductors above ground level. Also no intermediate earthing connection shall be made to Surge arrester, Voltage Transformer, earthing leads for which they shall be directly connected to rod electrode.

5.2 Every down conductor shall be provided with a test joint at about 150 mm above ground level. The test joint shall be directly connected to the earthing system.

5.3 The lightning protection system shall not be in direct contact with underground metallic service ducts and cables.

6. EQUIPMENT ERECTION NOTES

a. All support insulators, circuit breaker interrupters and other fragile equipment shall be handled with cranes with suitable booms and handling capacity.

b. Where, assemblies are supplied in more than one section, Bidder shall make all necessary mechanical and electrical connections between sections including the connection between buses. Bidder 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 Bidder at his own expense. The Bidder shall strictly follow manufacturer's recommendations for

handling and erection of equipment.

- c. The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc. Handling equipment, sling ropes etc. should be tested before erection and periodically thereafter for strength.
- d. Bending of piping should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced. The pipes shall be thoroughly cleaned before installation.
- e. 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.
- f. For cleaning the inside and outside of hollow insulators only Muslin or leather cloth shall be used.

7. STORAGE OF EQUIPMENT

Bidder is responsible for the proper storage and maintenance of all materials/equipment to be supplied by him for the work. The Bidder shall provide & construct adequate storage shed for proper storage of equipment. Sensitive equipment shall be stored indoors. All equipment during storage shall be protected against damage due to acts of nature or accidents. Bidder shall take all required steps to carryout subsequent inspection of materials/equipment stored as well as erected until the same is taken over by the EMPLOYER. The storage instruction of the equipment manufacturers/ Engineer-in-Charge shall be strictly adhered to.

8. CABLING

- 8.1 Cabling shall be in trenches, excavated trenches for direct burial, pulled through pipes and conduits run clamped on steel structures etc.
- 8.2 Cables inside the Sub-Station shall be laid on angle supports at 600mm spacing with separate tiers for control and power cables.
- 8.3 All interpole cables (both power & control circuit) for equipments shall be laid in cable trenches/G.I. Conduit Pipe of NB 50/100mm which shall be buried in the ground at a depth of 300mm.

9. CONDUITS, PIPES AND ACCESSORIES

- 9.1 The 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, bushings, reducers, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes etc. The size of the conduit/pipe shall be selected on the basis of maximum 40% fill criterion. 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 portion and entrance of moisture and foreign material.
- 9.2 Rigid conduits shall be flow-coat metal conduits of **XXX** (name) Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/pipes shall be of a reputed make.
- 9.3 The hume pipes and accessories shall be of reinforced concrete conforming to class NP2 of IS: 458. All tests on hume pipes shall be conducted as per IS: 458.

10. CABLE TAGS AND MARKER

- 10.1 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit

schedule.

- 10.2 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 conforming to IS:280. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.
- 10.3 Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanised iron plate.
- 10.4 The marker shall project 150mm above ground and shall be spaced at an interval 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.
- 10.5 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. Cable tags shall be provided inside the switchgear, motor control centres, control and relay panels etc., wherever required for cable identification, such as where a number of cables enter together through a gland plate.
- 10.6 Specific requirements for cabling, wiring ferrules as covered in respective equipment section shall also be complied with.

11. 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 practicable. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication the drums may be rolled in the same direction it was rolled during taking up the cables.

12. CABLE SUPPORTS AND CABLE TRAY MOUNTING ARRANGEMENTS

- 12.1 In cases where no embedded steel inserts are available, the Bidder shall have to secure the supports on wall or floors by suitable anchoring at no extra cost to the Employer. Details of fixing steel plates by anchor fasteners shall be decided during detailed engineering stage.
- 12.2 The cable supports shall conform to the requirements of this Specification.
- 12.3 Insert plates will be provided at an interval of 600mm wherever cables are to be supported without the use of cable trays, while at all other places these will be at an interval of 2000mm.

13. CABLE TERMINATIONS AND CONNECTIONS

- 13.1 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 Employer.
- 13.2 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.
- 13.3 Cost of all consumable material shall be included in the erection rates quoted.
- 13.4 The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Bidder shall be responsible for drilling of gland plates, painting and touching up. Holes shall not be made by gas cutting.

- 13.5 The Bidder shall tag/ferrule the 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.
 - 13.6 Spare cores shall be similarly tagged with cable numbers and coiled up.
 - 13.7 Control cables shall have stranded copper conductor. Bare portion of the solid conductors shall be tinned after removing the insulation and shall be terminated directly without using cable lugs.
 - 13.8 All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.
 - 13.9 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 Bidder as directed by the Employer.
14. Directly Buried Cables
- The Bidder shall construct the cable trenches required for directly buried cables. The scope of work and unit rates for construction of cable trenches for cables shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or concrete protective covers, back filling and reaming, supply and installation of route markers and joint markers. The bidder shall ascertain the soil parameters prevailing at site, before quoting the unit rates. Laying the cable and providing protective covering shall be as per approved drawing.
15. Installation of Cables
- 15.1 Power and control cables 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.
 - 15.2 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.
 - 15.3 Power and control cables shall be securely fixed to the supports. Trefoil clamps for single core cables shall be 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.
 - 15.4 Cables shall not be bent below the minimum permissible limit. The permissible limits are as follows:

a)	Type of cable & voltage grade	Minimum bending radius
b)	Power cable	12 D
c)	Control cables	10 D

Where D is overall diameter of cable.
 - 15.5 Where cables cross roads, drains and rail tracks, the cables shall be laid in reinforced spun concrete or steel pipes, buried at not less than one metre depth.
 - 15.6 In each cable run some extra length shall be kept at a suitable point to enable one (for LT Cables) or two (for H.T cables) straight through joints to be made, should the cable develop fault at a later date.

- 15.7 Selection of cable drums for each run shall be so planned as to avoid using straight through joints. In case joints are necessary the same shall be supplied by the Bidder. Cable splices will not be permitted except where called for by the drawings, unavoidable or where permitted by the Employer.
 - 15.8 Control cable terminations inside equipment enclosures shall have sufficient lengths so that switching of termination in terminal blocks can be done without requiring any splicing.
 - 15.9 Metal screen and armour of the cable shall be bonded to the earthing system of the station, wherever required.
 - 15.10 Rollers shall be used at intervals of about 2.0 metres, while pulling cables.
 - 15.11 All due care shall be taken during unreeling, laying and termination of cable to avoid damage due to twist, kink, sharp bends etc.
 - 15.12 Cable ends shall be kept sealed to prevent damage.
 - 15.13 Inspection on receipt, unloading and handling of cables shall generally be in accordance with IS: 1255 and other Indian Standard Codes of practices.
 - 15.14 Wherever cables pass through floor or through wall openings or other partitions, wall sleeves with bushes having a smooth curved internal surface so as not to damage the cables, shall be supplied, installed and properly sealed by the Bidder at no extra charges.
 - 15.15 The erection work shall be carried out in a neat workmanlike manner and the areas of work shall be cleaned of all scrap materials, etc. after the completion of work in each area every day. Bidder shall remove the RCC/steel bench 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.
 - 15.16 Bidder shall furnish three copies of the report on work carried out in a particular week, such as cable numbers and a date on which laid, actual length and route, testing carried out, along with the marked up copy of the cable schedule and interconnection drawing wherever any modifications are made.
 - 15.17 In case the outer sheath of a cable is damaged during handling/installation, the Bidder shall repair it at his own cost, and to the satisfaction of the Engineer-in-Charge. In case any other part of a cable is damaged, the same shall be replaced by a healthy cable, at no extra cost i.e. the Bidder shall not be paid for installation and removal of the damaged cable.
 - 15.18 All cable terminations shall be appropriately tightened to ensure secure and reliable connections. The Bidder shall cover the exposed part of all cable lugs whether supplied by him or not with insulating tape, sleeve or paint.
16. Conduits, Pipes Installation
- 16.1 Bidder shall supply all conduits, pipes and ducts as specified and to be shown in detailed engineering drawing. Flexible conduit should be used between fixed conduit and equipment terminal boxes. Where vibration is anticipated, the flexible conduit shall be as per the relevant IS.
 - 16.2 Bidder 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. Anti corrosive paint shall be applied at all field threaded portions. The Bidder shall supply and apply this protective material.

- 16.3 All conduit/pipes shall be extended on both sides of wall/floor/openings. Exposed conduits/pipes shall be adequately clamped at an interval of about 2m. The fabrication and installation of supports and the clamping shall be included in the scope of work by Bidder.
- 16.4 When two lengths of conduits are joined together through a coupling, running threads equal to twice the length of coupling shall be provided on any length to facilitate easy dismantling of two conduits.
- 16.5 Conduit installation shall be permanently connected to earth by means of special approved type of earthing clamps. G.I. Pull wire of adequate size shall be laid in all conduits before installation.
- 16.6 Each conduit run shall be painted with its designation as indicated on the drawings, such that it can be identified at each end.
- 16.7 Embedded conduits shall have a minimum concrete cover of 50mm. Positioning and ensuring proper alignment during concrete by other agencies shall be the responsibility of the Bidder.
- 16.8 Conduit runs sleeves shall be provided with the bushings at each end.
- 16.9 Metallic conduit runs at termination shall have two locknuts and a bushing for connection. Flexible conduits shall also be suitably clamped at each end. Bushings shall have rounded edges so as not to damage the cables.
- 16.10 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 the arc length of the bend shall be embedded.
- 16.11 For underground runs, Bidder shall excavate and back fill as necessary.

ANNEXURE-I : EARTHING NOTES

1. GENERAL

- 1.1 Neutral points of systems of different voltages, metallic enclosures and frame works associated with all current carrying equipments and extraneous metal works associated with electric system shall be connected to a single earthing system unless stipulated otherwise.
- 1.2 Earthing system installation shall be in strict accordance with the latest editions of Indian Electricity Rules/CEA Regulations, relevant Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.
- 1.3 Bolts and nuts required for earthing all main equipment structures and for connecting with earthing system shall be in the scope of the Bidder.

2. DETAILS OF EARTHING SYSTEM

Item	Size	Material
Main Earthing conductor	Suitable for a system current of 31.5 KA/1s as per IS	Mild Steel
Conductor above ground & earthing leads (for equipment)	To be submitted by the the vendor as per above	Galvanized Steel
Rod Electrode	Suitable for a system current of 31.5 kA/ 1s as per IS	Mild steel
G.I. Earthwire	7/8 SWG	GI

3. EARTHING CONDUCTOR LAYOUT

- 3.1 Earthing conductors in outdoor areas shall be buried at least 600mm below finished grade level unless stated otherwise.
- 3.2 Minimum 3000 mm spacing between rod electrodes shall be provided unless stipulated otherwise.
- 3.3 Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid at least 300 mm below them and shall be re-routed in case it fouls with equipment/structure foundations.
- 3.4 Tap connections from the earthing grid to the equipment/structure to be earthed, shall be terminated on the earthing terminals of the equipment/structure, if the equipment is available at the time of laying the grid. Otherwise, "earth insert" with temporary wooden cover or "earth riser" shall be provided near the equipment foundation / pedestal for future connections to the equipment earthing terminals.

- 3.5 Earthing conductor along their run on cable trench ladder columns, beams, walls, etc. shall be supported by suitable welding/cleating at intervals of 750 mm. Earthing conductors along cable trenches shall be on the wall nearer to the equipment. Wherever it passes through walls, floors etc. galvanized iron sleeves shall be provided for the passage of the conductor. Both ends of the sleeves shall be sealed to prevent the passage of water through the sleeves.
- 3.6 Earthing conductor around the building shall be buried in earth at a minimum distance of 1500mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500mm away from such location.
- 3.7 In outdoor areas, tap connections shall be brought 300mm above ground level for making connections in future, in case equipment is not available at the time of grid installations.
- 3.8 Earthing conductors crossing the road shall be either installed in hume pipes or laid at greater depth to suit the site conditions.
- 3.9 Earthing conductors embedded in the concrete fibre shall have approximately 50mm concrete cover.
4. EQUIPMENT AND STRUCTURE EARTHING
 - 4.1 The connection between earthing pads and the earthing grid shall be made by short and direct earthing leads free from kinks and splices. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with engineer. The equipments shall be earthed at two distinctive points on panels.
 - 4.2 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.
 - 4.3 Metallic conduits shall not be used as earth continuity conductor.
 - 4.4 A separate earthing conductor shall be provided for earthing lighting fixtures, lighting poles, receptacles, switches, junction boxes, lighting conduits, etc.
 - 4.5 Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam, conduits, etc. and steel reinforcement in concrete it shall be bonded to the same.
 - 4.6 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 minimum two points, whether specifically shown or not.
 - 4.7 Railway tracks within Sub-Station area shall be bonded across fish plates and connected to earthing grid at several locations.
 - 4.8 Earthing conductor shall be buried 2000mm outside the Sub-Station fence. Every post of the fence and gates shall be connected to earthing loop by one lead.
 - 4.9 Flexible earthing connectors shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.
5. JOINTING
 - 5.1 Earthing connections with equipment earthing pads shall be of bolted type. Contact surfaces shall be free from scales, paint, enamel, grease, rust or dirt. 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.

- 5.2 Connection between equipment earthing lead and between main earthing conductors shall be welded/brazed type. For rust protections, the welds should be treated with red lead and afterwards thickly coated with bitumen compound to prevent corrosion.
- 5.3 Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.
- 5.4 Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.
- 5.5 All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.
- 5.6 Bending of large diameter rod/thick conductor shall be done preferably by gas heating.
- 5.7 All arc welding with large diameter conductors shall be done with low hydrogen content electrodes.
6. POWER CABLE EARTHING

Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.
7. SPECIFIC REQUIREMENT FOR EARTHING SYSTEMS
 - 7.1 Earthing terminal of each surge arrester, capacitor voltage transformer and lightning down conductors shall be directly connected to rod electrode which in turn, shall be connected to station earthing grid.
 - 7.2 Earthing mat comprising of closely spaced (300mm x 300mm) conductors shall be provided below the operating handles of the isolators.
 - 7.3 For specific requirements for earthing at panel refer to Section-Control and Relay Panel of this specification.
8. SPECIFIC REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEM
 - 8.1 Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.
 - 8.2 Down conductors shall be cleated on the structures at 2000mm interval.
 - 8.3 Connection between each down conductor and rod electrodes shall be made via test joint located approximately 150mm above ground level.
 - 8.4 Lightning conductors shall not pass through or run inside G.I. conduits.
 - 8.5 Lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules/CEA regulations, Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.

9. PROCEDURE FOR NON DESTRUCTIVE TESTING

- A) LIQUID PENETRANT EXAMINATION OF WELDED JOINTS
 - a) Evaluation of indications – As per standard Test Procedure.
- B) RADIOGRAPHIC EXAMINATION OF WELDED JOINTS to be carried out as per standard test procedure on 10% welded joint.

B) TECHNICAL SPECIFICATIONS FOR 66 kV GAS INSULATED SWITCHGEAR

1.1 General

The specification covers scope of design, engineering, fabrication, manufacturing, shop assembly, inspection and testing before supply, transportation, delivery at destination, unloading & storage at site, site erection, site testing, commissioning and putting in to successful operation complete with all materials, support structures, anchoring bolts, accessories, commissioning spares & maintenance spares (utility to specify requirements), special spanners, tools & tackles, any specific required ancillary services, SF₆ Gas for first filling & spare, etc., for efficient and trouble free operation along with for 66 kV metal (aluminum alloy) encapsulated SF₆ gas insulated switch-gear suitable for INDOOR installation.

The scope also covers provision of additional bays (without equipments) over and above bays shown in SLD, with foundations & earthing arrangements so as to install the bay module as and when required without any works pending except the procurement of the required bay module and other related equipments.

1.2 Design Concept, construction & performance of SF₆ GIS

1.2.1 It is understood that each manufacture has its own particular SF₆ GIS design concept and it is not the purpose of this specification to impose unreasonable restrictions. However, in the interest of safety, reliability and serviceableness, the switch gear offered shall meet the following minimum requirements.

The station layout and equipment rating shall be based on the single line diagram and general layout enclosed. The supplier has to work out an optimum layout and building size based on the specific features of his product within the constraints of overall dimensions of the plot.

All equipment, accessories and wiring shall have tropical protection, involving special treatment of metal and insulation against fungus, insects and corrosion.

Furthermore, no part of the enclosure, or any loose parts may fly off the switchgear in such an event, and no holes may burn through the enclosure until the nearest protective relay has tripped. All grounding connections must remain operational during and after an arc fault.

Proper grounding for mitigating over voltages during disconnector operation shall be included.

Viewing windows shall be provided at the Disconnectors and earthing switches to ensure that each contact position can be inspected easily from the floor level. Each section shall have plug-in modules or easily removable connection pieces to allow for easy replacement of any component with the minimum of disturbance to the remainder of the equipment.

The number of transport/shipping splits shall be minimized to keep installation time of GIS to a minimum.

The arrangement shall afford maximum flexibility for routine maintenance. Equipment removal and SF6 handling should be accomplished with ease.

The ease of operation shall be ensured.

In general the contours of energized metal parts of the GIS and any other accessory shall be such as to eliminate areas or points of high electrostatic flux concentrations. Surfaces shall be smooth with no projection or irregularities, which may cause corona.

1.2.2 Modular Design & Future extensions

The GIS switch gear shall be of modular design offering high degree of flexibility. Each module shall be complete with SF6 gas circuit breaker, Disconnectors, Maintenance Grounding switches, fast Earthing switches, Voltage transformers, Current transformers, bus & elbow sections, cable end enclosures, L.A., local control cubicle and all necessary components required for safe & reliable operation and maintenance. All the three phases of the busbars and associated equipments like breakers, disconnectors, instrument transformers & earthing switches etc., as detailed in enclosed single line diagram are to be encapsulated in a single gas filled metallic enclosure.

The bus bars shall be sub-divided into compartments including the associated bus bar disconnector. Bus bars are partitioned at each bay with an objective to isolate Busbar compartment for the purpose of extension and at the same time avoid damage to adjacent bays in the event of fault.

1.2.2.1 Materials used in the manufacture of the switchgear equipment shall be of the type, composition and physical properties best suited to their particular purposes and in accordance with the latest engineering practices.

1.2.2.2 The switchgear shall be of the freestanding, self-supporting dead-front design, with all high-voltage equipment installed inside gas-insulated, metallic grounded enclosures, and suitably sub-divided into individual arc and gas-proof compartments.

1.2.2.3 Arc faults caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear. In case of any internal arc fault in a busbar, busbar disconnector or circuit breaker, of double bus system, repair works must be possible without shutting down complete substation and at least one busbar and the undisturbed bays must remain in operation.

Where bus Coupler / sectionaliser is specified and in case of any internal arc fault in a busbar, busbar disconnector or sectionaliser, repair work must be possible without shutting down the complete substation and at least one half of the substation must remain in operation. Documents indicating sequence of repair work steps and description of necessary restrictions during work shall be submitted with the technical bid.

Each bay module should be equipped with suitable arrangement for easy dismantling and refitting during maintenance without disturbing other units.

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

1.2.2.5 There shall not be any kind of interference to the connected & nearby equipment and system, when the equipment is operated at maximum service voltage.

1.2.3 Maintenance and repair of a circuit breaker

The positioning of the circuit breaker in the GIS shall be such that it shall be possible to access the circuit breaker of any feeder from the front side for routine inspection, maintenance and repair without interfering with the operation of the adjacent feeders.

The GIS shall be so designed that any component of the GIS can be removed easily. With minimum flexibility in the layout arrangement it shall be possible to remove the circuit breaker with both busbars remaining in service and it shall be possible to remove the disconnectors of the busbars, with one bus bar remaining in service.

1.2.4 Interchangeability

As much as possible, all the parts shall be of standard manufacture with similar parts and assemblies being interchangeable.

1.2.5 Future Extension

The modular design of GIS switch gear shall be capable of extension in the future on either end by the addition of extra feeders, bus couplers, busbars, circuit breakers, Disconnectors, and other switch gear components without drilling, cutting, welding or dismantling any major part of the equipment. The Vendor is required to demonstrate clearly in his submitted documents the suitability of the switchgear design in this respect. The arrangement shall be such that expansion of the original installation can be accomplished with minimum GIS down time. In case of extension, the interface shall incorporate facilities for installation and testing of extension to limit the part of the existing GIS to be re-tested and to allow for connection to the existing GIS without further dielectric testing.

1.2.6 The SF6 GIS shall be of INDOOR type and suitable for the atmosphere of the location which is heavily polluted, windy, sandy desert & service condition indicated at 2.1.

1.2.7 The required switchgear shall be capable of being supplied in a completely gas-insulated version in which case all switchgear components including the bus-bars shall be of gas-insulated type.

1.3 Specification requirements

The 66 kV GIS switch-gear shall be of a Double bus design having three-phase common enclosure concept, and it shall consist of Line & transformer bays as indicated in attached Single line Diagram and General lay out plan. This configuration shall meet within the given area indicated in layout plan.

1.4 Current Rating

The current rating of the switchgear should be assessed on the following requirements-

- a) Capable of handling power to an extent of as to an ambient day-time mean temperature between – 5 deg C and + 50 deg C
- b) The switchgear described in this specification is intended for continuous duty at the specified ratings and under all system operating conditions including sudden change of load and voltage within its ratings and at specified ambient conditions 24 hours a day, 365 days a year unless indicated otherwise.

The installed capacity of the power transformers is given in SLD attached.

1.5 Electrical, Mechanical and Thermal Capability

The assembled equipment shall be capable of withstanding the electrical, mechanical and thermal ratings of the specified system. All joints and connections shall be required to withstand the forces of expansion, vibration, contraction, and specified seismic requirements without deformation or malfunction and leakage. The apparatus shall be capable of withstanding the specified environment.

1.6 Insulation level

The switchgear and other equipment shall be designed for a maximum operating voltage and rated impulse withstand voltage according as specified in cl. 2.3. The switchgear may require to be installed in an unmanned distribution network with predominantly over head interconnection or EHV cable as the case may be. Circuit breakers shall be capable of interrupting line, transformer & cable charging currents of the magnitude indicated in the data schedules.

1.7 Physical arrangement

- a) The layout shall be properly designed by the bidder to completely accommodate the present & future requirements of the substation as per the furnished single line diagram and the enclosed site plan. They may be adjusted as necessary to suit the manufacturer's standard design and Utility need.
- b) The arrangement of the switchgear offered must provide adequate access for checking and maintenance.
- c) Optimized arrangements are required so as to reduce installation time, minimize maintenance & repair cost, provide ease of operation and facilitate future expansions.

1.8 Gas Sectionalisation

- a) The switch-gear gas enclosures must be sectionlised, with gas tight barriers between sections or compartments.
- b) The sections shall be so designed as to minimize the extent of plant rendered inoperative when gas pressure is reduced, ether by excessive leakage or for maintenance purposes, and to minimize the quantity of gas that has to be evacuated and then recharged before and after maintaining any item of equipment.
- c) The arrangement of gas sections or compartments shall be such that it is possible to extend existing bus-bars without having to take out of service another section of the bus-bar at a time.
- d) For limitation of any internal arc to the concerned bay and to reduce the extent of necessary gas works of each section of the bus-bar must be sectionalized bay by bay.
- e) Sectionalisation shall ensure that circuit breaker enclosure will not include any other equipment in its gas compartment.

1.9 Expansion Joints and Flexible Connections

- a) The layout shall sufficiently take care to the thermal expansion / contraction of the assembly by the provision of expansion joints. Expansion joints shall be placed in between any bay section of the busbar. All joint surfaces shall be machined, and all castings shall be spot faced for all bolt heads or nuts and washers.
- b) If necessary, the number and position of expansion joints or flexible connections are to be determined by the manufacturer to ensure that the complete installation will not be subject to any expansion stresses which could lead to distortion or premature failure of any piece of the SF6 equipment, support structures or foundations.

Bracing shall be provided for all mechanical components against the effects of short circuit currents specified under system parameter. The design of the equipment shall be such that the agreed permitted movement of foundations or thermal effects does not impair the assigned performance of the equipment.

The design calculations for all the supports shall be submitted to ensure care taken.

- c) The continuity of service during thermal expansion / contraction and vibrations shall be ensured. Expansion joints, flexible connections and adjustable mountings shall be provided to compensate for reasonable manufacturing and construction tolerances in the associated equipment to which the GIS may be connected. Required sliding plug-in contacts for conductors shall be provided. This is to ensure that unreasonably excessive accuracy is not required when installing such equipment and constructing the

associated foundations or support structures, e.g. transformers or the interconnection of isolated sections of switch-gear by means of long GIS bus-bar or duct installations. Flexible joints may also be provided to allow more efficient maintenance and future extensions of the GIS.

1.10 Barrier and Non-Barrier Insulators

- a) Support insulators shall be used to maintain the conductors and enclosure in proper relation. These support insulators may be of two types. Barrier insulators which are employed to isolate gas compartments and non-barrier insulators which allow the gas pressure to equalize.
- b) The gas barrier insulators sealing to the conductors and the enclosure wall shall be designed to withstand the maximum pressure difference that could occur across the barrier, i.e. maximum operating pressure at one side while a vacuum is drawn at the other side & in case of internal arc fault with a safety factor of 2.
- c) The support insulators and section barriers / insulators shall be manufactured from the highest quality material. They shall be free from all voids and the design shall be such as to reduce the electrical stresses in the insulators to a minimum. They shall also be of sufficient strength to ensure that the conductor spacing and clearances are maintained when short circuit faults occurs.
- d) Tests shall be carried out during the manufacture of the Switchgear to ensure that all parts of the equipment are free of partial discharge with a partial discharge extinction voltage which is at least 10% higher than the rated voltage.

1.11 Gas seals, Gas Density & pressure and other requirements.

- a) Single sealing of O-ring type shall be used for sealing the connections between the switch-gear modules. The leakage rates shall be kept to an absolute minimum under all normal pressure, temperature, electrical load and fault conditions. The guaranteed leakage rate of each individual gas compartment and between compartments must be less than 0.5% p.a. for the service life of equipment.
- b) Piping and fittings for gas monitoring and gas supply shall be made of copper or brass. The gas monitor device should be installed at each individual compartment of the module. Each gas compartment must be independent, external gas pipe connections should be avoided to minimize leakage.
- c) All gas compartments shall be fitted with filter material which absorbs the residual moisture and moisture entering inside the High-voltage enclosure. Filters in gas compartments with switching devices must also be capable to absorb the gas decomposition products resulting from the switching arc.
- d) The rated pressure of the SF₆ insulating gas in the metal-clad equipment shall be as low as is compatible

with the requirements for electrical insulation and space limitations to reduce the effects of leaks.

- e) The SF6 switch-gear shall be designed for use with SF6 gas complying with the recommendations of IEC – 60376 at the time of the first charging with gas.
- f) Connections including bolts and nuts shall be adequately protected from corrosion and easily accessible with the proper tools.
- g) All components shall be fire retardant and shall be tested in accordance with relevant standards. Gas emissivity when the Material is heated shall be minimal.

1.12 Gas Treatment Requirements

Under normal operating conditions it shall not be necessary to treat the insulating SF6 gas between major overhauls. In all gas compartments permanent efficient filters and desiccants shall be effective for the duration of time between major overhauls. Notwithstanding this, the insulators in the circuit breaker shall be made of epoxy resin composition that will resist decomposition products in contact with moisture.

1.13 Gas Monitoring Devices

Gas density or pressure monitoring devices shall be provided for each gas compartment. The devices shall provide continuous and automatic monitoring of the state of the gas. The SF6 gas monitoring device shall have two supervision and alarm settings. These shall be set so that, an advanced warning can be given that the gas density/pressure is reducing to an unacceptable level. After an urgent alarm, operative measures can be taken to immediately isolate the particular compartment electrically by tripping circuit breakers and opening disconnectors. It shall be ensured that there is no chance of the gas liquefying at the lowest ambient temperature.

The gas monitoring device shall monitor at least the following, locally and on remote.

- i) "Gas Refill" Level- This will be used to annunciate the need for gas refilling.
- ii) "Breaker Block" Level- This is the minimum gas density at which the manufacturer will guarantee the rated fault interrupting capability of the breaker. At this level the device contact shall trip the breaker and block the closing circuits.
- iii) Over pressure alarm level- This alarm level shall be provided to indicate abnormal pressure rise in the gas compartment.

It shall be possible to test all gas monitoring relays without de-energizing the primary equipment and without reducing pressure in the main section. Disconnecting type plugs and sockets shall be used for test purposes; the pressure/density device shall be suitable for connecting to the male portion of the plug.

Two potential free electrical contacts shall be provided with each and every alarm condition.

1.14 Conductors

The conductors shall be made of aluminum alloy suitable for specified voltage and current ratings. The electrical connections between the various gas sections shall be made by means of multiple contact connectors (plug-in type) so that electrical connection is automatically achieved when bolting one section to another. Field welding of conductor is not acceptable. The surface of the connector fingers and conductor on such connections shall be silver plated. Both, the conductors as well as the contacts for the conductor connections must be designed for the continuous rated current of the switch gear under the ambient conditions furnished, and shall not exceed the permissible temperature rise.

1.15 Enclosures

1.15.1 The metal enclosures for the SF6 gas insulated equipment modules shall be made from Aluminum alloy. Suitable anti corrosive paints shade 631 of IS:5, must be applied on the exterior of the enclosures. The enclosure shall be suitable for three phases, i.e. Single Enclosure. The external fixtures should be made of corrosion-resistant material and should be capped where required.

Bellow compensators shall be made of Stainless steel to preserve the mechanical strength of the equipment at the connection portions to deal with the following problems:

- a) Expansion and Contraction of outer enclosure and conductor due to temperature variations.
- b) Mismatch in various components of GIS
- c) Vibration of the transformer and switching equipment
- d) Dimensional variations due to uneven settling of foundation
- e) Seismic forces as mentioned in climatic condition.

1.15.2 Standard paint shade 631 of IS:5 shall be used with satin mat finish having high scratch resistance.

1.15.3 The gas-filled enclosures shall conform to the pressure vessel code applied in the country of manufacturer. Gas section barriers including seals to the conductor and enclosure wall shall be gas-tight and shall be capable of withstanding the maximum pressure differential that could occur across the barrier, i.e., with a vacuum drawn on the one side of the barrier and on the other side, at least the maximum gas pressure that can exist under normal operating or maintenance conditions and in case of internal arc fault.

The finish of interior surfaces of the metal-clad enclosures shall facilitate cleaning and inspection. High quality primer followed by two coats of anti corrosive paint of glossy white shade shall be

used such that they will not deteriorate when exposed to the SF₆ gas and other vapors, Arc products, etc., which may present in the enclosures. They shall also not contain any substances which could contaminate the enclosed gas or affect its insulating properties over a period of time.

1.16 General Finish and Cleaning

- a) The equipment shall be manufactured and assembled at the manufacturer's works under conditions of the utmost cleanliness.
- b) Very dusty / sandy conditions may exist at the site hence, whenever possible, the complete feeders or major assembly of components should be shipped as transport units. Before the metal clad enclosed sections are joined together and charged with the SF₆ gas they must be thoroughly cleaned.
- c) Paints shall be carefully selected to withstand heat and weather conditions. The paint shall not scale-off or crinkles or gets removed by abrasion due to normal handling.
- d) Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished with GIS.

1.17 Gas filling and Evacuating Plant/Gas reclaimer for 66 kV GIS unit.

- a) All apparatus necessary for filling, evacuating, and recycling the SF₆ gas into and from the switch-gear equipment shall be supplied by the bidder to enable any maintenance work to be carried out.
- b) Where any item of the filling and evacuating apparatus is of such a weight that it cannot easily be carried by maintenance personnel, it shall be provided with facilities for lifting and moving with the overhead cranes.
- c) The apparatus for filling, evacuating and recycling all gases to be used shall be provided with all necessary pipes, couplings flexible hoses, tubes and valves for coupling to the switch-gear equipment.
- d) The gas compartments shall preferably be fitted with permanent vacuum couplings through which the gas is pumped into or evacuated from the compartments.
- e) Details of the filling and evacuating apparatus that will be supplied, and also a description of the filling, evacuating and recycling procedures, shall be provided with the bid.
- f) The initial gas filling of the entire switch-gear including the usual losses during commissioning shall be supplied over and above the required quantity of spare gas.

- g) An additional quantity of SF₆ gas for compensation of possible losses during installation and 10% extra quantity of SF₆ gas for future uses shall be supplied. The quantity of the same shall be indicated in GTP.

Such spare gas shall be supplied in sealed cylinders of uniform size, which shall be decided during detailed engineering.

- h) Gas reclaimer shall have gas storage facility of sufficient capacity.
- i) SF₆ Gas Processing Unit :
 - A. An SF₆ gas-processing unit suitable for evacuating, liquefying, evaporating, filling, drying and purifying SF₆ gas during the initial installation, subsequent maintenance and future extension of GIS shall be provided. The cart shall be equipped with rubber wheels and shall be easily maneuverable within the GIS building.
 - B. A wheeled maintenance unit shall be supplied which shall be self-contained (except for additional gas storage bottles and external power supply at 415 V AC, 3-phase, 50 Hz) and fully equipped with an electric vacuum pump, gas compressor, gas drier, gas filter, refrigeration unit, evaporator, gas storage tank, full instrumentation for measuring vacuum, compressor inlet temperature, tank pressure and temperature, valving and piping to perform the following operations as a minimum requirement:
 - i) Evacuation from a gas filled compartment using the vacuum pump,
 - ii) Transfer of SF₆ gas from a system at some positive or negative pressure to the storage tank via the gas drier and filter;
 - iii) Recirculation of SF₆ gas in the storage tank through the drier,
 - iv) Recirculation of SF₆ gas in any switchgear or bus duct compartment through the drier and filter;
 - v) Evaporating and filling SF₆ gas,
 - vi) Drawing off and liquefying SF₆ gas,
 - vii) A combination operation of filling SF₆ gas into a gas system and evacuating a second gas system using the vacuum pump.
 - C. Adequate length of hoses with necessary adaptors shall be provided for filling of SF₆ gas in any of the gas compartment with the help of gas cart.
 - D. GA drawing and Schematic drawing for gas processing unit shall be submitted for approval.

1.18 Support Structures

All supporting structures necessary for the support of the GIS equipment including associated parts such as anchor bolts, beams etc. shall be supplied. Sufficient attachment points to the apparatus and concrete foundations shall be furnished to ensure successful installation, with required clearances, while taking into account thermal expansion and contraction. Earthquake requirements are also to be considered.

Any scaffolding or a movable platform, required for maintenance, shall also be supplied.

All steel structure members shall be hot-dip galvanized after fabrication. Minimum thickness of Galvanizing shall be 610 grams per square meter. All field assembly joints shall be bolted. Field welding shall not be acceptable.

Non-corrosive metal or plated steel shall be used for bolts and nuts throughout the work. Manufacturer shall provide suitable foundation channels and anchor bolts to support the switchgear assemblies. All mounting bolts, nuts and washers shall be provided to fasten the switchgear base frames to the foundation channels.

Foundation channels and anchor bolts shall be installed in the civil works in accordance with instructions provided by the manufacturer.

1.19 Auxiliary Equipment

The following items shall be included for a complete installation:

- a) Control system including local control cabinets
- b) Cable and wiring between individual items of supplied equipment.
- c) Nameplates
- d) All ladders, platforms, stairs, walkways, and supports necessary to operate and maintain all equipment safely and efficiently.
- e) Special tools and tackles for installation
- f) Special tools and tackles for maintenance

1.20 Safety Precautions

- 1 The switch-gear must provide a maximum degree of safety for the operators and others in the vicinity of the switch gear under all normal and fault conditions. The safety clearances of all live parts of the equipment shall be as per relevant standards.
- 2 It must be made impossible to touch any live part of the switch-gear unwillingly, i.e. without use of tools or brute force.

3 An operator standing in the normal operating position should not be endangered by any moving external part of the switch-gear.

4 INTERLOCKS:

Mechanical & electrical interlocks must be provided to ensure absolute and reliable protection against potentially harmful Mal-operation of the switchgear. All interlocks that prevent potentially dangerous mal-operations shall be so constructed such that they cannot be defeated easily i.e. the operator must use tools and/or technique to over-ride them only in case of emergency.

The following functions shall be provided:

- 1) The operator must be forced in to the only safe and logical sequence to actuate the circuit breakers, disconnectors & earthing switches.
- 2) The actual, completely closed or completely opened position of all switching devices must be checked before and after each move.
- 3) Implementation of logic checks and issuing the resultant signals Enabled or Blocked for the switching device.

5 If in spite of all possible safety measures if any arc occurs, the following is required.

- i) The effects of an internal arcing fault must be limited to the related gas compartment.
- ii) Each gas compartment must have its own automated external pressure relief device to provide instant and safe discharge of accidental overpressure during internal arc. Rupture diaphragms shall be preferably used as pressure relief mechanisms. The bursting pressure of relief device should be effectively coordinated with the rated gas pressure and the pressure rise due to arcing. PRD shall be positioned such that it will not be below any circuit breaker or disconnector drive or LCC.
- iii) All earthing connections must remain operational.
- iv) The enclosure of the switch gear must withstand the thermal effects of an arc at the full rated short circuit current until the nearest protective relay has acted and tripped the breaker.
- v) To limit the effects of an internal arc the switch gear shall be suitably subdivided into individual arc and gas-proof compartments, at least for
 - Bus-bar together with bus-bar isolator and earthing switch

- Circuit breaker
- Line isolators and earthing switch, (Line, transformer)
- Instrument transformers.

6 The following requirements are to be followed.

- i) The bracing/welding of all components subject to mechanical forces caused by short circuit currents shall be capable so as to withstand the effects of at least 2.5 times the rated symmetrical short time withstand current.
- ii) The thermal rating for all current carrying parts and insulating materials shall be a minimum of three seconds for the rated short time withstand current.
- iii) All components of the switch gear which are on ground potential shall be electrically interconnected and effectively earthed.

1.21 Special tools, tackles and equipments

Special tools, tackles and equipment that are required to perform installation, commissioning, operation & maintenance of the gas insulated switch gear shall be included in scope of supply. Minimum following tools shall be supplied.

- 1 Dew point measurement meter
- 2 SF6 gas leakage detector
- 3 Precision pressure gauge
- 4 Gas-service carts
- 5 Any other special tool/tackle required.

The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

The requirement of HV testing during commissioning or repairing or replacement shall be fulfilled by successful bidder by arranging the required HV testing equipment at no extra cost to Utility. No delay shall be permitted on account of the non availability of the HV test equipments.

1.22 Grounding of GIS:

- a) GIS will be housed on GIS floor. The bidder will provide under-ground mat below the substation. The bidder shall also provide adequate number of Galvanized steel risers to be connected to grounding mat, as per relevant standards and in consultation with Utility during detailed engineering, in the event of an order.
- b) The bidder shall supply entire material for ground bus of GIS such as conductor, clamps,

joints, operating and safety platforms etc. to be laid / embedded in GIS floors. The bidder is also required to supply all grounding connectors and associated hardware material for:

- i) Connecting all GIS equipment, Bus duct, enclosures, control cabinets, supporting structures etc. to the ground bus of GIS
 - ii) Connecting ground bus of GIS to the ground mat risers.
- c) The grounding arrangement of GIS shall ensure that touch and step voltages are limited to safe values as per IEEE std. 80-2000. The enclosures of the GIS shall be grounded at several points such that there shall be a grounded cage around all live parts. The ground continuity between each enclosure shall be affected over flanges, with or without links or straps to bridge the flanges. Copper/Aluminum straps shall however bridge the metallic expansion bellows. The grounding switches shall be connected to ground through the enclosure. Individual ground leads for the ground switches are not allowed. The inductive voltage against ground in each part of the enclosure shall not be more than 65 Volts.
- d) Where operating mechanism cabinets are mounted on the switchgear, the grounding shall be made by separate conductor. Bay control cabinets shall be grounded through a separate conductor.
- e) All conduits and control cable sheaths shall be connected to the control cabinet grounding bus. All steel structures shall be grounded.
- f) Each removable section of catwalk shall be bolted to the support structure for ground continuity.
- g) The enclosure grounding system shall be designed to minimize circulating currents and to ensure that the potential rise during an external or internal fault is kept to an acceptable level. The guidelines of IEEE Std. 80-2000 on GIS grounding, especially the transient ground potential rise caused by high frequency phenomena, shall be taken into consideration while designing the grounding system for GIS.
- h) The manufacturer shall furnish readily accessible connectors of sufficient mechanical strength to withstand electromagnetic forces as well as capable of carrying the anticipated maximum fault current without overheating by at least from two paths to ground from the main ground bus.
- i) Provisions of IEC 517 & 694 regarding safeguards in grounding of connected cables, testing during maintenance and other safety measures shall be ensured.
- j) Earthing conductors shall be designed to allow flow of short circuit current. Conductors with copper bars are preferred over copper wires.

2.0 SERVICE CONDITIONS:

2.1 Climatic Conditions:

The equipment and the accessories to be supplied against this technical specification shall be suitable for satisfactory continuous operation under the following tropical conditions (to be customized by utility as per requirement).

Max ambient temperature	:	50 deg C
Min. ambient temperature	:	-5 deg C
Max daily average ambient temperature	:	38 deg C
Max relative Humidity (%)	:	As per IEC
Max altitude above M.S.L (meters)	:	< 1000
Average Annual Rainfall (mm)	:	1000
Max wind pressure (kg./sq.mtr.)	:	130
Isoceraunic level (days/yr)	:	50
Average no. of rainy days / annum	:	120
Condensation	:	Occasional
Induced electromagnetic disturbance	:	1.6 kV
Pollution class / Creepage distance	:	III / 25 mm/kV
Seismic Zone	:	Zone V
Acceleration due to gravity, g	:	0.5

2.2 System Particulars

2.2.1 Pole designation

2.2.1.1

Enclosure

2.2.1.1.1 Bus bar	:	Three Phase
2.2.1.1.2 Bay	:	Three Phase
2.2.1.1.3 Enclosure material	:	Aluminum Alloy

2.2.2 Standards

Common clauses for high voltage switchgear & control gear	:	IEC 60694
High voltage metal enclosed switchgear for 72.5 KV & above	:	IEC 62271-203
Specification for acceptance of new Sulphur Hexa fluoride	:	IEC 60376

Guide to checking of Sulphur Hexa fluoride taken from Electrical equipment	:	IEC 60480
Surge Arresters	:	IEC 60099
Overhead line, Cable and Transformer Terminals Bushings for alternating voltages above 1000 V	:	IEC 60137
Cable connections for gas insulated metal enclosed Switchgear for rated voltages of 72.5 KV above	:	IEC 60859
High voltage test techniques	:	IEC 60060
Insulation coordination	:	IEC 60071
Electrical Relays	:	IEC 60255
High voltage switches	:	IEC 60265
Partial discharge measurement	:	IEC 60270
Degree of protection	:	IEC 60529
Pollution levels	:	IEC 60815
EMC	:	IEC 61000
Use and handling of SF ₆ gas	:	IEC 61634
Standards for station grounding	:	IEC 60364/ 60479/ IEEE 80
Pressure vessel code	:	CENELEC/ SVDB
Recommendation for heat treated Aluminum alloy busbar material of the aluminum-magnesium-silicon type	:	IEC 60114
IEEE Guide for Gas-Insulated Substations	:	IEEE std C37.122.1- 1993
Seismic design	:	IEC 693
2.2.3.1 Instrument Transformers		
Instrument transformers	:	IEC 60044
Current transformer	:	IEC 60185
Voltage transformer	:	IEC 60186
2.2.3.2 Circuit Breaker		
High voltage Alternating current circuit breakers	:	IEC 62271-100
Report on Synthetic testing of high voltage Alternating Current Circuit breakers	:	IEC 60427

2.2.4 Disconnectors and earthing switch

Alternating current Disconnectors (isolators)	:	IEC 60129
and earthing Switch		IEC 62271-102
Alternating current disconnectors, Bus	:	IEC 61128
transfer current Switching by disconnectors		
Alternating current earthing switches,	:	IEC 61129
induced current Switching		
2.2.5 Artificial pollution test on HV	:	IEC 60507
insulators to be used on ac system		
2.2.6 Gas insulated metal enclosed switchgear	:	IEC 60517
for rated voltages of 72.5 kV and above		
2.2.7 Classification of degree of protection	:	IEC 60529
provided by enclosures		

2.3 Electrical data: ((To be customized by utility as per requirements & capacity))

Rated System Voltage /	kV	66 /
Highest System/Equipment Voltage		72.5
One min. Power frequency withstand voltage	kV rms	140
Across open isolator	kV rms	160
Across the open gaps of CB	kV rms	140
Rated Lightning Impulse withstand voltage (1.2/50 micro second peak value)		
Phase to phase	kVp	350
Phase to earth	kVp	350
Across open isolator	kVp	375
Across the open gaps of CB	kVp	350
Rated Frequency	Hz	50
Rated Continuous current at 40 deg C ambient temperature Bus bar	Amps	1600
Feeder and Transformer Bay	Amps	1600
Rated Short circuit Withstand current for 3 seconds	kA	25

Rated dynamic withstand current	kAp	62.5
Partial Discharge (at 1.1 Un)	pico-coulombs	5(max.)
System Neutral earthing		Solidly earth
Maximum SF ₆ Gas leakage rate per year	% per year	0.5

2.3.1 Auxiliary Supply:

For Operation, control and signaling : 110 Volts DC (+10% & -20%) or as reqd by utility

For other loads : 440 / 230 Volts, AC 50 Hz.
 (+10% & -15%)

2.4 Seismic requirements:

The GIS shall comply with IEEE STD 693 – 1984 guideline to ensure functional adequacy under seismic disturbances. The maximum ground acceleration shall be 0.5 g.

3 Detailed technical requirements for GIS Components

3.1 Circuit Breaker:

3.1.1 General:

3.1.1.1 The GIS circuit breakers shall comply with the following general requirements for circuit breakers and the latest revisions of the relevant IEC-62271-100 specifications

3.1.1.2 Circuit-breakers shall be of single pressure, single break, self compression self blast / auto puffer type with SF₆ as arc quenching & insulation medium and with a minimum- maintenance contact system

3.1.1.3 They shall be of three phase encapsulated type.

3.1.1.4 Ratings of the circuit breaker shall be as per enclosed technical parameters

3.1.1.5 They should be shipped as a completed three-phase unit within a complete bay module.

3.1.1.6 Each circuit-breaker shall have spring/Hydraulic/combined drive mechanism ensuring proper closing and opening, and shall permit checking of adjustments and opening/closing characteristic.

The ON/OFF latches shall be mechanically interlocked with each other. The circuit breaker shall be completely factory assembled, adjusted and tested.

3.1.1.7 The total break time from energizing the trip coil at rated control voltage to final arc extinction shall be as short as possible, but in any event not greater than 3 cycles i.e. 60 ms.

3.1.1.8 The circuit breaker shall be capable of breaking all currents from zero up to the specified maximum fault current in accordance with the relevant IEC recommendations.

3.1.1.9 The breakers are to be restrike-free.

3.1.1.10 The circuit-breakers shall be capable of tripping and re-closing (Auto reclose) according to the specified duty cycle without derating: O-0.3 s – CO – 3 min. – CO.

Breaker shall be suitable for following switching duties:

- Terminal faults
- Short line faults
- Out of phase switching
- Interruption of small inductive current including transformer
- magnetizing inrush currents.
- Interruption of line and cable charging currents.

The circuit breaker shall meet all the double Circuit overhead transmission line and cable characteristics for any type of fault or fault location, and also for line charging and dropping when used on an effectively grounded system. Effect of second circuit in parallel shall also be considered.

The circuit breakers shall be capable of being operated locally or from remote. Local operation shall be by means of an open/close control switch located in the bay control cabinet.

The minimum guaranteed nos. of maintenance free operations of complete GIS shall be 10000 nos. at rated capacity.

3.1.1.11 The Drive shall have sufficient stored energy for completing 2 CO with auxiliary power switched off.

3.1.1.12 Circuit breakers, being an arcing device, shall not house any passive device like current transformer in its housing.

3.1.1.13 The breaker layout arrangement shall be vertical or horizontal but shall provide higher mechanical stability and ease in maintenance. The operating principle of the breaker shall ensure minimized dynamic floor loading. Low reaction forces on foundations especially dynamically, are favorable and considered in the elevation.

3.1.2 Closing Devices

3.1.2.1 The closing coils shall be suitable for operation at any voltage between 110% and 80% of the nominal control voltage measured at the device terminals.

3.1.2.2 The breaker shall close correctly when an electrical closing pulse of 50 msec. duration is applied to the closing coil.

3.1.3 Tripping Devices

3.1.3.1 All electrical tripping coils shall be suitable for operation at any voltage between 110% and 70% of the nominal control voltage measured at the device terminals.

3.1.3.2 Each circuit-breaker shall be equipped with two shunt trip system. The one shunt trip system shall be electrically separated from the other system.

3.1.3.3 An emergency hand tripping (mechanical) device shall be provided in the operating mechanism.

3.1.4 Anti-Pumping

The circuit-breaker mechanism shall be provided with means to prevent pumping while the closing circuit remains energized, should the circuit breaker either fail to latch, or be tripped during closing due to the operation of the protective relays.

3.1.5 Operating Mechanism

3.1.5.1 The breaker shall include suitable spring/Hydraulic/combined operating mechanism to assure proper opening & closing operations. The provision shall be made for checking adjustments and opening characteristics. The mechanism shall be capable of re-closing within the range specified in the applicable standards. The mechanism shall include dual trip coils. Charging of opening mechanism shall be possible in the event of failure of the motor drive.

Spring Operated Mechanism

- a) Spring operated mechanism shall be complete with motor, opening spring, closing spring with limit switch for automatic charging and all necessary accessories to make the mechanism a complete operating unit.
- b) As long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible.
- c) After failure of power supply to the motor, at least two close-open (C-O) operations of the circuit breaker shall be possible.
- d) Breaker operation shall be independent of the motor which shall be used solely for compressing the closing

spring.

- e) Motor rating shall be such that it requires only about 30 seconds for fully charging the closing spring.
- f) Closing action of the circuit breaker shall compress the opening spring ready for tripping.
- g) When closing springs are discharged after closing a breaker, closing springs shall automatically be charged for the next operation.

Hydraulic Operated Mechanism

- a) Hydraulic operated mechanism shall comprise self contained operating unit with power cylinder, control valves, high and low pressure reservoir, motor, etc. A hand pump set shall also be provided for emergency operation.
- b) The oil pressure controlling the oil pump and pressure in the high pressure reservoir shall be continuously monitored. Necessary hardware to achieve this, including the loose pressure gauge, instruments and interconnecting piping etc shall form integral part of this mechanism.
- c) The mechanism shall be suitable for at least two close-open operations after failure of AC supply to the motor.

- 3.1.5.2 The mechanism shall be in a dust proof (IP55) box for this outdoor installation of Gas Insulated Switchgear.

One vermin-proof, sheet steel cabinet of adequate size shall be provided for housing the operating mechanism, aux relays, control and auxiliary equipment and for terminating all control, alarm and auxiliary circuits in suitable terminal boxes. The control cabinet shall be provided with hinged doors with provision for locking and removable cable gland plates for bottom cable entry. Viewing windows shall be provided for observation of the instruments without opening the cabinet. Suitably engraved nameplates shall be provided to identify all equipment in the control cabinet.

3.1.6 Auxiliary Switches

Each breaker shall have auxiliary switches with adequate number of NO and NC contacts all wired to terminals located in the local control cabinet of the circuit breaker bay. 20 % spare contacts should be provided.

3.1.7 Indicating Devices

- 3.1.7.1 Position indicators shall be provided to clearly indicate whether a circuit-breaker is open or closed.
- 3.1.7.2 Each circuit-breaker shall be provided with an operation counter to record the number of tripping operations performed. The counter may be located at the local control cabinet.
- 3.1.7.3 All position indicators and counters shall be readable at a convenient elevation i.e. from the place of operation.

3.1.8 Gas Connections

Necessary valves and connections shall be provided to assure ease in handling the SF6 gas.

3.1.9 Timing Test

Timing tests are to be carried out after the switch gear has been completely charged with SF6 gas.

3.1.9.1 Testing instruments

- _ Air / gas humidity tester,
- _ Gas purity detector for SO2, H2O, CF4, AIR etc.,
- _ Gas leakage tester,
- _ Breaker timing measurement kit,
- _ Set of equipment for pressure measurement and gas density meter.

3.1.9.2 TESTING FACILITIES:

Timing test facility shall be provided with switchgear such that it is not necessary to open up any gas section to make test connections to the circuit breaker terminals. All details of test facilities to be provided shall be submitted with technical bid.

3.1.10 PRINCIPLE PARAMETERS

The Circuit Breakers of GIS equipment shall confirm to the specific technical requirements given as under.

Circuit Breaker (To be customized by utility as per requirements & capacity)

S. No	Particulars	66 kV
1a)	Enclosure	Three Phase
1b)	Enclosure material	Aluminum Alloy
2)	Rated voltage	72.5 kV
3)	Rated current	1600A
4)	Rated frequency	50 Hz
5)	Rated short-circuit breaking current	25 kA rms, 3 sec
6)	Rated break-time	3 cycle
7)	Rated short-circuit making current	62.5 kA peak
8)	Difference for simultaneity of 3 poles	4 ms (Max.)

9)	Rated insulation level under minimum SF6 gas pressure	
a)	Power frequency withstand voltage	140 kV rms
b)	Lighting impulse withstand voltage	350 kV peak
c)	Rated operating sequence	O-0.3s-CO-3min-CO
10)	Type of operating mechanism for circuit Breaker	Spring – Spring/hydraulic
11)	Rated control voltage - Closing coil	110/220 VDC 110/220
12)	Mechanical Endurance class	M1
13)	Electrical Endurance class	E1
14)	Restriking probability class	C1
15)	Rated line charging breaking current	10 A
16)	Rated cable charging breaking current	125 A
17)	Rated capacitor bank switching current	410 A
18)	Rated out of phase making and breaking current in % of rated short circuit breaking current	25
19)	Characteristic for short line fault related to rated short circuit breaking current	As per IEC 62271 - 100
20)	TRV characteristics	As per IEC 62271 - 100
21)	Inductive current breaking capability	Switching No Load current of transformer
22)	First pole to clear factor	As per IEC 62271 - 100
23)	Opening time in ms	Not more than 40
24)	Closing time in ms	Not more than 100
25)	Noise level at the base of CB	As per NEMA standard
26)	No of tripping coils per breaker	2
27)	No of closing coils per breaker	1

3.2 Disconnecter Switches and Maintenance Grounding switches

3.2.1 General

- a) The GIS disconnecter switches and grounding switches shall comply with the following general requirements of disconnect switches and the latest version of the relevant specifications IEC 60129, 61128, 61129, 61259.

- b) Disconnect switches shall be three phase encapsulated, group operated, no break, with one common motor operated mechanism for all the three poles. They shall also have facilities for emergency manual operation and necessary handles shall be provided.
- c) Maintenance earthing switches shall be three phase encapsulated, group operated, no break, with one common motor operated mechanism for all the three poles. They shall also have facilities for emergency manual operation and necessary handles shall be provided.
- d) Disconnect switches and grounding switches shall have electrical and Mechanical interlocks to prevent grounding switch from closing on an energized section.

Interlocks with other bays for bus transfer switching shall be done through bay control cabinets. Actuation of the emergency manual operating device shall also disable the electrical control. Disconnectors in open condition shall be secured against reclosure.

Disconnecting switches and adjacent safety grounding switches shall have electrical interlocks to prevent closure of the grounding switches when the disconnecting switches are in the closed position and to prevent closure of the disconnecting switch when the grounding switch is in the closed position. The disconnector shall be pad lockable in the close & open position.

Interlocks

Interlocking devices must provide absolute and positive protection against potentially harmful mal-operations of the switchgear. The following functions shall be assured:

- i) Forcing the operator into the only safe and logic sequence to actuate breakers, switches, isolators and grounding switches.
- ii) Checking the actual fully closed or fully open position of all switching elements before and after each move.
- iii) Providing the logical checks and issuing the resulting PERMISSIVE or BLOCKED signals for the switchgear.
- iv) Indicating positively the absolute condition/position of the supervised equipment.
- v) Local manual and remote electrical operation of all essential functions.
- vi) Local emergency unlocking facilities via safety-key switches under the full responsibility of the operator.

Intrabay and interbay interlocking shall be provided.

Electrical interlocking arrangement shall be fail-safe type.

Mechanical interlocks for isolator & Earthing Switch shall be fail-safe type.

- e) All main contacts, male and female, shall be silver plated.
- f) Each disconnect switch and grounding switch shall open or close only due to motor driven or manual operation independently. The switch contact shall not move due to gravity or other means, even if a part fails. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact be held closed.
Operation of respective end position limit switches shall only disconnect the motor mechanism. There should also be a pre-set timer in motor circuit for protection against time over-run in case of inadvertent failure of drive mechanism in any intermediate position of the disconnect travel path.
- g) The disconnect switches and grounding switches shall be located as shown in the Single Line Diagram.
- h) The disconnect switches shall be capable of interrupting the charging current of the connected GIS bus & associated components.

i) Duty requirements:

The disconnecting switches shall have breaking capabilities as per IEC requirements. Contact shielding shall be designed to prevent restrikes and high local stresses caused by the transient recovery voltages when currents are interrupted.

The bus disconnecting switches shall reliably handle capacitive currents due to the making and breaking of switchgear components as well as commutation currents due to bus bar reconfiguration.

The fast acting ground switches, used for overhead double circuit lines and underground cable feeders shall be capable of switching induced current as per IEC requirement.

Short Circuit Requirements

The rated peak short-circuit current or the rated short time current carried by an isolator or earthing switch for the rated maximum duration of short circuit shall not cause:

- a) Mechanical damage to any part of the isolator or earthing switch.
- b) Separation of the contacts or contact welding.
- c) A temperature rise likely to damage insulation.

j) Access for maintenance and repair:

Suitable means of access should be provided in each disconnect-switch and grounding-switch housing and mechanism for repair and/or maintenance of contacts.

3.2.2 Operation Mechanism.

- 3.2.2.1 Mechanism shall be arranged mechanically, electrically, so that all three phases of any particular disconnect switch or grounding switch operate simultaneously.
- 3.2.2.2 All mechanisms shall be suitable for electrical motor operation to achieve a fully automatic operation. For emergency situations manual operation shall be possible. Handles or hand cranks shall be provided, together with all necessary operation rods and rod guides. Manual operation shall be prevented if the interlocking system does not allow the operation of the switch.
- 3.2.2.3 The auxiliary supply shall be electrically decoupled from the motor when the switch is operated manually.
- 3.2.2.4 The mechanisms shall be arranged for locking in the open and in the closed position. Facility shall be available to allow the switch to be padlocked in any position.
- 3.2.2.5 Disconnecting operating mechanism of all disconnecter/ isolator & earth switches shall be at easy operable height.
- 3.2.2.6 The isolator shall be provided with positive continuous control throughout the entire cycle of operation.

The operating pipes and rods shall be sufficiently rigid to maintain positive control under most adverse conditions and when operated in tension or compression for isolator closing. They shall also be capable of withstanding all torsional and bending stresses due to operation of the isolator.

It shall not be possible, after final adjustment has been made, for any part of the mechanism to be displaced at any point in the travel sufficiently to a low improper functioning of the isolator when the isolator is opened or closed at any speed.

The operating mechanism design shall be such that during the operation of the isolator (especially manual operation), once the moving blades reach the sparking distance, springs shall take over to give a quick, snap action closing so that the isolator closing is independent of manual efforts. Similarly, the springs must assist during the opening operation to give quick breaking feature.

Disconnecter and high speed motor operated earthing switch mechanisms shall be provided with a mechanism with stored energy to always assure completed operations.

3.2.3 Auxiliary Switches:

All disconnecting switches shall be provided with electrically independent auxiliary switch, directly driven by the common operating shaft. Each disconnect switch and grounding switch shall be furnished with sufficient Nos. of NO – NC as per entire scheme requirement plus two (2) NO-NC electrically independent

contacts terminated up to terminal board, at user's disposal. The auxiliary switches shall indicate the position of the switch contacts, and shall be independent of the motor operation.

3.2.4 Position Indicators

3.2.4.1 Mechanically connected position indicators shall be provided externally to permit observation of close/open position of the disconnect switch and grounding switch. The place of Position Indicators should be easily visible from the place of operation of respective equipment.

3.2.4.2 Visual verification shall be provided for each pole of each disconnect switch and grounding switch to permit visual inspection of each switchblade position.

3.2.5 Technical Data Requirement: Disconnectors:

(To be customized by utility as per requirements & capacity)

Sr No.	Particulars	Parameters
1)	Enclosure	Three Phase
2)	Enclosure material	Aluminum Alloy
3)	Rated voltage	72.5 kV
4)	Rated current	1600 A
5)	Rated short-time current	25 kA rms, 3 sec
6)	Rated control and operating voltage	110/220 V DC
7)	Type of operating mechanism	Motor operated
8)	Type	Mechanically ganged operated
9)	Rated insulation level	
a)	Power frequency withstand voltage	
	- phase to phase, between phases	140 kV rms
	- Across the isolating distance	160 kV rms
b)	Lightning impulse withstand voltage	
	- phase to phase, between phases	350 kV peak
	- Across the isolating distance	375 kV peak
10)	Mechanical Endurance Class	M1
11)	Bus transfer switching capability (% of rated current)	80
12)	Rated bus charging current	0.1 A

3.2.6 Low-voltage test provision:

A low-voltage test provision may be supplied with a grounding switch to permit test voltages of up to 10kV (optional 2.5kV) and upto 200 A to be applied to the conductor without removing SF6 gas or other components, except for ground shunt leads.

3.3 Fast Acting Grounding Switches

3.3.1 General.

- 3.3.1.1 Fast acting grounding switches can be located at the terminal of HV/EHV overhead line/ cable. They shall be able to switch safely load currents of overhead lines. They must have fault making capability and be able to switch on a live line. Applicable standards are IEC 60129, 60517, 61129. The fast acting grounding switches shall comply with the following general requirements of fast acting grounding switches and the latest revision of the relevant IEC specifications.
- 3.3.1.2 Fast acting grounding switches shall be of three phase, encapsulated, three phase linkage group operated by a maintenance-free self contained electrical motor. They shall also have facilities for emergency manual operation and the necessary operating handles or hand cranks shall be supplied.
- 3.3.1.3 Fast acting grounding switches shall be electrically or mechanically interlocked with related disconnectors, to prevent the fast acting grounding switch from closing on an energized bus section.
- 3.3.1.4 All main contacts, male and female, shall either be silver plated or shall have silver inserts.
- 3.3.1.5 Each fast acting grounding switch shall open or close only due to motor-drive or manual operation but shall be operable from local only. The switch contact shall not move due to gravity or other means, even if a part fails. Once initiated, the motor mechanism shall complete an open or close operation without requiring the initiating contact to be held closed.
- 3.3.1.6 Each fast acting grounding switch shall be fully insulated and connected to ground by a removable bolted link in order that the grounding switch may be used for various test purposes. The insulation shall be capable of withstanding an applied power frequency voltage of 5 kV.

3.3.2 Operation Mechanism.

- 3.3.2.1 Mechanisms shall be coupled either mechanically or electrically or by both, so that all three phases of any particular fast acting grounding switch operate simultaneously without any discrimination.
- 3.3.2.2 All mechanisms shall be equipped with a motor suitable for operation from the auxiliary supply, and a set of springs so arranged that energizing of the motor will cause the springs to be charged and then released. The springs in turn shall close the fast acting grounding switch.
- 3.3.2.3 Motors shall be suitable for operation at any voltage between 80% and 110% of the rated auxiliary voltage, measure at the motor terminals.

3.3.2.4 For emergency situations manual operation shall be possible. Handles or hand cranks shall be provided, together with all necessary operation rods and rod guides.

3.3.2.5 The auxiliary energy shall be electrically uncoupled from the motor when the switch is operated manually.

3.3.2.6 The mechanisms shall be arranged for locking in the open and in the closed position.

3.3.3 Auxiliary Switches

Each fast acting grounding switch shall be furnished with sufficient Nos. of NO – NC as per entire scheme requirement plus two (2) NO-NC electrically independent contacts, suitably terminated at terminal blocks, at user's disposal. The auxiliary switches shall indicate the position of the switch contacts, and shall be independent of the motor operation.

3.3.4 Position Indicators

Mechanically connected position indicators shall be provided externally to ascertain the open/close position of the grounding switch. It should be easily visible from the place of operation of equipment.

Visual verification shall be provided for each pole of each disconnect switch and grounding switch to permit visual inspection of each switchblade position.

3.3.5 Test Facility

Each fast acting grounding switch shall be fully insulated and connected to ground by a removable bolted link in order that the grounding switch may be used for various test purposes. The insulation shall be capable of withstanding an applied power frequency voltage of 5 kV.

High speed earthing switches shall be capable of interrupting line coupling currents upon opening and in worst conditions closing.

3.3.6 Technical Data Requirement: High Speed Earthing Switch:

(To be customized by utility as per requirements & capacity)

S.No.	Particulars	66 kV
1)	Enclosure	Three phase
2)	Enclosure material	Aluminum Alloy
3)	Rated voltage	72.5 kV
4)	Rated short-time current	25 kA rms, 3 sec
5)	Rated peak withstand current	62.5 kA peak

6)	Type of operating mechanism	Motor operated
7)	Rated control and operating voltage	110 / 220 V DC
8)	Power frequency withstand voltage	140 kV rms
	across the open gap	160 kV rms
9)	Lightning impulse withstand voltage	350 kVp
	across the open gap	375 kVp
10)	Electrical Endurance class	E1
11)	Rated induced current switching capability	As per IEC 62271 – 102 class B

Maintenance Earthing Switch:

66 kV

1)	Enclosure	Three phase
2)	Enclosure material	Aluminum Alloy
3)	Rated voltage	72.5 kV
4)	Rated short-time current	25 kA rms, 3 sec
5)	Type of operating mechanism	Motor operated
6)	Electrical Endurance class	E0
7)	Power frequency withstand voltage	140 kV rms
	across the open gap	160 kV rms
8)	Lightning impulse withstand voltage	350 kVp
	across the open gap	375 kVp

3.4 Current Transformers:

3.4.1 General

3.4.1.1 The current transformers provided for each phase shall be supplied in accordance with the following general requirements and the latest revisions of the relevant IEC 60044 specifications.

3.4.1.2 The current transformers must be suitable for continuous operation when installed on the conditions.

3.4.1.3 The current transformer shall be ring / toroidal type, multi ratio with fully distributed secondary windings with relay accuracy as per IEC 60185 (1987), incl. IEC 60044-4 (1992), multi core as per requirement and shall be mounted inside the high voltage enclosure.

3.4.1.4 The secondary terminals of current transformers shall be placed outside the high voltage enclosures, mounted in suitable, accessible terminal boxes and the secondary leads of all the current transformers shall be wired to shorting type terminals.

- 3.4.1.5 It shall be possible to test each current transformer without the removal of gas through the insulated grounding switches.
- 3.4.1.6 The number and position of the current transformers shall be relative to the circuit-breakers, disconnecting switches and ground switches as detailed in the single line diagram.
- 3.4.1.7 The rating, No of cores, ratios, accuracy class, characteristics etc. for the individual current transformer secondary cores shall be as specified. The various ratios of current transformers shall be obtained by changing the effective number of turns on the secondary winding.
- 3.4.1.8 Each current transformer shall be provided such that the enclosure current does not affect the accuracy or the ratio of the device or the conductor current being measured. Provision shall be made to prevent arcing across the enclosure insulation.

3.4.2 Rating and Diagram Plates

Rating and diagram plates shall be provided. The information to be supplied on each plate shall be as specified in the relevant IEC specification, which shall be given for the tap for which the rated performance is specified and for each transformer core.

3.4.3 Technical Data Requirements (To be customized by utility as per requirements & capacity)

<u>66KV class CT - Bay wise core requirement considering 20 MVA Transformer</u>								
Core No	Purpose	Ratio	Output burden	Accuracy class	Instrument security factor	Min. Knee point voltage at	Max. excitation current at KPV	Max. CT Rct Sec. at
Feeder bay								
1	Metering	600-300 / 1	15	0.5	≤5	--	--	--
2	Dir. O/C-E/F Protection	600-300 / 1	10VA	5P	10	--	--	--
3	Dir. O/C-E/F Protection	600-300 / 1	10VA	5P	10	--	--	--
Transformer bay (HV)								
1	Metering	200-100 / 1	15	0.5	≤5	--	--	--
2	Non - Dir. O/C-E/F Protection	200-100 / 1	10VA	5P	10	--	--	--
3	Differential Protection	200-100 / 1	--	PS	--	600V	25 mA	< 5 Ohm
4	Differential Protection	200-100 / 1	--	PS	--	600V	25 mA	< 5 Ohm
Bus coupler bay								
1	Metering	600-300 / 1	15	0.5	≤5	--	--	--

2	Non - Dir. O/C-E/F Protection	600-300 / 1	10VA	5P	10	--	--	--
3	Non - Dir. O/C-E/F Protection	600-300 / 1	10VA	5P	10	--	--	--

3.5.1 VOLTAGE TRANSFORMER:

3.5.1.1 SF6 insulated:

Each voltage transformer shall be metal enclosed, SF6 insulated in accordance with relevant IEC 60044. The location, polarity, ratios, and accuracy shall be as specified.

3.5.1.2 Construction:

VTs should be in segregated compartment and not forming a part of bus bar. Transformers should be of either plug-in construction or the disconnect-link type, and be attached to the gas-insulated system in such a manner that they can be easily disconnected while the system is being dielectrically tested.

Alternately, a voltage transformer designed so that it does not have to be disconnected during dielectric testing may be specified. The metal housing of the transformer should be connected to the metal enclosure of the GIS with a flanged, bolted, and gasketed joint so that the transformer housing is grounded to the GIS enclosure. Adequate measures shall be provided to prevent any unacceptable impact on the secondary control and protection circuits, which might result from fast transients (VFT) or Ferro-resonance.

3.5.1.3 Covers and shields:

Special covers and any necessary corona shields should be supplied so that the system can be pressurized and dielectrically tested after removal of the transformer.

3.5.1.4 Primary and secondary terminals:

Primary and secondary terminals should have permanent markings for identification of polarity, in accordance with IEC.

3.5.1.5 Provision shall be made for grounding of the secondary windings inside the local control cabinet.

3.5.1.6 Test condition for tests at site: Power frequency tests for the completed GIS at site shall be possible without removing the VT. The primary and secondary neutral terminal points, intended to be earthed, should be insulated and shall withstand power frequency voltage of 3 kV rms for 1 minute. The VT shall be capable to withstand discharge current arising from capacitance of underground cable circuits.

3.5.1.7 Technical Data Requirement:

S. No.	Particulars	Parameters
1)	Rated voltage	66 kV
2)	Highest system voltage	72.5 kV
3)	Rated frequency	50 Hz
4)	P F (dry) withstand voltages	140 kV
5)	Voltage factor	1.2 continuous
6)	1.2/50 micro sec. lightning impulse withstand voltage	350 kVp
7)	Earthing	Effective

66 KV class PT Core Details

Core	Purpose	Ratio	Burden	Class of accuracy
1	Metering	$\frac{66KV}{\sqrt{3}}$ $\frac{110V}{\sqrt{3}}$	50 VA	0.5
2	Protection	$\frac{66KV}{\sqrt{3}}$ $\frac{110V}{\sqrt{3}}$	50 VA	3P
3	Protection	$\frac{66KV}{\sqrt{3}}$ $\frac{110V}{\sqrt{3}}$	50 VA	3P

3.5.2 BUSHINGS:

Outdoor bushings shall be provided for connection of conventional external conductors to SF6 GIS if asked in general layout plan.

Suitable clamp & connectors shall be supplied with bushing. The dimensional and clearance requirements for the metal clad enclosure shall be maintained as per requirement of relevant standards.

All the bushings shall have an impulse & power frequency withstand level that is higher or equal to the level specified in cl. 2.3.

Only SF6 insulated composite silicon bushings will be accepted. The terminals on the outdoor bushings shall be a solid stem with dimensions specified.

3.5.3 Metal-Enclosed Surge Arresters:

The 60 kV, hermetically sealed, Gapless, ZnO, Surge arrester, suitable for use with GIS, for each phase, at the 66 kV line underground cable entry terminals of GIS shall be provided, if indicated in Schedule of requirements. Each Surge Arrester shall be provided with self leakage current monitoring device at convenient elevation.

They shall have adequate thermal discharge capacity for severe switching surges, long duration surges and multiple strokes. The surge arresters when provided with pressure relief devices shall be capable of withstanding the internal pressures developed during the above discharges without operation of the pressure relief devices.

Surge Arresters, if any provided, shall be of either the "plug-in" construction or the disconnect-link type and be attached to the gas-insulated system in such a manner that they can be readily disconnected from the system while the system is being dielectrically tested. The metal housing of the arrester shall be connected to the metal enclosure of the GIS with a flanged, bolted joint.

The ground connection shall be sized for the fault level of the GIS. It shall be insulated from the GIS-enclosure and grounded externally to permit periodic maintenance and monitoring of the leakage current.

If the arresters are not equipped with removable links, special covers and any necessary corona shields should be supplied so that the system can be pressurized and dielectrically tested after removal of the arrester.

Access to the arrester ground connection, when it is provided with means for leakage current monitoring should not be obstructed.

3.6 Insulating Gas and gas leakage rate

The GIS shall be furnished with sufficient sulfur hexa fluoride (SF₆) gas to pressurize the complete system in a sequential approach, one zone or compartment at a time to the rated nominal density. The guaranteed leakage rate of each individual gas compartment and between compartments must be less than 0.5% p.a. for the service life of equipment.

The quality of new filled-in SF₆ gas shall meet the following requirements in line with IEC 60376.

SF₆ > 99.90 % by weight

Air < 500 ppm by weight (0.25 vol.-%)

CF₄ < 500 ppm by weight (0.1 vol.-%)

H₂O < 15 ppm by weight (0.012 Vol-%)

Mineral oil < 10 ppm by weight

Acidity, in terms of HF < 0.3 ppm by weight

Hydrolysable fluorides,

In terms of HF < 1 ppm by weight

3.7 Reuse or recycling of removed gas:

The supplier should provide guidelines or recommended practices for the reuse or recycling of SF₆ gas removed from the equipment. These guidelines should be consistent with current industry practices, as they pertain to the effect of SF₆ on global warming; i.e. SF₆ gas should be reused and recycled whenever possible and never be unnecessarily released into the atmosphere. Clear instructions shall be provided by bidder about handling, recycling & treatment of new and used SF₆ gas.

During commissioning dew point of SF₆ gas shall be measured and documented.

Components may be filled with N₂ for transportation and refilled with SF₆ at site.

3.8 Gas sections

The GIS enclosures (one enclosure for all the three phases) shall be divided into several gas sections separated by gas-tight barriers. Each section shall be provided with necessary valves to allow evacuation and refill of gas without evacuation of any other section. Location of gas barrier insulators is to be clearly discriminated outside the enclosure by a band of distinct colour normally used for safety purposes.

The gas system proposed shall be shown on a "gas single line diagram" and submitted with the technical bid. It should include the necessary valves, connections, density monitors, gas monitor system and controls, indication, orifices, and isolation to prevent current circulation. Means of calibrating density monitors without de-energizing the equipment should be specified by the supplier.

For the purpose of gas monitoring and maintenance, the GIS shall be divided into various individual zones in each bay. The CB gas zone shall be independent from all other gas compartments and shall meet the requirement of relevant IEC.

Each gas zone shall be furnished with a gas monitoring system consisting of a gas density continuous monitoring device provided with two electrically independent contacts which operate in two stages as follows:

- a) First alarm : At a gas density normally 5 to 10% below the nominal fill density.
- b) Second alarm: Minimum gas density to achieve equipment ratings.

In special cases determined by the supplier, a third stage with a set of contacts may be necessary in certain areas.

Provisions shall be made for connecting pressure gauges, service cart, and moisture test instrumentation to any one of the gas sections.

Permanent Gas Treatment Devices:

Means shall be provided inside each enclosure for treating the SF₆ gas by the use of Desiccants, driers, filter, etc. to remove impurities in the gas. All gas compartments shall be fitted with static filter material containers that will absorb residual and entering moisture inside the high voltage enclosures. Filters inside the breaker compartment shall also be capable of absorbing gas decomposition products resulting from the switching arc.

3.9 GIS Connection:

3.9.1 GIS to TRANSFORMER:

Transformers shall be connected to the GIS by termination of 66 kV XLPE power cable. The connection between GIS and high voltage cable at GIS end shall be done through cable termination / cable sealing end. For transformer end connection the cable termination on structure shall be provided outdoor, if specified in schedule of requirements. The plug in cable sealing ends for XLPE cables shall consist of gas tight plug in sockets and prefabricated plugs with grading elements of silicone rubber.

3.9.2 GIS to LINE:

The 66 kV line will be terminated to GIS by XLPE power cable

3.9.3 66 kV Power Cable connection:

The connection between GIS and high voltage cable at GIS end is done through cable termination / cable sealing end. Plug in cable sealing ends for XLPE cables shall consist of gas tight plug in sockets, and prefabricated plugs with grading elements of silicone rubber.

A separate cable basement is provided for cable entry, its distribution and installation.

The design of the cable end box shall fully comply with the IEC standard. The type and size of cable is specified. All end cable modules shall be suitable for connecting single core, XLPE specified cable.

Necessary provision for termination of specified nos. of such power cables shall be made in GIS. GIS supplier shall either carry out the work of termination or coordinate with cable terminator for such connection as specified in schedule of requirement. Provision shall be suitable for terminating cable size and type approved by utility.

3.10 Local & Remote Control and Operation

3.10.1 General

One local control cabinet (LCC) for GIS shall be supplied for the local control and operation of each bay. Each LCC shall contain the local control, interlocking, operation and indication devices for the associated GIS bay.

The LCC shall be mounted on each GIS bay. The LCC's shall be located with sufficient space for access and the possibility to work at the equipment even when the LCC doors are open, or directly at the switch-gear in front of the related circuit breaker.

The LCC's shall be installed indoor and care must be taken with the design to ensure that all LCC's are drip and splash proof. The LCC's shall also be dust and vermin proof. The control and operation circuits shall be well shielded and with safety measures to protect operator from touching energized parts. Power frequency withstand of control circuits shall be 2 kV for 1 minute.

The LCC should have required arrangement for control and operations of GIS from Remote i.e. from the control room through SCADA compatible control and protection panel.

The LCC shall include all required functions for control and supervision of a complete GIS as well as the marshalling of all connections to and from the GIS bays.

Safe station operation is ensured through following base functions.

- i) Feeder & station interlocking, depending on the position of all high voltage components with their blocking functionality.
- ii) Blocking of commands when crank handle of disconnect or earthing switches is introduced.
- iii) Extensive circuit breaker supervision through "Anti-Pumping", pole discrepancy, Gas density and position supervision of circuit breaker,

3.10.2 Required features for conventional local control cabinets

The LCC's shall be provided with the following features:

- a) A mimic diagram showing the single line diagram. Position indicators, on/off switches for the HV devices and local / off / remote switches shall be installed on or adjacent to the various symbols of the mimic diagram.

The following devices shall be supplied as a minimum:

- Circuit breaker control switches with ON – OFF indicating lamps. – Circuit breaker "local-remote" selector switch.
 - Disconnect switch, control switch with ON – OFF indicating lamps.
 - Grounding switch, control switch with ON – OFF indicating lamps.
 - Mimic bus including symbols according to the single line diagram.
 - Monitoring control of all high voltage switching devices in a bay.
 - Digital display of current, voltage, active and reactive power, power factor etc.
- b) Any interposing relays and control switches associated with the circuit breakers disconnect switches, grounding switches etc.
 - c) The alarm and indication for devices specified e.g. gas, DC & AC supervision.

- d) Fuses and links. These shall be installed in the interior of the LCC's
- e) Terminal blocks for the terminating and marshalling of auxiliary supply circuits, control, interlocking, and indication & alarm circuits from the GIS and for cable connections to the remote control room or the owner's control system.
- f) Each LCC shall be furnished with a guarded resistance heater to prevent the internal equipment from humidity deposit. The heater shall be rated 230 V AC and fed through a two pole fused disconnect switch.
- g) A fluorescent lamp and a duplex convenience outlet rated 230 V AC, 15 amps with ground fault interrupter shall be installed in each LCC.
- h) The Local control cubicle shall be fitted with pre wired interface terminal blocks for connection to user's control & protection panels. The interface includes CT & PT inputs for protection & measuring system, Protection trip 1 & 2 signals, Aux switch contacts etc.

3.10.3 Wiring Requirements

- i) Each circuit breaker shall have control suitable for operation on 110 V DC with two electrically independent trip circuits. The miniature circuit-breakers (MCB) shall be provided for the closing circuit and an independent separate switch fuse unit of suitable rating shall be provided for the primary and back up trip circuits.
- ii) Wiring shall be complete in all respects to ensure proper functioning of the control, protection, and monitoring and interlocking schemes.
- iii) DC circuit for trip coil 1 & 2 shall be wired separately.
- iv) Wiring shall be done with flexible 1100V grade, FRLS, PVC insulated, switchboard wires with 2.5 mm² stranded copper conductor. The control wire in a grouped environment shall not convey flame, continue to burn. Wiring between equipment and control cubicle shall be routed through G.I. rigid conduits and shall be done by PVC & screened cable only, with safety measures to protect operator from touching energized parts.
- v) Each wire shall identify at both ends with permanent markers bearing wire numbers as per Contractor's wiring diagram.
- vi) Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.
- vii) All spare contacts of relays, push buttons, auxiliary switches etc. shall be wired up to terminal blocks in the control cubicle.
- viii) Terminal blocks shall be 1100V grade, stud type with engraved numbers suitable for termination of at least two numbers of 2.5 mm² stranded copper conductor. Terminal blocks for CT, PT, auxiliary AC & DC supply shall be disconnecting link type.
- ix) Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.
- x) Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.
- xi) Terminal connectors that carry power supply should be shrouded from adjoining connectors.
- xii) Manufacturer shall provide all control wiring and terminations internal to the switchgear, and connecting the switchgear to the bay control cabinets.
- xiii) All control cables shall be shielded. Cable shields shall be grounded. Grounding connections shall be as short and direct as possible and shall terminate at the point of entry to cabinets or terminal boxes.
- xiv) Co-axial type cable glands suitable for use with shielded cables shall be used at each termination.
- xv) All control cables shall be installed and terminated in such a manner as to limit the effects of transient electromagnetic voltages on the control conductors to an acceptable level.
- xvi) Any cabling within GIS shall be supported on cable tray. No cable shall be in hanging position.

- xvii) Insulator cones shall be embedded in full return current carrying metal fixing rings in order to avoid mechanical stresses to the cast resin part and to impart full conductivity across the flange connection. Earthing of different gas compartments/enclosures is not allowed with cross bonding with any metal strips.

3.10.4 Connections within the GIS and their LCC's

All cable connections between the various GIS modules and the LCC's shall be made by prefabricated multi-core cables with multipoint plug in connections on both the ends. PTs & CTs circuit shall be wired with crimped type copper lugs.

All cables shall be shielded and adequate for their application (indoor / outdoor). The cables shall be fire retardant low smoke.

The length and the number of terminal points of control wiring & SF6 gas connections shall be minimized.

The electrical connections between the various gas sections shall preferably be made by means of multiple contact connectors so that electrical connection is automatically achieved when bolting on section to another. The surface of the connector fingers and conductor tubes on such connections shall be silver plated.

3.11 Name plates

Name plates of the following types shall be furnished in a convenient central location to provide information for operation and maintenance.

- a) Gas Single Line Diagram showing all HV devices in a single line diagram with the gas sectionalizing of the GIS indicated. Also shown shall be the GIS nomenclature, a legend, Manufacturer's type and serial number and year of manufacture.
- b) GIS Rating / Name plate:
 - Manufacturer's name & address, type & designation, Sr. No, Maximum ambient temperature, System frequency, Maximum continuous voltage, Maximum continuous current at 40°C ambient temperature, Basic Impulse Level, Power Frequency one minute voltage, Short circuit current, rms., symmetrical Short time (rms) current & duration, symmetrical Momentary current, peak, Total weight of gas at rated density, Rated gas pressure at 20°C. Opening pressure of the bursting disc, recommended moisture limits of insulation gas (PPMV), Auxiliary voltages, Contract/Purchase Order numbers, Total weight of the equipment
- c) Equipment nameplate containing nameplate rating information for all HV modules (like circuit breaker, disconnect switches, current transformer, voltage transformer, surge arrester, etc.) as required in relevant IEC.

- d) Nameplates showing serial numbers and similar data specific to individual components shall be mounted on the components. Each instrument transformer must have its own rating plate mounted adjacent to each terminal box cover, will all terminal and ratio markings. Each bay auxiliary control cubicle must be identified with its designation to which it is assigned.

3.11.1 Bidder shall specify the number of skilled / semi-skilled / unskilled persons, supervisors and Engineers required to be deputed for complete erection, testing, commissioning of GIS board.

3.12 Type Tests:

Following type test reports from NABL laboratory, as specified in IEC standard 62271 – 203 & 62271-100 (amended up to date) shall be submitted for the offered type, rating of GIS invariably with the technical bid. Bid without type test reports will not be considered for evaluation. The type test reports shall not be older than FIVE years and shall be valid up to expiry of validity of offer.

1. Tests to verify the insulation level (Lightning impulse, Switching impulse and ac withstand test with PD) test on each GIS device (CB, Disconnecter, bus, etc).
2. Dielectric tests on auxiliary circuits.
3. Tests to prove the radio interference voltage (RIV) level.
4. Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
5. Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short time withstand current.
6. Tests to verify the making and breaking capacity of the included switching devices.
7. Tests to prove the satisfactory operation of the included switching devices.
8. Tests to prove the strength of enclosures.
9. Verification of the degree of protection of the enclosure.
10. Gas tightness tests
11. Electromagnetic compatibility tests (EMC).
12. Additional tests on auxiliary and control circuits.
13. Tests on partitions.
14. Tests to prove the satisfactory operation at limit temperatures.
15. Tests to prove performance under thermal cycling and gas tightness tests on insulators.
16. Corrosion test on earthing connections (if applicable).
17. Tests to assess the effects of arcing due to an internal fault.
18. Tests on solid dielectric components (operating rods, spacers, etc)
19. Seismic test
20. Test on Auxiliary switches (Electrical & Mechanical Endurance, Heat run, IR & HV test)

Important note for type tests: The type test report shall be submitted for the offered class and rating of GIS. However, the type test report for higher class/rating can be accepted for scrutiny of technical bid but the same test/s shall have to be carried out on the offered class/rating GIS. Bidder shall invariably confirm to carry out the required type test/s, special tests, before commencement of supply, without affecting delivery schedule, free of cost, at NABL approved laboratory, or at suppliers works in presence of Utility representative, in the event of order.

3.13 Routine / Acceptance Testing:

During manufacture and on completion, all equipment shall be subjected to the Routine tests as laid down in IEC Standard IEC 62271-203. All the acceptance tests shall be carried out in presence of Utility representative on offering the material for inspection and testing by successful bidder. Tests shall include the following:

1. Dielectric test on the main circuit.
2. PD test
3. Tests on auxiliary and control circuits.
4. Measurement of the resistance of the main circuit.
5. Tightness test.
6. Design and visual checks.
7. Pressure tests of enclosures.
8. Functional tests
9. Tests on auxiliary circuits, equipment and interlocks in the control mechanism.
10. Pressure test on partitions.

3.14 Test Certificates:

- a. Certified reports of all the tests carried out at the works shall be furnished in required number copies for approval of the Owner.
- b. The equipment shall be dispatched from works only after receipt of Owner/ Purchaser's written dispatch clearance & approval of the test reports.
- c. Routine test certificates of bought out components shall be furnished.
- d. Type test certificate on any equipment or component if so desired by the Owner shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

3.15 Tests after installation of complete GIS at Site:

After installation and before being put into service, the GIS shall be tested in order to check the correct operation and dielectric integrity of the equipment as laid down in IEC 62271-203. The successful bidder shall furnish a commissioning test plan and a statement method for the tests on site. Tests shall include the following:

1. Dielectric tests on the main circuits.
2. Dielectric tests on auxiliary circuits.
3. Measurement of the resistance of the main circuit.
4. Gas tightness tests.
5. Checks and verifications.
6. Gas quality verifications.
7. On site power frequency voltage withstand test with PD test.
8. Tests as per IEEE C37.122.1 clause 4.10.5
9. Functional & interlock tests for all items
10. Demonstration of operational compatibility with SCADA, if installed
11. Visual inspection, checks & verifications.
12. Mechanical operation tests of circuit breakers, Disconnectors and earthing switches and high-speed earthing switches

13. Insulation resistance measurement
14. Tests on CTs and PTs
15. Tests on Surge Arresters

3.15.1 Required test equipment

During the onsite tests, the supplier shall provide all necessary test facilities and equipment for the switch-gear power frequency tests, i.e. test bushing or test cable, test adapter, test transformer or resonant test set etc.

3.16 SPARES:

Bidder shall submit a list and supply of following spares.

- i) Recommended spare parts for three (3) years after guarantee period of satisfactory and trouble-free operation.
- ii) Commissioning spares
- iii) Maintenance spares
- iv) Special tools, tackles & spanner required during commissioning, operation and maintenance.
- v) Viewing mechanism
- vi) Spare GIS modules of CT, Breaker and Isolator & LA. All spares indicated in list for above shall be considered in the scope of supply.

Each list shall be complete with specification, ratings, type, make, identification number, unit rate, quantity etc.

3.17 DRAWINGS, DATA & MANUALS:

Drawings, Data and Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions on Contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.

To be submitted with the Bid:

1. Typical general arrangement drawings of the equipments indicating space requirement, room dimensions, crane capacity etc.
2. Technical Specifications of equipment and special tools explaining construction features, principle of operation, special features etc.
3. Comprehensive QAP, FQP, SLD, Gas Schematic diagram, Technical brochures, building requirements, Earth mat design, List of recommended spares, special tools or fixtures, O&M manuals, environmental guide for handling SF₆ gas & decommissioning, estimated time schedule for installation & commissioning, bill of materials, and any other documents required for successful commissioning & operation of complete GIS.

4. Control and protection:

Block & principle diagram showing proposed scheme, layout & equipment arrangement drawings, catalogues & brochures of offered devices.

Successful bidder shall submit 3 sets of spiral bound volume of following drawings & data for approval before commencement of supply:

1. A comprehensive Manufacturing Quality assurance plan with effective quality assurance system.
2. Field Quality plan indicating instruction & procedures sequenced for storage, assemble, maintenance and disassembly.
3. Assemble and maintenance clearance requirements.
4. Dimensional general arrangement drawing showing disposition of various fittings, name plates indicating equipment ratings.
5. Structure Plan with details and loading
6. Foundation plan indicating loadings for all GIS equipment, supporting structure and anchor bolt arrangements.
7. Assembly drawing for erection at site with part numbers and schedule of materials Transport/shipping dimensions with weights.
8. Control schematic and wiring diagrams.
9. Gas schematic Diagram
10. Gas system installation procedures, gas handling procedures.
11. Grounding arrangement and ground bus details including Manufacturer's recommendation on Grounding of reinforcement bars of Column foundation.
12. Calculation of Voltage rise for GIS enclosure
13. Calculated point to point resistance for each assembly.
14. Calculation for Surge Protection
15. Design Calculations for Bus-bar sizing, Short circuit forces and vibration on Bus-bar & each equipment, thermal stability and losses.
16. Any other relevant drawing or data necessary for satisfactory installation, operation and maintenance.
17. Operating instruction & manuals for GIS and its accessories
18. The manual shall clearly indicate method of installation, checkups and tests to be carried out before commissioning of the equipment.
19. The bidder shall note that the approval of drawings & documents by the Owner does not relieve him of his contractual obligation.

The bidder may note that the drawings, data and manuals listed herein are minimum required only. The bidder shall ensure that all other necessary write-up etc. required to fully describe the equipment are to be submitted with the bid.

All drawings shall be prepared by using AutoCAD and documents shall be generated using Electronic version. The paper copy of the drawings & document shall be submitted for approval & reference. All final drawings and documents shall be submitted in CD in AutoCAD and MS office format as applicable for Owner's future reference. Also AutoCAD version of Main GA drawings is to be submitted for Owner's layout finalization.

3.18 MAINTENANCE:

The operational integrity of the GIS switchgear shall not subject to external influences, such as pollution, moisture, dust etc. As a consequence of this GIS switchgear should be practically maintenance free, however, the details of inspection required at regular interval shall be indicated in the offer. Visual inspection shall be required not below 2 (two) years interval.

Inspection shall not be required often than every 10 years. During inspection it must not be necessary to open the switchgear enclosures for interrupt operation of substation. Provision of functional testing of the close and trip coils, auxiliary switches, pressure and control switches etc. shall be provided. Following minimum maintenance period shall be accepted.

- (a) Circuit breaker: 5000 closing and opening or 20 interruption at max rated current
- (b) Disconnecter: 5000 closing and opening operations.
- (c) Fast acting earth switch: 2000 closing and opening operations or 2 making operations on to max rated fault current.

The bidder shall provide the services of experienced persons, supervisors, engineers, experts, etc., for complete specified work for satisfactory operation.

The bidder shall have dedicated localized after sales & service team which should be capable any activity to operate complete GIS satisfactorily.

3.19 GIS Building

The GIS building, if it is a part of schedule of requirements, shall comply with the requirements of Civil specifications.

The proposed arrangement of building and positions in which the switchgears shall be installed relative to lines, transformers, cable circuit and any other switchgear of any other voltages will be indicated in general arrangement layout. The overall height of building shall allow for overhead traveling crane.

3.20 Design information to be submitted by bidder.

The bidder shall provide complete floor plan detailing the fixing positions, levels and size of fixing bolt pockets and foundation required for all equipments. Drawings giving similar details shall be provided.

All static and dynamic loads plus dimensional tolerances shall be given on these drawings.

3.21 Guaranteed and technical particulars as called for in attached SCHEDULE 'A' shall be furnished along

with the technical bid.

3.22 Training:

Training to (...) persons of Utility on construction, installation, commissioning and O&M shall be imparted by bidder free of cost.

Duration of the complete training shall be 7 working days, covering minimum below specified curriculum. Any other specific area may be brought to notice and included.

1. General Explanation for GIS
2. Layout and Architecture of GIS
3. Gas Sectionalisation of GIS
4. Construction of CB
5. Operating Mechanism of CB
6. Maintenance of CB
7. Overhaul of CB (Interrupting chamber)
8. Overhaul of CB (Operating Unit)
9. Construction of DS/ES
10. Maintenance of DS/ES
11. Overhaul of DS/ ES
12. Construction of Bus/ Cable head/ SF6 – air bushing
13. Maintenance of Bus/ Cable head/ SF6 – air bushing
14. Overhaul of Bus/ Cable head
15. Overhaul of various transformer connections
16. Operation of GIS with SCADA (if SCADA installed)
17. Construction & Maintenance of Lightning Arrester
18. Construction & Maintenance of VT/CT
19. Construction & Maintenance of Local control panel
 20. Erection of GIS at site.
 21. Installation & Testing of GIS at site
 22. Type tests of GIS
 23. Routine tests of GIS.
 24. Faults simulation of GIS
 25. Localization of GIS fault.

Bidder shall at his cost arrange for the above training facilities. The purchaser shall bear all TA/DA expenses of all the trainees.

3.23 Shipment storage and installation:

All equipments shall be suitably packed and protected during shipment/transportation. Each shipping unit shall be sealed in a clean dry condition with leak-tight shipping covers securely mounted for shipment. All covers to be

removed during installation shall be clearly marked. Each shipping section shall be carefully sealed and filled with dry gas to a slightly positive pressure to prevent the entrance of moisture and contamination.

The packing method for the GIS equipment shall be standard and it shall be guaranteed that each component of the equipment will not be damaged, deformed or lost. The storage instructions shall be submitted by bidder for long term storage. Component requiring indoor storage shall be so identified. Gas insulated switchgear (GIS) shall be properly packed to protect during ocean shipment, inland transport, carriage at site and outdoor storage during transit and at the site. Completely assembled bays (subject to transport limitations) of the GIS shall be transported as one shipment unit.

Packing materials shall be dust and waterproof. All packages shall be clearly, legibly and durably marked with uniform block letters on at least three sides. Fragile items like bushings, CTs, VTs, LAs and fully assembled bays shall be securely packaged and shipped in containers. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment wherever necessary.

As far as possible, transshipment should be avoided.

Impact recorders (Accelerometers) shall be provided on the packages to confirm that GIS has not suffered any shocks during shipment, transport, handling, etc. The impact recorders readings are to be noted on receipt of equipment at site and reported to user & manufacturer, in case the readings are exceeding the permissible values. It shall be at discretion of user to accept or reject the same.

3.24 QUALITY ASSURANCE

Superior quality control system shall be adopted to assure high product quality. Raw materials of the best commercial grade quality and high reliability shall be used in the manufacture of GIS. High reliability of materials shall be ensured so as to keep maintenance work to a minimum.

A quality assurance plan for major components such as breakers, disconnecting switches, lightning arrestors, earth switches, etc. with in-process inspection methods, tests, records, etc. shall be submitted with the technical bid. Customer hold points will also be included in the plan, which shall be mutually agreed by the PURCHASER and MANUFACTURER, and approved.

BIDDING SCHEDULE (To be filled in and signed by the Bidder)

SCHEDULE 'A'

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR GAS INSULATED SUBSTATION

Sr No	Particulars	To be Filled by BIDDER
1	General	
2	Name of manufacturer (OEM)	
3	Country of Origin	
4	Delivery from (location)	
5	Type & Designation	
6	Type tested at Name of Laboratory Address of laboratory	
7	Installation (indoor or outdoor)	
8	Standards applicable	
9	No. of Phases	
10	Single or Three Phase design	
11	Configuration	
i	Number of Feeder bays	
ii	Number of transformer bays	
iii	Number of Bus coupler bay	
iv	GIS to transformer connection	
v	GIS to Feeder connection	
vi	Number of VT	
vii	Number of SA	
	Future extension possibility	
12	Service conditions	
i	Ambient Air Temp. in Deg. C	
ii	Max Temp. in Deg. C	
iii	Min Temp. in Deg. C	
iv	Daily Average Temp. in Deg. C	
v	Solar Radiation W/sq mtr	
vi	Altitude above MSL, in mtr	
vii	Pollution class	
viii	Creepage distance, in mm/kV	
ix	Relative humidity	
x	Condensation	
xi	Vibration level	
xii	Noise level	
xiii	Induced Electromagnetic Disturbance, in kV	
xiv	Seismic conditions	
a	Vertical	
b	Horizontal	

13	Enclosure	
i	Code of pressure vessel	
ii	Type of manufacturing	
iii	Design temperature in Deg.C	
iv	Material	
v	Material grade & applicable standard	
vi	Outside diameter in mm	
vii	Minimum Wall Thickness, in mm	
viii	Painting Shade & Thickness	
a	- External	
b	- Internal	
ix	Degree of Protection	
x	Inductance in H/mt	
xi	Capacitance in pF/mt	
xii	Resistance in Ohm/mt	
xiii	Expansion Bellow	
a	Material	
b	Min allowable adjustable displacement Longitudinal	
xiv	Sealing system	
a	Type	
xv	Estimated life in years	
xvi	Barrier	
a	Material	
b	Dielectric strength	
14	Support Structure	
i	Material	
ii	Minimum thickness of galvanizing	
iii	Foundation channels /Anchor bolts	
15	Grounding	
i	Grounding Material	
ii	Grounding of complete GIS	
iii	Grounding of individual compartment	
iv	Grounding at flange joints	
16	System Parameters	
i	Highest System voltage in kV	
ii	Rated voltage of System in kV	
iii	Rated voltage of Equipment in kV	
iv	Rated Insulation level Phase to Earth and between Phases	
a	One Min Power Frequency withstand voltage kVrms	
b	Switching impulse withstand voltage, kVp	
	- Phase to Earth	
	- Between Phases	
c	Lightning Impulse withstand voltage, kVp	
iv	Rated Frequency	

v	Rated current in Amp	
vi	Rated current at 50 °C (equipment) in Amp	
vii	Rated current at 50 °C (bus bar) in Amp	
viii	Rated short circuit withstand current kArms	
a	Duration in sec	
b	Peak, kAp	
ix	Enclosure withstand time for an internal fault in sec.	
x	Estimated total energy loss at	
	100 % of rated capacity	
	75 % of rated capacity	
	50 % of rated capacity	
	25 % of rated capacity	
xi	Measures taken to minimize Over Voltage	
xii	Phase labeling	
xiii	Auxiliary supply (AC Voltage, Frequency; DC voltage)	
	- Operation	
	- Control	
	- Illumination & heater	
17	Delivery conditions	
i	Bays fully assembled at works	
ii	Dimensions of longest section for transportation	
iii	Weight of heaviest package	
iv	Pressure of SF6 gas during transportation	
v	SF6 gas monitoring system provided during transportation	
18	Bus Bar	
i	Configuration (Single / Double)	
ii	Nos of Phases	
iii	Material	
iv	Size	
v	Rating	
vi	Current density adopted	
vii	Current density as per type test report	
viii	Short time current withstand rating in kA	
ix	Duration	
x	Resistance per phase	
xi	Surge impedance	
xii	SF6 immersed insulator	
a	Material	
b	Dielectric strength	
xiv	Maximum Partial Discharges measured at HSV	
19	SF6 Gas	
i	Applicable standard	
ii	Quantity of SF6 Gas of complete GIS at filling pressure, in kg	

iii	Quantity of SF6 Gas of largest compartment GIS at filling pressure, in kg		
iv	Nos of Gas compartments		
v	Quantity of SF6 Gas of individual compartment GIS at filling pressure, in kg		
vi	Maximum permissible dew point, in Deg.C		
vii	Composition of Gas		
a	SF6 > 99.90 % by weight		
b	Air < 500 ppm by weight (0.25 vol.-%)		
c	CF4 < 500 ppm by weight (0.1 vol.-%)		
d	H2O < 15 ppm by weight (0.012 Vol.-%)		
e	Mineral oil < 10 ppm by weight		
f	Acidity, in terms of HF < 0.3 ppm by weight		
g	Hydrolysable fluorides, In terms of HF < 1 ppm by weight		
	PRESSURE	in MPa	in kG/sqcm
vii	Design pressure		
a	Circuit breaker		
b	Other compartments		
ix	Rated filling pressure		
a	Circuit breaker		
b	Other compartments		
x	Type tested pressure.		
a	Circuit breaker		
b	Other compartments		
xi	Routine test pressure		
a	Circuit breaker		
b	Other compartments		
xii	Operating pressure of PRD		
a	Circuit breaker		
b	Other compartments		
xiii	Alarm Pressure		
a	Circuit breaker		
b	Other compartments		
c	CB lock out Pressure		
d	Over pressure signaling		
xiv	Maximum SF6 Gas leakage rate, in % per year		
xv	Density Monitor to be provided for each Individual gas compartment.		
20	Circuit Breaker		
i	Applicable standard		
ii	Type		
iii	Designation		
iv	Operating Mechanism type		

v	Nos. of phases	
vi	Rated current in Amp	
vii	Mechanical Endurance class	
viii	Electrical Endurance class	
ix	Restrike probability class	
x	Rated SC breaking current	
xi	Rated SC breaking current - single phase test	
xii	Rated Line charging breaking current	
xiii	Rated Cable charging breaking current	
xiv	Capacitor bank switching capability, BC1	
xv	Inductive current	
xvi	Reactive current	
xvii	Out of phase making & breaking current	
xviii	Rated short line fault current	
xix	TRV characteristic	
xx	First Pole to Clear factor	
xxi	Nos. of interrupters per phase	
xxii	Type of arc control device provided, if any	
xxiii	Type of arcing contacts	
xxiv	Material of main contact	
xxv	Material of Arcing contacts	
xxvi	Filter material	
xxvii	Timings of operations	
a	- Opening at nominal control voltage	
	- Opening at minimum control voltage	
b	Closing time at nominal control voltage	
xxviii	Maximum pole discrepancy time Tripping	
xxix	Rated operating duty cycle	
xxx	Tripping Coils	
	- No of coils	
	- Rated Voltage	
	- Rated Current	
	- Rated Watts	
	- Resistance	
xxxi	Closing Coil	
	- Rated Voltage	
	- Rated Current	
	- Rated Watts	
	- Resistance	
xxxii	Spring Charging Motor	
	- Rated Voltage	
	- Rated Current	
	- Rated Watts	
xxxiii	Spring charging time at rated Aux supply	

xxxiv	Spring charging time at min Aux supply	
xxxv	Maintenance required after nos. of operation at	
i	No load	
ii	Rated current	
iii	25% of rated SC current	
iv	50% rated SC current	
v	Rated SC current	
e	Provision of anti pumping	
f	No of operations after switching off of motor Aux. supply	
xxxvi	Provision of Manual trip	
xxxvii	Electrical interlocking	
xxxviii	Padlocking	
xxxix	Type of Operation counter provided	
21	DISCONNECTORS	
i	Applicable standards	
ii	Type	
iii	Rated current in Amp for	
	- Bus disconnecter	
	- Line disconnecter	
	- Transformer disconnecter	
	- PT disconnecter	
iv	Maximum Current that can be safely interrupted by the Isolator (Amp).	
	- Inductive	
	- Capacitive	
v	Rate Short time withstand Current in kA, for 3 sec	
vi	Rated peak short time Current, kAp	
vii	Rated bus charging current, in Amp	
viii	Type of contacts	
ix	Material of contacts	
x	Current Density at minimum cross section (A/mm ²)	
xi	Rated lightning impulse withstand voltage across the open gap, kVp	
xii	Rated Power Freq withstand voltage across the open gap, kVrms	
xiii	Mechanical Endurance class	
xiv	Type of Operating Mechanism	
xv	Operating Motor details	
	- Type	
	- Rated Voltage	
	- Rated Current	
	- Rated Watts	
xvi	Operating Time	
	- Closing	
xvii	Mechanical indication on drive shaft	

22	Maintenance Grounding Switch	
i	Applicable standards	
ii	Type	
iii	Rate Short time withstand Current in kA, for 3 sec	
iv	Rated peak short time Current, kAp	
v	Rated lightning impulse withstand voltage across the open gap, kVp	
vi	Rated Power Freq withstand voltage across the open gap, kVrms	
vii	Type of Operating Mechanism	
viii	Operating Motor details	
	- Type	
	- Rated Voltage	
	- Rated Current	
	- Rated Watts	
ix	Operating Time	
	- Closing	
x	Mechanical indication on drive shaft	
23	Fast Acting Grounding Switch	
i	Applicable standards	
ii	Type	
iii	Rate Short time withstand Current in kA, for 3 sec	
iv	Rated peak short time Current, kAp	
v	Rated induced current switching capability	
vi	Rated lightning impulse withstand voltage across the open gap, kVp	
vii	Rated Power Freq withstand voltage across the open gap, kVrms	
viii	Electrical Endurance class	
ix	Type of Operating Mechanism	
x	Operating Motor details	
	- Type	
	- Rated Voltage	
	- Rated Current	
	- Rated Watts	
xi	Operating Time	
	- Closing	
xii	Mechanical indication on drive shaft	
24	Current transformers	
i	Type	
ii	Material	
iii	Position of Current Transformer	
iv	Reference Standard	

v	Rated Continuous thermal current	
vi	Rated Short Time current	
vii	Duration	
a	Feeder Bay CT	
i	Metering Core	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ISF	
ii	Protection Core -1	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ALF	
iii	Protection Core -2	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ALF	
b	Transformer Bay CT	
i	Metering Core	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ISF	
ii	Protection Core -1	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ALF	
iii	Protection Core -2	
	- Ratio	
	- Accuracy Class	
	- Minimum Knee Point Voltage at highest ratio	
	- Maximum Excitation Current at Vk	
	- Maximum Resistance at highest ratio	
iv	Protection Core -3	
	- Ratio	
	- Accuracy Class	
	- Minimum Knee Point Voltage at highest ratio	
	- Maximum Excitation Current at Vk	
	- Maximum Resistance at highest ratio	
c	Bus Coupler Bay CT	
i	Metering Core	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
	- ISF	

ii	Protection Core -1	
	- Ratio	
	- Burden	
	- Accuracy Class	
	- ALF	
iii	Protection Core -2	
	- Ratio	
	- Burden	
	- Accuracy Class	
	- ALF	
25	Voltage Transformer	
	Type	
	Position of Voltage Transformer	
	Reference Standard	
	Rated Over Voltage Factor - Continuous	
	Short Time Over Voltage Factor	
	Duration	
	Partial Discharge Level	
	Thermal Rating of Primary Winding	
26	Line & Bus VT	
i	Metering Core	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
ii	Protection Core -1	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
iii	Protection Core -2	
	- Ratio	
	- Output Burden	
	- Accuracy Class	
27	Enclosed Surge Arrester	
ii	Name of Manufacturer	
iii	Arrester Class & Type (with mfr type designation)	
iv	Applicable Standard	
v	Rated system voltage (kV)	
vi	Rated Arrester Voltage (kV)	
vii	Max continuous operating voltage (MCOV) – (kV)	
viii	i)Nominal Discharge Current (KA) with 8/20 Micro-second wave	
	ii)Max resistive component of cont current at MCOV-mA crest	
	iii)Max capacitive component of cont current at MCOV -mA crest	
ix	Long Duration Discharge Class	

x	Min. Energy Discharge Capability (KJ/KV rating)	
xi	Max. switching current impulse residual voltage (KVP) 1000 Amps 250 Amps	
xii	Pressure Relief Class KA (rms)	
xiii	High Current short duration impulse withstand level with 4/10 micro-second wave (KA) peak	
xiv	Over –voltage withstand capability – KV	
	a) 100 Seconds	
	b) 10 Second	
	c) 1.0 Second	
	d) 0.1 Second	
	e) Reference Voltage (KV)	
	f) Reference Current (KA)	
xv	Surge counter	
xvi	Leakage monitor	
28	Local Control Cubical	
i	Name of Manufacturer (OEM of GIS)	
ii	Location in GIS	
iii	Material	
iv	Sheet Thickness	
v	Degree of Protection	
vi	Padlocking arrangement	
vii	Major components of LCC	
	- Bay control mimic diagram	
	- Control Switches	
	- Indicating lamps	
	- Position indicators	
	- Annunciation scheme	
	- Auxiliary relays	
	- Contact multiplication relays	
	- System parameters display	
	- Heater with thermostat	
	- Interface terminal blocks for relaying & protection	
29	GIS to Line connection	
i	Nos of XLPE cable can be terminated	
ii	Type of cable termination required	
30	GIS to Transformer connection	
i	Nos of XLPE cable can be terminated	
ii	Type of cable termination required	
31	Maintenance	
i	Maximum down time for replacement or removal of any part	
ii	Maximum down time for degassing and re-filling the biggest compartment	
iii	Time between two refilling of SF6 gas.	
iv	Recommended period for overhauling	
v	Operation and Maintenance manual attached	

vi	Nearest local service centre	
vii	Minimum time of availability of local service	
viii	Availability of spares at local service centre	
ix	List of recommended spares attached?	
x	List of recommended special tools, etc attached?	
xi	List of commission spares attached?	
xii	List of maintenance spares attached?	

C) 11 KV SF6 Ring Main Units (RMUs)

1.0 SCOPE:

The specification covers site survey, engineering, manufacturing, pre dispatch testing, supply, and transportation, unloading at site complete erection, testing and commissioning of feeders with 11KVway RMUs, (Manual /SCADA enabled) . as per the in AREA under IPDS funding and in accordance with the specifications technical requirements mentioned in the specification, relevant standard, code of operation. The scope also includes the handing over the complete installation after successful commissioning.

11 kV way RMU's (Manual) : Nos.

11 kVway RMU's (SCADA enabled) : Nos.

STANDARDS:

- a) The equipment delivered shall be new and of high quality, suitable for the purpose it is intended for, free from defects and imperfections and of the classifications listed herein, or their equivalents, subject to acceptance by theUtility
- b) Materials used in the manufacture of the specified equipment shall be of the kind, composition and physical properties best suited to their various purposes and in accordance with the best engineering practices.
- c) The equipment design shall be suitable to render satisfactory operation under the conditions prevailing at site, and the equipment shall operate satisfactorily under normal load and voltage variations and frequency variations (50 Hz \pm 3%) ensuring the safety, further include all necessary provisions ensuring the safety of the operating and maintenance personnel.
- d) The applicable standards of various equipment for the DMS project is as specified here below:

2.1 11kV Ring Main unit

Description	Standard
<u>11kV Ring Main unit</u>	
AC metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV	IS 3427
Classification of degrees of protection provided by enclosures of electrical equipment	IS 12063
High Voltage Switches	IS 9920 (Parts 1 to 4)
Specification for AC disconnectors and earthing switches for voltages above 1000 V	IS 9921 (Parts 1 to 5)

HV AC Circuit Breakers	IS 13118
Dimensions of terminals of HV Switchgear and Control gear	IS 10601
General requirements of switchgear and control gear for voltages exceeding 1000 V	IS 12729
High voltage/Low voltage prefabricated substations	IEC 1330
Common clauses for MV switchgear standards	IEC 62271-100/200
Monitoring and control	IEC 6081
Current Transformers	IS 2705
Voltage transformers	IS 3156
Specification for Static Protective Relays	IS 8686
Standards for high voltage metal clad switchgear up to 52 KV.	IEC 62271-200

Wherever IEC standards are indicated, suitable equivalent IS standards may be considered

2.2 Key RMU Configurations of RING MAIN UNIT

- As a minimum, the RMUs shall be equipped with on-load break switches and a fault passage indicator (FPI), circuit breakers, and numerical relays for the protection of transformer feeders, and provision for wiring for multifunction transducer (MFT for monitoring voltage, current, power, energy, and power factor readings and tripping and protection functionalities from the Communicable Numerical relay to be provided on the RMU. The Load Break Switches and earthing switches shall be housed in SF6 and the Circuit Breakers used in the RMU shall be vacuum interrupter type.

Key Configurations

- 3 WAY RMU – Both side extensible Two (2) Motor operated load break switches (LBSs) with Motor operated earthing switches in SF6 and 1 vacuum circuit breaker with Electrical closing and tripping along with disconnecter and earthing switches WITH BUS PT metering module and base channel and suitable space for mounting FRTU (For future Implementation of SCADA by utility . In case of Manual RMU space for FRTU is not required) , battery charger , Auxiliary PT of suitable rating inside metering cubical. The Battery charger along with batteries required for Electrical operations of RMU is in the scope of the Bidder.
- 5 WAY RMU - Both side extensible Two (2) Motor operated load break switches (LBSs) with earthing switches in SF6 and (3) vacuum circuit breakers with Electrical closing and tripping along with disconnecter and earthing switches WITH BUS PT metering module and base channel suitable space for

mounting FRTU(For future Implemetation of SCADA by utility . In case of Mnaual RMU space for fro FRTU is not required), battery charger , Auxiliary PT of suitable rating inside metering cubical. The Battery charger along with batteries required for Electrical operations of RMU is in the scope of the Bidder.

Other configurations may also be adopted based on the requirement

CLIMATIC CONDITIONS OF THE INSTALLATIONS.

The equipment designed shall be capable of withstanding the following climatic conditions.

- a. Maximum Ambient Air Température -°C
- b. Average ambient Air température -C
- c. Minimum ambient Air Temperature -C
- c. Relative Humidity -%
- d. Altitude - 0 to Meters
- e. Annual rain fall - mm
- f. Rainy Months -
- g. Average no. of Rainy Days -
- h. Average no of Thunder Storms -
- I. Average Wind speed - kmph

If the derating of the equipment is applicable for above climatic conditions same shall be specified by the bidder.

2.3 RATINGS:

The Protection and control unit range shall be designed to accommodate the control power supply voltages ofV DC voltage.

3.0 Technical parameters

11 kV RMU

3.1 Scope of Work

- The Package scope of work shall include design, manufacture, testing, delivery installation commissioning Ring Main Units capable of being monitored and controlled by the SCADA/DMS and also manually operated RMUs. This also includes supply of relevant 11 kV cable termination kits including the jointing as per this tender specification

- Where relevant, the RMU scope of work shall be coordinated with the work to be carried out like providing of UG cable under the project's other construction packages.
- Each RMU shall include its own power supply unit (including auxiliary power transformer, batteries, and battery charger), which shall provide a stable power source for the RMU. In case of remote operated RMUs, the same will be connected to the FRTU including the power supply required will be procured by utility later.
- Each new RMU shall be equipped with main-line load break switches and a fault passage indicator (FPI). Furthermore, to protect each of its lateral / transformer feeders, it shall be equipped with a corresponding set of circuit breakers and self-powered numerical relays. The RMU shall include potential-free contacts so as to connect to SCADA/DMS via FRTUs in case of remote operated RMUs, so as to:
 - Monitor and control the open/closed status of the RMU circuit breakers and load break switches.
 - Monitor the local/remote position of RMU manually-operated switches that can be used to enable and disable remote monitoring.
 - Monitor the health of the power supply, which will include battery failure and low voltage indications.
 - Monitor the open/closed status of RMU earthing switches.
 - Monitor for low SF6 gas pressure indication in case of SF6 Breaker .
 - Monitor for circuit breaker relay operations.
 - Monitor for indication of main-circuit fault detected by the RMU's FPI.
 - Power supply indications including battery failure and voltage alarms
 - FPI reset control
 - The civil works, foundations works including providing of Earth pits and earth flat and their connectivity to earth pits for erection and commissioning of the RMU's are in the scope of the Bidder.
 - Any site/ equipment/ statutory approvals at site etc. required shall be in Utility scope.

RMU shall have local indications as minimum

1. Operation counter on Front / Inside , the RMU Panel to be provided for each LBS & CB with 4 digits , non resettable type
2. Cable charge status for each LBS & CB - LED indication for each phase
3. Spring charge status in front for breaker
4. Earth switch close status for each LBS
5. LBS On/off indication – Green Off , Red On
6. Flag for CB Protection relay operated on Fault

- 7. Flag for FPI on LBS
- 8. Battery charger fail indication

3.1.1 Environmental Conditions

All materials supplied shall be capable of operating under relevant environmental conditions are listed as follows:

- Maximum ambient air temperature: -°C
- Minimum ambient air temperature: -°C
- Average ambient air temperature : - °C
- Maximum relative humidity: -%
- Average thunder storm days per annum: -
- Average rainfall per annum: - mm
- Maximum wind speed: -km/hr
- Altitude above mean sea level: - m

3.1.2 Distribution Network Electrical Parameters

The main parameters of the distribution network are as follows:

- Nominal system voltage: - 11 kV (rms)
- Highest system voltage: - 12 kV (rms)
- Number of phases: - 3
- Frequency: - 50 Hz
- Variation in frequency: - 50 ±3% Hz
- Type of earthing: - Solid
- Power frequency withstand voltage: - 28 kV rms
- Basic impulse withstand voltage: - 75 kV peak

3.1.3 Testing

The specified RMUs shall be subject to type tests, routine tests, and acceptance tests. Where applicable, these tests shall be carried out as per the standards stated above. Prior to acceptance testing, the supplier shall prepare and submit a detailed test plan for review and approval by the Utility.

3.1.4 11 kV RMU TECHNICAL PARAMETERS

- The scope of supply is supply 11 kV RMU suitable for outdoor application.

The RMU to be supplied shall be compact and shall meet the following requirements:

- Easy to install
- Safe and easy to operate
- Compact
- Low maintenance

It shall include, within the same metal enclosure number of MV functional units required for connection,

- Power supply including the battery bank for controlling the LBS and breakers ,
- Load break switches,
- Earthing Switches
- Breakers
- Relays
- BUS PT metering module, FPI's and other allied equipment.
- Dimensions of FRTU, Battery bank for powering the FRTU will be provided to the successful bidder.
- The cutouts for housing the FRTU and Battery bank will be provided by the utility to the successful bidder for making the provision in the control panel.
- Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case copies of English version of the standard adopted shall be submitted.
- The electrical installation shall meet the requirement of Indian Electricity Rules, 1956 as amended up to date, relevant IS code of practice and Indian Electricity Act, 1977. The Electricity Act, 2003 and Amendment if any shall also apply. In addition other rules and regulations applicable to the work shall be followed. In case any discrepancy the most stringent and restrictive one shall be binding.

The high-tension switchgear offered shall in general comply with the latest issues including amendments of the following standards but not restricted to them.

All design features of the proposed RMU, as described in the supplier's bid and in the bid's reference materials, shall be fully supported by the equipment actually delivered. The key design features include those that relate to:

- Maintainability, expandability, and life span
- Ability to operate in severe outdoor environmental conditions.
- Immunity to electrical stress and disturbance.
- Acceptable insulation properties.
- Convenient FRTU interconnection features.
- The Utility intends to be self-reliant for RMU maintenance. To this end, the Supplier shall provide the support, documentation, and training necessary to operate and repair the RMU. The Utility will prefer RMU designs that do not require periodic preventive maintenance and inspections. To facilitate expansion and maintenance, the RMUs should be of modular type.
- The whole switchgear (RMU) should be suitable for extension on at least one side either left or right.
- Each RMU shall have a design life of at least 20 years from the date of final acceptance. The Contractor shall make available, at no cost to the Employer, the manufacturing drawings, wiring diagrams, bill of

material, foundation detail drawings, unpacking and transportation instructions, operation & maintenance manual, As-built drawings, installation and commissioning manual, and other relevant documentation. The specific components of each component /sub-assembly shall be identified and referenced in Supplier-supplied documentation.

- Each RMU shall include its own power supply, including battery and battery charger. In addition, RMU should have a bus connected PT panel (air insulated), which shall serve as the power supply's 230 V AC input.

3.1.5 Outdoor Features

- The RMUs shall be designed specifically for outdoor installation with ingress protection degree of IP54. They shall also be suitable for conditions in which they will be exposed to heavy industrial pollution, and high levels of airborne dust.
- The Outdoor RMU shall be conformably coated to meet these climatic conditions. In this respect, standards such as IEC 62271-200, covering equipment, systems, operating conditions, and environmental conditions shall apply. In particular, the RMU equipment shall have been type tested for IP54 from a national NABL aggregated laboratory. Failure to conform to this requirement shall constitute grounds for rejection of the proposal
- In addition to the above, materials promoting the growth of fungus or susceptibility to corrosion and heat degradation shall not be used, and steps shall be taken to provide rodent proofness.
- The main SF6 tank, housing the on-load break switches and the vacuum circuit breakers, should be of no other material except 2.5 mm stainless steel tank so as to have high corrosion resistance and ensure high longevity. This tank containing SF6 to a maximum pressure of 1.55 bars should be hermetically welded and sealed for life, ensuring a leakage rate not more than 0.1 % per annum. Except for stainless steel, all steel surfaces that are not galvanized shall be treated to protect against corrosion. As a minimum, corrosion treatment shall include the following procedures:
 - The surface shall be cleaned to bare material by mechanical or chemical means.
 - Must be powder coated by means of seven tank process
 - All outdoor metal enclosures shall be treated in 7 tank Pre-treatment process & should be painted with UV Resistant Pure Polyester Powder coating. The powder coated sheet steel fabrication to withstand tropical heat and extremes of weather.

3.1.6 Immunity to Electrical Stress and Disturbance

The electrical and electronic components of the RMU shall conform to relevant standards concerning insulation, isolation, and the product shall comply with IEC 60270 Immunity to electrical stress & disturbance. The ability to meet these requirements shall be verified by type tests carried out by accredited test laboratories that are independent of the bidder and/or the manufacturer of the RMU components. Certified copies of all available type test certificates and test results shall be included as part of the bidder's proposal.

3.1.7 Minimum Insulation of Equipment

- The RMUs shall be of SF6 gas-insulated type with a maximum gas operating pressure up to 1.2 BAR @ 20 deg C.

3.1.8 Nameplate Information

RMU nameplate information shall be determined in agreement with the Employer. This information may include for example:

- Name of manufacturer and country
- Type, design, and serial number
- Rated voltage and current
- Rated frequency
- Rated symmetrical breaking capacity
- Rated making capacity
- Rated short time current and its duration
- Rated lightning impulse withstand voltage
- Purchase Order number and date
- Month and year of supply

Each RMU shall also exhibit a Danger Board to indicate the presence of high voltage (11,000 V).

3.1.9 Interconnecting Cables, Wiring, Connectors, and Terminal Blocks

- The Contractor shall provide all interconnecting wires, cables, connectors, terminations and other wiring accessories such as terminal blocks required by the RMU.

3.1.10 Metallic Cables

- All metallic cables and wiring shall be of required cross-section solid or multiple strands of round copper conductors and have flame retardant insulation. All wiring shall be neatly laced and clamped.

- All wire and cable connectors and terminators shall be permanently labeled for identification. All connection points for external cables and wires shall be easily accessible for connection and disconnection and shall be permanently labeled. Conductors in multi-conductor cables shall be individually color-coded.

3.1.11 Connectors

- Plug-type connectors with captive fasteners shall be used for all interconnections. The connectors shall be polarized to prevent improper assembly.

3.1.12 RMU-FRTU Connectors (Only for SCADA enabled RMU and not for Manual RMU)

- For ease of installation and maintenance, the interconnection between the RMU and the FRTU (IF remote communicable), (For future FRTU installation later by utility separately in a separate enclosure shall be supported by having heavy-duty terminal blocks with screw type terminals shall be provided by the supplier for necessary cable terminations. In using a terminal block, no more than two cables or wires shall be connected to any of its individual terminals.
- Making strips shall be used to identify all external connection blocks. Marking tags shall be read horizontally. All terminals to which battery or other high voltages are connected shall be provided with fireproof covers.
- All individual status input, AC voltage input, and control output points shall be isolatable without the need to remove wiring by means of individual terminal blocks of the removable link type. In order to avoid open circuits on the secondary side of CTs, termination blocks with by-pass bridges shall be provided for all AC current inputs.
- Terminal blocks shall comply with IEC 60947-7-1 (2009): Low-voltage Switchgear and Control Gear, Part 7-1: Ancillary Equipment, Terminal Blocks for Copper Conductors.
- Each RMU shall be equipped with all necessary connectors, terminal blocks, and other accessories that will allow it to be connected to the FRTU, which in-turn will send required indications and measurements to the DMS via the communications system. (For SCADA enabler RMUs only)

3.1.13 Parameter Requirements

The RMUs shall be suitable for cable networks of 630 Amps and loop cable networks of 400 Amps. The minimum design parameters to which their major components shall conform or exceed are summarized in the following tables.

Table 0-1: System Parameters

Parameter	Value
Nominal System Voltage	11 Kv
Highest System Voltage	12 Kv
Rated Voltage	12 Kv
System frequency	50 Hz
Number of Phases	3 Phase/3 Wire

Table 0-2: Circuit Breaker Parameters

Parameter	Value
Lightning Impulse Withstand Voltage	75 Kv (peak)
Phase-to-Phase & Phase-to- Earth:	
Power Frequency Withstand Voltage to Earth, Between Poles, & Across Opening Span	28 Kv rms for 1 minute
Rated Short Time Withstand/Breaking Current:	20 Ka (rms)
Rated Duration of Short Circuit:	3 seconds
Rated Normal Current:	630 Amps (rms)

Table 0-3: Load Break Switch Parameters

Parameter	Value
Rated Short Circuit Making Capacity	50 Ka peak at rated voltage (both LBS & Earthing Switch)
Rated Load Interrupting Current	630 Amps
Rated Cable Charging Interrupting Current	25 Amps

The RMU switchgear shall be capable of withstanding the specified currents without damage in accordance with the latest versions of IEC 60694 (Common Specifications for High-Voltage Switchgear and Control Gear Standards) and IS 3427 (AC Metal Enclosed Switchgear and Control Gear for Rated Voltages above 1 Kv and up to and including 52 Kv).

The equipment offered shall be as per the standards specified in the bid specification and if the offered equipment is tested with any other international standards which is superior to the standards specified they can also be considered and the bidder has to submit the documentary evidence for the same to (Utility Name) .

3.1.14 Design Details

- The RMU shall be designed to operate at the rated voltage of 12 kV.
- It shall include, within the same metal enclosure, On-load break switch, circuit breakers and earthing switches for each Load Break Switch/Circuit Breaker.
- Suitable fool-proof interlocks shall be provided to the earthing switches to prevent inadvertent or accidental closing when the circuit is live and the concerned Load Break Switch/Circuit Breaker is in its closed position.
- The degree of protection required against prevailing environmental conditions, including splashing water and dust, shall be not less than IP 54 as per IS 12063.
- The active parts of the switchgear shall be maintenance free. Otherwise, the RMU shall be of low-maintenance type.
- The tank shall be made of minimum 2.5 mm thickness of stainless steel.
- The Stainless Steel tank should be completely welded so as to ensure IP 67 degree of protection and shall be internal arc tested.
- The RMU shall be suitable for mounting on its connecting cable trench.
- For each RMU enclosure, a suitably sized nameplate clearly identifying the enclosure and the electrical characteristics of the enclosed devices shall be provided.
- The access to the cable compartment should be from the front / Side /Rear of the switchgear only to have minimum operating & maintenance space at site.
- The RMU design shall be such that access to live parts shall not be possible without the use of tools.

- The design shall incorporate features that prevent any accidental opening of the earth switch when it is in the closed position. Similarly, accidental closing of a Circuit Breaker or Load Break Switch shall be prevented when the same is in an open position.
- The RMU tank must be equipped with a suitable pressure relief device. The pressure relief must ensure that the escaping gases are dissipated to the rear / top of the switchgear.
- The complete RMU shall be tested in an accredited INDIAN or FOREIGN laboratory and designed for an Internal Arc.

3.1.15 Earthing

- There shall be continuity between metallic parts of the RMUs and cables so that there is no dangerous electric field in the surrounding air and the safety of personnel is ensured.
- The RMU frames shall be connected to the main earth bars, and the cables shall be earthed by an Earthing Switch having the specified short circuit making capacity.
- The Earthing Switch shall be operable only when the main switch is open. In this respect, a suitable mechanical fail-proof interlock shall be provided.
- The Earthing Switch shall be provided with a reliable earthing terminal for connection to an earthing conductor having a clamping screw suitable for the specified earth fault conditions. The connection point shall be marked with the earth symbol. The flexible connections between the earthing blade and the frame shall have a cross-section of at least 50 mm² copper or equivalent in GI
- The Earthing Switch shall be fitted with its own operating mechanism. In this respect, manual closing shall be driven by a fast acting mechanism independent of the operator's action.

3.1.16 Incomer Load Break Switches

- The Load Break Switches shall be maintenance free. With outdoor canopy doors open, the position of power contacts and earthing contacts shall be clearly visible from the front of the RMU through the Mimic facia.
- The position indicator shall provide positive contact indication in accordance with IS 9920. In addition, the manufacturer shall prove the reliability of indication in accordance with IS 9921. These switches shall have three positions (or states), i.e., Open, Closed, and Earthed, and shall be constructed in such a way that natural interlocking prevents unauthorized operations.
- The switches shall be fully assembled, tested, and inspected in the factory.

- In case of Manual operation without motors, opening and closing shall be driven by a fast-acting mechanism independent of manual operator action.
- The Load Break Switches shall be provided with a motorized operating mechanism suitable for SCADA control. (Not required for Manual RMU)
- A facility shall be provided with an electrical operating mechanism allowing an operator at the RMU site to operate the Load Break Switches without any modification of the operating mechanism and without de-energizing the RMU.
- The switch and earthing switch mechanisms shall have a mechanical endurance of at least 1,000 operations.

3.1.17 Circuit Breakers

- The Circuit Breakers shall be maintenance free and, when standing in front of the RMU with outdoor canopy doors open, their positions shall be clearly visible, through the Mimic facia. The position indicator shall provide positive contact indication in accordance with IS 9920. The breakers shall have three positions (or states), i.e., Open, Closed, and Earthed, and shall be constructed in such a way that natural interlocking prevents unauthorized operations. They shall be fully assembled, tested, and inspected in the factory.
- An operating mechanism shall be used to manually close the Circuit Breaker and charge the mechanism in a single movement. It shall be fitted with a local system for manual tripping. There shall be no automatic reclosing. The Circuit Breaker shall be capable of closing fully and latching against the rated making current. Mechanical indication of the OPEN, CLOSED, and EARTHED positions of the Circuit Breaker shall be provided.
- Each Circuit Breaker shall operate in conjunction with a suitable protection relay under transformer feeder/ circuit phase and earth fault conditions. In addition, the Circuit Breaker shall be provided with a motorized operating mechanism that can be remotely controlled by the SCADA (Not for Manual RMU).

3.1.18 Cable Termination

- Bushings shall be conveniently located for working with the specified cables and shall allow for the termination of these cables in accordance with the prevailing practice and guidelines of cable manufacturers. The dimensions of the terminals shall be in accordance with IS 10601.
- A non Ferro-magnetic cable clamp arrangement shall be provided for each cable to be terminated in the RMU.

- A suitable arrangement for the Circuit Breakers, Earthing Switches, and Load Break Switches shall be provided so that these devices can be padlocked in the "Open" and "Closed" positions.
- A permanent "Live Cable" indication as per IEC 61958 shall be provided for each cable using a capacitor voltage divider.
- It shall be possible to test the core or sheath insulation of the cables without disconnecting the cables in the cable compartment, after accessing the cable compartment. The cable end kits including the supply and erection is in the scope of the successful bidder.
- Two earth pits of 10 ohms each shall be provided diagonally and earthing to the equipment shall be done as detailed in the scope of supply.
- Cable termination can be either front or rear termination as per the requirements of the site.

3.1.19 Safety of Equipment

- With respect to the RMU's SF6-filled equipment, any accidental overpressure inside the sealed chamber shall be limited by the opening of a pressure-limiting device in the enclosure so that the gas will be released away from the operator and to the rear bottom or top of the tank without endangering the operator or anyone else in the vicinity of the RMU.
- All manual / motorized operations, monitoring of open/close position of switches/breakers, live line indicators, FPI indication, SF6 gas pressure indication and access to the cable compartment shall be carried out from the front of the RMU only.

3.1.20 Current and Voltage Transformers.

- The RMU shall be provided with current and voltage transformers. These CTs & PTs shall meet the electrical and mechanical ratings as per the relevant standards.

3.1.20.1 Current Transformers

- 3 Nos. ring type, single core CTs shall be provided in each incoming load break switch for metering purposes. A similar arrangement shall be provided in each circuit breaker cable compartment to mount a 3 Nos. single-core, ring type CT for protection purposes.
- The CTs shall conform to IS 2705. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitably to a terminal block, which will be easily accessible for testing and terminal connections.

- Further characteristics and features distinguishing CTs used for metering from CTs used for protection are listed as follows:

CTs for Metering:

- Material : Epoxy resin cast/ Tape wound
- Burden : 2.5VA
- Ratio : 400-200-100/1 A
- Accuracy Class : 0.5

CTs for Protection:

- Material : Epoxy resin cast/ Tape wound
- Burden : 2.5VA
- Ratio : 400-200-100/1 A
- Accuracy Class : 5P10
- The RMU's other CTs / sensors, i.e., those used by Fault Passage Indicators (FPIs), shall be supplied by the FPI manufacturer. These CTs/sensors shall be an integral part of the FPI's design to ensure that they properly match the requirements of the FPI.

3.1.20.2 Voltage Transformers

- A 3 phase single or 3 nos. single phase potential transformers shall be provided. These should be housed in a separate air insulated PT Panel, directly connected to the RMU through main bus. The burden per transformer shall not be more than 50 VA and the voltage ratio shall be 11000/110 V or 230 V. The accuracy class shall be 0.5.
- HRC fuses shall be provided on the HV side.
- The PTs shall be of cast epoxy-resin construction, and they shall conform to IS 3156. Their design and construction, in particular, shall be sufficiently robust to withstand the thermal and dynamic stresses during short circuits.

3.1.21 Fault Passage Indicator for RMU

- The FPI shall facilitate quick detection of faulty section of line. The fault indication may be on the basis of monitoring fault current flow through the device. The FPI should be self-powered and should have internal lithium battery for external indication and setting of FPI in the absence of current.

3.1.21.1 The FPIs shall include:

- Fault detection - Phase to phase and Phase to earth faults.
- One potential-free output contacts for hardwiring to FRTUs. On this basis, the SCADA/DMS will be able to monitor phase / earth fault condition (Not for Manual RMU).
- Local fault indications - LCD display on FPI front panel along with LED indication on front panel of RMU enclosure.
- Multiple reset option –
- End of time delay (Adjustable from 2 to 16 Hrs)
- Remote reset (Via potential free input contact of FPI)
- Manual reset (Reset button on front panel of FPI)
- Automatic reset on current restoration.

3.1.21.2 The characteristics of the FPIs shall include:

- Phase fault thresholds configurable from at least 100 to 800 A
- Earth fault thresholds configurable from at least 20 to 200 A
- Multiple number of steps for adjusting phase and earth fault thresholds.
- Fault current duration range configurable from at least 40 ms to 100 ms in 20 ms steps and further 100 ms to 300 ms in 50 ms steps.
- Variations with respect to these characteristics may be acceptable as long as they prove applicable and provide the same or better flexibility.

3.1.22 Protection Relay

- The RMU shall be equipped with self-powered numerical relays(Communicable relays shall be with auxiliary power which shall be given from battery but the tripping shall

The Circuit Breaker in the RMU shall be fitted with a communicable-type, self-powered numerical relay, i.e., one for each outgoing circuit breaker. The protection relay's auxiliary contacts shall be provided for hardwiring to the FRTU. The relay shall also interface with the FRTU via an RS 232/485 port in order to send, as a minimum, real-time reading using the MODBUS /IEC 103 protocol. (Not for Manual RMUs)

The numerical relay shall be self-powered and should provide Inverse Definite Minimum Time (IDMT) and Instantaneous protection characteristics. On this basis, the relay as a minimum shall provide:

- Phase Overcurrent Protection (50/51)
- Earth Fault Protection (50N/51N)

The relay shall be provided with an input for remote tripping, which shall be realized via an electric output pulse even without presence of phase current. A flag indicator shall be installed for signaling the occurrence of trip conditions.

3.1.23 Features and Characteristics

The numerical relay shall have the following minimal features and characteristics noting that variations may be acceptable as long as they provide similar or better functionality and/or flexibility:

- It shall be housed in a flush mounting case and powered by the RMU power supply unit.
- It shall have three phase overcurrent elements and one earth fault element.
- IDMT trip current settings shall be 50-200% in steps of 1% for phase overcurrent and 10-80% in steps of 1% for earth fault.
- Instantaneous trip current settings shall be 100-3000% in steps of 100% for phase overcurrent and 100-1200% in steps of 100% for earth fault.
- Selectable IDMT curves shall be provided to include, for example, Normal Inverse, Very Inverse, Extreme Inverse, Long Time Inverse, and Definite Time. Separate curve settings for phase overcurrent and earth fault shall be supported.
- For IDMT delay multiplication, the Time Multiplier Setting (TMS) shall be adjustable from 0.01 to 0.1 in 0.01 steps.
- The relay shall also be provided with:
 - Alphanumeric Liquid Crystal Display (LCD) for relay setting.
 - Communications via a MODBUS RS232/RS485 /IEC 103 port to provide the FRTU (and hence the DMS) with phase current measurements. It is also desirable that this same means of communication can be used by the FRTU to send setting and control commands to the relay.
 - Parameter change capability that is password protected.

3.1.24 Power Supply and auxiliary power transformer

Each RMU shall be fitted with a power supply, including batteries and battery charger, suitable for operating the motors of the On-load Isolators and Circuit Breakers. On this basis, the following operational specifications shall apply:

- The power supply unit shall conform to the following requirements:
 - Input: 230 V AC nominal from the RMU's auxiliary power transformer allowing for possible variations from 190 to 300 V AC
 - Output: Stable 24 V / 48.....DC.
 - Batteries: 24 /48 /V DC
- The auxiliary power transformer shall be of suitable rating as per the load calculation and the Auxiliary power transformer inputs shall be equipped with surge protection devices in accordance with IEC 62305.
- The 24 V /.....DC batteries shall have sufficient capacity to supply power to the following devices with a nominal backup of 4 hours:
 - RMU's motors for a minimum of five (5) operations
 - RMU's trip coils, close coils, FPI.
- The batteries shall be of sealed lead acid VRLA or dry type and shall have a minimum life of five (5) years at 25°C.
- The battery charger shall be fully temperature compensated.
- To prevent deep discharge of the batteries on loss of AC power source, the battery charger shall automatically disconnect all circuitry fed by the batteries following a user-adjustable time period or when the battery voltage falls below a preset value. If the battery voltage falls below the preset value, the time to fully recharge all batteries shall not exceed twenty-four (24) hours.
- An automatic battery checking device shall be provided to check the battery's health and initiate a battery-failed alarm signal in case battery deterioration is detected. Such detection may be based on comparing measurement values with set values (e.g., internal resistance, voltage, etc.).
- The battery charger shall be provided with an alarm displayed at the local control panel and remotely at the DAS to account for any of the following conditions:
 - Low battery voltage
 - High battery voltage
 - Battery failed
 - Battery charger overvoltage
 - Grounded battery/battery-charger
 - Others according to manufacturer's design

3.1.25 Multi-Function Transducer (MFT)

- The RMU main incoming On-load switches circuits shall be equipped with Communicable Numeric relays and the multi-function transducers for providing distribution system voltage, current, power factor, power, and energy readings and is in the scope of the bidder.

Each MFT shall have the following minimum features:

- Measurement, display, and communications capability of up to 31 parameters
- THD measurement and power quality data
- True rms measurement
- Digital communications
- Simple menu driven interface
- High quality LED display
- Able to monitor:
 - Voltage: line-to-line and line-to-neutral
 - Current: phase and neutral
 - Frequency
 - Power factor
 - Power (active, apparent, and reactive)
 - Energy (active and reactive)
 - Total harmonic distortion

3.1.26 Construction

- The RMU shall be sufficiently sturdy to withstand handling during shipment, installation, and start-up without damage. The configuration for shipment shall adequately protect the RMU equipment from scraping, banging, or any other damage.

3.1.27 Enclosures

- All supplied enclosures shall be sized to provide convenient access to all enclosed components. It shall not be necessary to remove any component to gain access to another component for maintenance purposes or any other reason.
- The enclosures shall also be designed to ensure that the enclosure remains rigid and retains its structural integrity under all operating and service conditions with and without the enclosure door closed.
- The thickness of all enclosure panels shall be at least 2 mm.

The appropriate corrosion treatment and finish requirements shall apply to both inside and outside enclosure surfaces. Other required features are as follows:

- Constructed of mild steel according to IEC 60529 with IP rating 54 or better. Must be grit/shot blasted, thermally sprayed with Zinc alloy, phosphate, and subsequently painted with polyurethane based powder paint, the overall paint layer thickness including Zinc spraying shall be of the order of 80 to 90 microns
- Means, such as insulated heat shields and/or air vents, to prevent high temperatures from damaging the RMUs enclosed components. If air vents are installed, these vents shall in no way reduce the effectiveness of the enclosure's protective characteristics.
- A metal pocket attached to the inside of the front door to hold documentation, maintenance log sheets, and other such information.
- Door opening mechanism with built-in key-lock facility suitable for padlocking. An opening mechanism that is less prone to breaking than a projecting door handle is preferred, e.g., a push-button opening mechanism.
- A grounding terminal including grounding bolt and lock washer for connecting a 50 mm² copper or galvanized steel grounding conductor. The grounding bolt and lock washer shall be made of stainless steel.
- Means of preventing moisture from condensing on electronic components mounted inside the enclosure proposed for housing the FRTU. If necessary, heaters providing adjustable thermostat-control within the range 20 to 60 °C shall be installed in the enclosure for this purpose.
- Means of protection against rain water, and high levels of airborne dust, should be provided.
- Means of enabling the SCADA to monitor the open/closed status of the enclosure door. A SCADA equipment alarm shall be produced whenever the enclosure door is open. (Not for manual RMU)
- The outdoor RMU shall include having a minimum protection class of IP 54. It shall be tested in accordance with the latest IEC 60529 standard.
- The outdoor canopy shall have a hinged front access door with a two-point latch locking system with a latch operating lockable handle. The door shall be fitted with a perimeter flange and gasket (rubber or neoprene) to prevent the entrance of water. In addition, a means of monitoring and indicating that the door is open shall be provided.

3.1.28 Motors

- The RMU shall be fitted with spring charging motors of high insulation class allowing the circuit breakers and load break switches to be operated without manual intervention.

- In addition to allowing circuit breaker tripping by the RMU's protection relays, the motorized operating mechanism shall be suitable for remote control by the SCADA. (For SCADA enabled RMUs)
- The motors along with the supplied control card and push buttons shall allow Utility's personnel to electrically operate the circuit breakers and load break switches at site without any modification of the operating mechanism and without de-energizing the RMU.

3.1.29 Inspection and Test

- Inspections and tests shall be performed to ensure RMU compliance with these Technical Specifications. Responsibility for conducting the inspections and tests shall rest with the Supplier. The Utility representatives will participate in the RMU inspections and will witness the testing as described in the following sub-clauses.

3.1.29.1 Inspections

- Utility's representatives shall be allowed access to supplier's facility where the RMU or its parts are being produced or tested. Such access will be used to verify by inspection that the RMUs are being or have been fabricated and tested in accordance with the Technical Specifications.
- The supplier shall give the utility's representatives 15 days notice in writing concerning the date and place at which the equipment will be ready for inspection or testing. The supplier shall provide all the necessary assistance and facilities to utility's representatives to carry such inspections and test witnessing.
- The supplier shall provide any and all documentation that is necessary to complete the inspections. The representatives shall be allowed to inspect the supplier's quality assurance standards, procedures, and records. Inspections, as a minimum, shall include checks on inventory, general appearance, cabling, drawing conformance, and labeling.

3.1.29.2 Test Procedures

- The supplier shall provide test plans and detailed procedures for all required testing. The plans and procedures shall ensure that each test is comprehensive and verifies proper performance of the RMU under test and, in this respect, shall be submitted for review and approval by the Utility.
- The test plans shall include all routine tests and acceptance tests as per relevant BIS/IEC standards and shall describe the overall test process including the responsibilities of the test personnel and how the test results will be documented.
- The test procedures shall describe the individual tests segments and the steps comprising each segment, particularly the methods and processes to be followed.

3.1.29.3 Test Reports

- The Tenderers should, along with the tender documents, submit copies of all Type test certificate of their make in full shape as confirming to relevant IS/IEC of latest issue obtained from a International/National Govt. Lab/Recognized laboratory.
- The above type test certificates should accompany the drawings for the materials duly signed by the institution that has type test certificate.
- The supplier shall maintain complete records of all test results. The records shall be keyed to the test procedures.
- Upon completion of each test, the supplier shall submit a test report summarizing the tests performed and the results of the tests.

3.1.29.4 Factory Acceptance Test

- A formal factory acceptance test shall be conducted to ensure that the RMUs have been designed to meet the utility's functional requirements in all respects. Utility representatives shall witness the test on a representative RMU, and the test shall be carried out in accordance with the supplier's test plan and procedures as approved by the Utility. Should the factory acceptance test prove unsatisfactory in any way, the Utility reserves the right to have further tests conducted and, if applicable, request further improvements in the supplier's RMU design.

3.1.29.5 Routine Factory Tests

- These tests shall be carried out during RMU manufacture as a quality control measure, i.e., to ensure each RMU to be delivered meets the Employer's minimum requirements including all relevant standards. Recording and reporting the routine test results shall be the responsibility of the Supplier.
- At the Utility's discretion, Utility representatives will witness such testing. This may include requesting the Supplier to perform tests on RMUs selected at random from each batch of RMUs that the Supplier deems ready to be delivered to site. Should any such test prove unsatisfactory, the Utility reserves the right to have further tests conducted and for delivery not to take place until a mutually agreed course of action has been reached.
- Further for additional reliability of the manufactured RMU it is mandatory to have the complete assembled tank tested for partial discharge.

3.1.30 Operating Manuals

- The Supplier shall submit, operating manuals for all RMU components including items such as FPI, Relay, and other equipment provided by the bidder. These manuals shall be in English. They shall

include the RMU operating instructions. Context sensitivity shall be used to go directly to the appropriate place in the manual.

- The manuals shall be organized for quick access to each detailed description of the operator procedures that are required to interact with the RMU functions. This shall include the procedures to define, build, edit, and expand all data points provided with the RMU.
- The manuals shall present in a clear and concise manner all information that operators, including maintenance personnel, need to know to understand and operate RMUs satisfactorily. The manuals shall make abundant use of diagrams and/or photographs to illustrate the various procedures involved.

3.1.31 As-Built Documents and Drawings

The supplier shall submit as built documents including applicable drawings for review and approval. All deliverable documents and drawings shall be revised by the supplier to reflect the as- built RMU components including all the FPI, LLI & Relay. Any errors in or modifications to an RMU resulting from its factory and/or site acceptance test shall be incorporated. Within this same context, all previously submitted documents that are changed because of engineering changes, contract changes, errors, or omissions shall be resubmitted for review and approval. The successful bidder has to provide his quality document to Utility.

D) 11 KV SECTIONLIZER

1.1 Scope of Work

This Technical Specification determines the requirements that shall be satisfied for the supply of high-voltage three-phase 11-kV class automatic circuit-Sectionalizer, as well as its accessories, for outdoor installation, entirely new and without prior use, to be used in the overhead primary distribution.

The Sectionalizers should be provided with necessary take off terminal units for automations. Remote operation of the Sectionalizers must be possible. It should provide the control and monitoring of networks from remote central point. Location of problems and re-configuration is completed with minimum downtime & without manual intervention.

1.2 Standards

The following standards contain provisions that, through reference in the text, constitute requirements of this specification at the time of publication the revisions indicated were valid. All standards are subject to review and parties to purchasing agreements based on this specification are encouraged to investigate the possibility of applying the most recent revisions of the standards listed below.

- IEC 60265-1 High Voltage Switches
- IEC 60529:1989, Degrees of protection provided by enclosures (IP Code).
-

General Characteristics in accordance with the IEC standards

Degree of protection

- Enclosure IP 54
- Operating mechanism IP 2X

Site Condition

- Altitude - up tom ;(For altitudes above 1000m derate in accordance with ANSI C37.60)
- Ambient temperature minimumC;
- maximum -..... °C;
- Maximum daily variation -.... °C;
- relative humidity : %
- Average thunder storm days per annum :
- Average rainfall per annum : mm
- Maximum wind speed :km/hr

AC metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV	IS 3427
Classification of degrees of protection provided by enclosures of electrical equipment	IS 12063
High Voltage Switches	IS 9920 (Parts 1 to 4)

Specification for AC disconnectors and earthing switches for voltages above 1000 V	IS 9921 (Parts 1 to 5)
HV AC Circuit Breakers	IS 13118
Dimensions of terminals of HV Switchgear and Control gear	IS 10601
General requirements of switchgear and control gear for voltages exceeding 1000 V	IS 12729
High voltage/Low voltage prefabricated substations	IEC 1330
Common clauses for MV switchgear standards	IEC 62271-100/200
Monitoring and control	IEC 6081
Current Transformers	IS 2705
Voltage transformers	IS 3156
Specification for Static Protective Relays	IS 8686
Standards for high voltage metal clad switchgear up to 52 KV.	IEC 62271-200

- Pollution level -medium/heavy

1.3 Technical Descriptions

The Sectionalizer shall be three-phase, automatic, appropriate for pole installation. The Sectionalizer shall be supplied with its respective pole-fixing support. All the requirements shall be taken into account in its design so that the electrical operation of the Sectionalizer can be done from remote location using SCADA.

It shall also be self-sufficient in functioning of protection and control. The Sectionalizer shall have the following electrical characteristics:

1.3.1 Distribution Network Electrical Parameters

The main parameters of the distribution network are as follows:

- | | | |
|--|---|------------|
| 1) Nominal system voltage (U) (r.m.s.) | - | 11 kV; |
| 2) Maximum system voltage (Um) (r.m.s.) | - | 12 kV; |
| 3) Load current | - | 630A; |
| 4) Short circuit-breaking capacity | - | 20kA; |
| 5) Lightning Impulse Withstand Voltage (BIL) | - | 75 kVpeak |
| 6) System frequency | - | 50 / 60Hz; |
| 7) Number of phases | - | 3 |

8) Interrupting medium	-	SF6
9) Insulation medium	-	SF6
10) Minimal number of rated load operations	-	600
11) Minimal number of no load mechanical operation	-	3000
12) Operating Mechanism	-	LV motor , Manual

Typical features

- Type: Three pole, operated simultaneously by a common shaft
- Arc interruption in dielectric medium SF6 gas
- Local/Remote operation selector switch be provided
- Motor rated voltage 24V / 48V DC
- Emergency trip / open push button On panel front

1.3.2 Mounting

The sectionalizer shall be suitable for single pole mounting. It shall be fitted with an external M12 earthing stud, complete with a nut, lock nut and spring washer. The earth stud shall be welded to the tank for optimal earthing connection. A detailed drawing of the single pole sectionalizer mounting arrangement with surge arresters fitted shall be provided. The minimum phase-to-earth clearances shall be indicated on the drawing.

1.3.3 Detection characteristics:

- The following detection elements shall be available: over-current (O/C), earth fault (E/F) and sensitive earth fault (SEF).
- Each of the detection elements is monitored with independent definite time settings and fault thresholds.
- The ratio of drop-off current to pick-up current shall be at least 90% for all detection functions.
- The SEF function shall be equipped with harmonic filtering to prevent operation when harmonics are present in the primary residual earth currents.
- A low pass filter with 3rd harmonic rejection > 28dB shall be supplied.

1.3.4 Over-current (O/C) element

- The over-current pick-up setting range shall be selectable from 10 A to 1260 A in the steps not greater than 10 A.
- The Definite Time for fault to persist setting range shall be selectable from 0.05 to 100.0 sec in the steps not greater than 0.1 sec.

A cold load pick-up (CLP) feature shall be provided that allows user selectable modification of detection element characteristics under conditions of system power restoration. The pick-up current setting of the O/C element may be modified with a settable factor to increase the pick-up current for the CLP duration.

The CLP function shall have the following characteristics:

- the CLP function shall not in any way interfere with any of the other functions elements' pick-up current settings except as mentioned above;
 - the CLP functionality shall be such that the active duration of the CLP is selectable from 0 min to 200 min in 1 min steps
 - the modification factor should be settable from 1 to 5 in steps of 0,1.

1.3.5 Earth fault (E/F) element

- The earth fault setting range shall detect primary earth fault currents down to 20A. The earth fault pick-up setting range shall be selectable from 20A to 1260A in the steps not greater than 10A.
- The definite time for fault to persist setting range shall be selectable from 0.05 to 100.0 sec in the steps not greater than 0.1 sec.

1.3.6 Sensitive earth fault (SEF) element.

- A primary earth fault current of 4A to 20A in steps not exceeding 1A shall be detectable. The Definite time for fault to persist setting range shall be selectable from 0.05 to 100.0 sec in the steps not greater than 0.1 sc.

1.3.7 Current Transformer

- Current transformer ratio: 200-100/1-1A.
- Number of cores: 2
- CT accuracy class 10P10 for protection core and 1 for metering core.
- The VA burden of the CTs shall be sufficient to supply the energy required by the relay and the MFT.

1.3.8 Voltage Transformer

- Voltage ratio : Primary 11 KV (Phase to Phase)
- Voltage ratio : Secondary 230 V ac or as per manufacturer controller requirement
- Highest Service voltage : 12 KV
- Insulation level : 12/28/75KV
- Voltage factor : 1.2 continuous and 1.9 for 8 hrs.
- Winding wires of PT shall be of grade 3 doubled enameled
- THE HV terminal shall be adequately long from the bushing epoxy material such that the connecting lug shall not rest directly on the bushing epoxy
- Voltage transformer shall be provided for metering purpose
- The VA burden of Voltage transformer should be sufficient to provide auxiliary supply for battery charging and operation of MFT.

1.3.9 Requirements of sealed housing live parts

- Enclosure Stainless steel enclosure suitable for IP67
- SF6 gas pressure low alarm
- Provision for SF6 gas pressure indication Manometer with non return valve
- Arc interruption method for SF6 breaker: Puffer type / rotating arc type

1.3.10 Indication & signals (for SCADA / Local)

- Spring charge status indication on front of Sectionalizer
- Sectionalizer On/OFF indication Green for OFF / Red for ON
- Protection relay operated on fault Flag
- Status signals to SCADA- to be wired to marshalling terminal block
- Battery charger Fail potential free contacts
- Sectionalizer CB close / open potential free contacts
- Protection relay operated potential free contacts
- SF6 gas pressure low potential free contacts
- Spring charge Status indication potential free contacts
- Local/Remote potential free contacts

- Commands from SCADA- to be wired to terminal block CB Close Open
- Provision for local electrical and manual control should be given.
- Metering core of both CT and PT should be wired upto TB for SCADA metering.
- Relay auxiliary contacts for remote indication. Potential free contact 1NO + 1NC wired to terminal block

1.4 Earthing Arrangement

All Sectionalizer should have a special earth bar with a sectional area of not less than 100 mm² run along the whole of metal enclosed switch structure, each end being connected to the main earthing system where metal cases are used on instruments these shall be connected to this bar by conductors of not less than 16 mm² section.

- It should be easily possible to test the cables by a simple earthing arrangement.
- Equipment earthing of GI / Copper strips of adequate size be provided.

1.5 Voltage Indicator Lamps and Phase Comparators

The Sectionalizer shall be equipped with a voltage indication. It shall be possible for the each of the function of the Sectionalizer to be equipped with a permanent voltage indication as per IEC 601958 to indicate whether or not there is voltage on the cables.

1.6. POWER SUPPLIES

The Sectionalizer system shall provide power for the electronics, operation of the Sectionalizer and Controller operation (Future FRTU and Modem) shall be capable of supplying at least 45VA or higher suitable for self-operation of Sectionalizer and Modem.

Primary supply: Preference will be given to the ability to obtain primary power directly from the HV power system requiring no additional primary supply connection.

Test supply: The LBS shall accept an external AC 230 V 50 Hz supply. Optional supply: the LBS shall accept an external DC 110 V supply.

Auxiliary supply: An auxiliary supply with the following minimum characteristics shall be provided

One battery and constant voltage charger with current limiting shall be part of the Sectionalizer.

Battery standby time shall not be less than 24 hours and shall allow for a minimum of ten (10) sequences of LRC trip-close operations and a transmit/receive standby duty cycle of 10/90 percent with respect to the GPRS modem. The battery shall recharge to 80 % of its capacity in a maximum of 15 h. The total number of circuit-breaker operations under the above communications scenario shall be at least 10 Sectionalizer operations preventing closing if the battery will not have enough stored energy to open the circuit- breaker for a protection trip condition. Batteries shall be disconnected at the manufacturer's specified minimum voltage. Battery Low' indication shall be available locally and remotely and shall include a battery test. The indication of "Battery Low" status shall allow for a further ten LBS operations. The minimum battery life expectancy shall be 5 years. Details of the guaranteed life expectancy of the battery shall be stated in the tender documentation.

1.7 Tests

1.7.1 Type Tests

The load break switch/sectionalizer shall have been type tested in accordance with, and found to comply with, the requirements of IEC 60265-1 for the following, and the appropriate values shall be stated in the tender documentation:

- Operating duty.
- Making current.
- Insulation (dielectric tests).
- Temperature rise.
- Mechanical operations
- Control equipment surge withstand capability , Electromagnetic Compatibility, Immunity Requirements.

The LBS / Sectionalizer shall have been type tested in accordance with, and found to comply with, the requirements of either IS or IEC/ANSI/IEEE C37.63-2005 for the following, and the appropriate. Values shall be stated.

Test records (on identical equipment) in the form of validated copies of test certificates issued by a recognized testing authority shall be submitted with the tender documentation.

1.7.2 Routine tests

Routine tests, as required in the relevant standards, shall be carried out as a normal requirement of the contract and, unless otherwise agreed upon, shall be witnessed by the purchaser or by his appointed representative. No additional charge shall be levied for such tests or for the production or presentation of documentation related to routine tests.

Duplicate copies of routine test certificates shall be supplied together with the equipment when the latter is delivered to the final destination stated in the order.

1.7.3 Packing/ Documentation

- All equipment shall be carefully packed to prevent damage or deterioration during normal transportation, handling and storage.
- Each container shall bear the following information on the outside of the container:
 - The address of the destination
 - The gross mass, in kilograms
 - The name of the manufacturer

E) 3PHASE 3 / 4 WIRE CT/PT OPERATED FULLY STATIC AMR COMPATIBLE TRI-VECTOR ENERGY METERS FOR AREA RING FENCING, SUBSTATION FEEDERS, DISTRIBUTION TRANSFORMERS, HT (PT/CT) & LT (CT) CONSUMERS

1.0 SCOPE

Design, manufacturing, testing, supply and delivery of AC, 3 Phase, 3 / 4 Wire, CT/PT operated fully Static and AMR compatible Tri-Vector Energy Meters for measurement of different electrical parameters listed elsewhere in the document including Active Energy (KWH), Reactive Energy (KVARH), Apparent Energy (KVAH) etc. The detail scope is given below.

2.0 APPLICATION

- a) As Boundary Meters for Ring fencing of an Area,
- b) In Substation on incoming/Outgoing HT feeders,
- c) On Distribution Transformers LT side,
- d) HT (PT/CT) & LT (CT) Consumers

3.0 STANDARDS TO WHICH METERS SHALL COMPLY

IS: 15959 (including amendment 2): Data Exchange for Electricity Meter Reading, Tariff and Load Control – Companion Specification

IS: 14697 /1999 (reaffirmed 2004) Specification for AC Static Transformer operated Watt Hour & VAR-Hour meters (class 0.5S);

IS-15707 Specification for Testing, evaluation, installation & maintenance of AC Electricity Meters-Code of Practice

The equipment meeting with the requirements of other authoritative standards, which ensure equal or better quality than the standard mentioned above, also shall be considered; in case of conflict related with communication protocol, IS: 15959 (including amendment 2) shall prevail upon. For conflict related with other parts of the specification, the order of priority shall be – i) This technical specification ii) IS: 14697 /1999 (reaffirmed 2004).

4.0 GENERAL TECHNICAL REQUIREMENTS

1	TYPE	AMR Compatible Static, 3 Ph, 3 / 4 Wire Tri-Vector Energy Meter (Export/Import type for Boundary/ring fencing/interface meters)
2	FREQUENCY	50 Hz ±5%
3	ACCURACY CLASS	0.5S
4	STD REFERENCE VOLTAGE	i) For CT/PT operated HT Meters- Suitable for operation from 110V Ph-Ph or 63.5V Ph-N ii) For Distribution Transformer , other LTCT operated Meters- Suitable for operation from 415 Volts Ph-Ph /or 240 Volts Ph-N
5	BASIC CURRENT (I _b)	-/1 Amps or -/5 Amps as per existing CT for -feeders
6	MAXIMUM CONTINUOUS CURRENT	2.0 I _b ; Starting and Short time current shall be as per IS-14697
7	POWER CONSUMPTION	i) The active and apparent power consumption, in each voltage circuit, at reference voltage, reference temperature and reference frequency shall not exceed 1.5 W and 8 VA. ii) The apparent power taken by each current circuit, at basic current, reference frequency and reference temperature shall not exceed 1.0 VA
8	POWER FACTOR	0.0 Lag -Unity- 0.0 Lead

9	DESIGN	Meter shall be designed with application specific integrated circuit (ASIC) or micro controller; shall have no moving part; electronic components shall be assembled on printed circuit board using surface mounting technology; factory calibration using high accuracy (0.05 class) software based test bench.
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5.0 CONSTRUCTIONAL REQUIREMENT/ METER COVER & SEALING ARRANGEMENT

The utilities may add their specific sealing requirements and meter COVER constructions required. Wherever poly carbonate cover is specified, it shall conform to IS 11731 (FH-1category) besides meeting the test requirement of heat deflection test as per ISO 75, glow wire test as per the IS:11000 (part 2/SEC-1) 1984 OR IEC PUB,60695-2-12, Ball pressure test as per IEC--60695-10-2 and Flammability Test as per UL 94 or as per IS 11731(Part-2) 1986.

6.0 WORKING ENVIRONMENT

As per IS 14697-1999 (reaffirmed 2004). Meter to perform satisfactorily under Non-Air Conditioned environment (within stipulations of IS)

Meter body will conform to IP51 degree of protection. For outdoor use meter shall be installed in sealed enclosure conforming to IP 55.

The meter shall be suitable designed for satisfactory operation under the hot and hazardous tropical climate conditions and shall be dust and vermin proof. All the parts and surface, which are subject to corrosion, shall either be made of such material or shall be provided with such protective finish, which provided suitable protection to them from any injurious effect of excessive humidity.

7.0 MANUFACTURING PROCESS, ASSEMBLY AND TESTING

Meters shall be manufactured using latest and 'state of the art' technology and methods prevalent in electronics industry. The meter shall be made from high accuracy and reliable surface mount technology (SMT) components. All inward flow of major components and sub assembly parts (CT, PT, RTCs/Crystal, LCDs, LEDs, power circuit electronic components etc.) shall have batch and source identification. Multilayer 'PCB' assembly with 'PTH' (Plated through Hole) using surface mounted component shall have adequate track clearance for power circuits. SMT component shall be assembled using automatic 'pick-and-place' machines, Reflow Soldering oven, for stabilized setting of the components on 'PCB'. For soldered PCBs, cleaning and washing of cards, after wave soldering process is to be carried out as a standard practice. Assembly line of the manufacturing system shall have provision for testing of sub-assembled cards. Manual placing of components and soldering to be minimized for items, which cannot be handled by automatic machine. Handling of 'PCB' with ICs/C-MOS components, to be restricted to bare minimum and precautions to prevent 'ESD' failure to be provided. Complete assembled and soldered PCB should undergo functional testing using computerized Automatic Test Equipment.

Fully assembled and finished meter shall undergo 'burn-in' test process for 12 hrs at 55 degree Celsius (Max. temperature not to exceed 60 degree Celsius) under base current (Ib) load condition.

Test points should be provided to check the performance of each block/stage of the meter circuitry. RTC shall be synchronized with NPL time at the time of manufacture. Meters testing at intermediate and final stage shall be carried out with testing instruments, duly calibrated with reference standard, with traceability of source and date.

8.0 DISPLAYS

The meter shall have 7 digits (with \pm indication), parameter identifier, backlit Liquid Crystal Display (LCD) of minimum 10 mm height, wide viewing angle. Auto display cycling push button required with persistence time of 10 Seconds. LCD shall be suitable for temperature withstand of 70 deg C; Sequence of display of various instantaneous electrical parameters shall be as desired by Purchaser at the time of order.

The data stored in the meters shall not be lost in the event of power failure. The meter shall have Non Volatile Memory (NVM), which does not need any battery backup. The NVM shall have a minimum retention period of 10 years.

9.0 PERFORMANCE UNDER INFLUENCE QUANTITIES

The meters performance under influence quantities shall be governed by IS 14697-1999 (reaffirmed 2004). The accuracy of meter shall not exceed the permissible limits of accuracy as per standard IS: 14697 (latest version).

10.0 OUTPUT DEVICE

Energy Meter shall have test output, accessible from the front, and be capable of being monitored with suitable testing equipment while in operation at site. The operation indicator must be visible from the front and test output device shall be provided in the form of LED. Resolution of the test output device shall be sufficient to enable the starting current test in less than 10 minutes.

11.0 REAL TIME INTERNAL CLOCK (RTC)

RTC shall be pre-programmed for 30 Years Day/date without any necessity for correction. The maximum drift shall not exceed +/- 300 Seconds per year.

The clock day/date setting and synchronization shall only be possible through password/Key code command from one of the following:

- a) Hand Held Unit (HHU) or Meter testing work bench and this shall need password enabling for meter;
- b) From remote server through suitable communication network or Sub-station data logger 'PC'.

12.0 QUANTITIES TO BE MEASURED & DISPLAYED

The meter shall be capable of measuring and displaying the following electrical quantities within specified accuracy limits for polyphase balanced or unbalanced loads:

- a) Instantaneous Parameters such as phase and line voltages, currents, power factors, overall kVA, kW, kVAh, power factor, frequency etc as per IS: 15959 (including amendment 2).
- b) Block Load Profile Parameters such as kVAh/kWh/kVAh (lag/lead)/Maximum Demand (MD) in kW/kVA/power factor/phase and line voltages/currents etc as per IS: 15959 (including amendment 2).
- c) Daily Load Profile Parameters such as cumulative energy kWh (import/export)/cumulative kVAh (while kW-import/export)/cumulative energy kVAh (quadrant-1/2/3/4)/reactive energy high ($V > 103\%$)/low ($V < 97\%$), etc as per IS: 15959 (including amendment 2).
- d) Billing Profile Parameters such as cumulative energy kWh/ cumulative energy kWh, Cumulative Energy kVAh – Lag/Lead/ cumulative energy kVAh/ cumulative energy kVAh/MD – kW/kVA, etc as per IS: 15959 (including amendment 2).

In addition to above the meter shall also record the Name plate details, programmable parameters (readable as profile), occurrence and restoration of tamper events along with the parameters.

Detail of category wise parameters requirement suitable for specific location such as feeder/DT metering, interface points/boundary points is given in following table (based on IS: 15959 (including amendment 2)):

Category	Parameter group	Meter Category
Substation Feeder/ Distribution Transformer/ HT (PT/CT) & LT (CT) Consumer Meters	Instantaneous parameters	C1
	Block Load Profile parameters	
	Billing Profile parameters	
	Daily Load Profile parameters	
Boundary/Ring fencing/Interface Meters (i.e. for Import/Export Points)	Instantaneous parameters	B
	Block Load Profile parameters	
	Billing Profile parameters	
	Daily Load Profile parameters	
Substation Feeder/ Distribution Transformer/ Boundary/Ring fencing/ Interface/ HT (PT/CT) & LT (CT) Consumer Meters	Name Plate details	
	Programmable Parameters	
	Event Conditions	
Logging parameters for each of the event condition – shall be selected	Capture parameters for event as applicable (Event Log Profile)	

13.0 DEMAND INTEGRATION PERIOD

The maximum demand integration period may be set at 15 minute or 30 minute by purchaser as per requirement.

14.0 MD RESET

It should be possible to reset MD by the following options:

- a) Communication driven reset
- b) Local push button
- c) Auto reset at 24:00 hrs at the end of each billing cycle

15.0 MARKING OF METERS

The marking of meters shall be in accordance with IS: 14697 /1999 (reaffirmed 2004). The meter shall also store name plate details as per IS: 15959 (including amendment 2). These shall be readable as a profile as and when required.

16.0 COMMUNICATION CAPABILITY

The meter shall be provided with two ports for communication of the measured/collected data as per IS: 15959 (including amendment 2), i.e. a hardware port compatible with RS 232 or RS 485 specifications which shall be used for remote access through suitable Modem (GPRS/GSM/EDGE/CDMA/PSTN/LPR) and an Optical port complying with hardware specifications detailed in IEC-62056-21. This shall be used for local data downloading through a DLMS compliant HHU.

The RS 485 port shall be used at Substations suitable for multi-drop connections of the meter for exporting data to sub-station data logger/DCU/Computer and the remote end server. The RS 232 port shall be used at boundary points meters and Distribution Transformer meters capable to transfer and export data to the remote end server through suitable communication mediums (GPRS/GSM/EDGE/ CDMA/ PSTN/LPR). Both ports shall support the default and minimum baud rate of 9600 bps. The PIN configuration for RS 232 port and RS 485 port shall be as under:

RS 232 Port				
RJ11 (4 PIN 4 connection)	RJ11 (6 PIN 4 connection)	RJ12 (6 PIN 6 connection)	DB9 (Male)	DB9 (Female)
1GND,2Rx, 3TX,4Vcc	2GND,3Rx, 4Tx,5Vcc	1NC,2GND,3Rx, 4Tx,5Vcc,6NC	1DCD,2Rx,3Tx,4DTR,5GND, 6DSR,7RTS,8CTS,9RI	1DCD,2Rx,3Tx,4DTR,5GND, 6DSR,7RTS,8CTS,9RI
VCC voltage should be 6 to 12 V and 15mA				
RS 485 Port				
RJ11 (4 PIN 2 connection)	RJ11 (4 PIN 4 connection)	RJ11 (6 PIN 4 connection)	RJ 12 (6 PIN 3 connection)	Terminal type
1A, 2B,3 Nc, 4Nc	1A, 2B, 3GND, 4Vcc	1NC, 2A, 3B, 4GND, 5Vcc, 6NC	1NC, 2A, 3B, 4GND, 5NC, 6NC	1A, 2B, 3GND

17.0 HAND HELD UNIT (HHU)

To enable local reading of meters data a DLMS compliant HHU shall be used. The HHU shall be as per specification given in the IS: 15959 (including amendment 2). It shall be compatible to the DLMS compliant energy meters that are to be procured/supplied on the basis of this specification.

18.0 TAMPER & FRAUD MONITORING FEATURES

The meter shall work satisfactorily under presence of various influencing conditions like External Magnetic Field, Electromagnetic Field, Radio Frequency Interference, harmonic Distortion, Voltage/Frequency Fluctuations, and electromagnetic High Frequency Fields etc. The meter shall be immune to abnormal voltage/frequency generating devices and shall record the occurrence and restoration of such tamper events along with parameters such as current, voltages, kWh, power factor, event code, date & time etc.

Tamper details shall be stored in internal memory for retrieval by authorized personnel through either of the following:

- i) HHU.
- ii) Remote access through suitable communication network.

Minimum 200 numbers of events (occurrences & restoration with date & time) should be available in the meter memory.

19.0 TYPE TESTS

The meter offered should have successfully passed all type tests described in the IS 14697 and the meter Data Transfer and Communication capability as per enclosed guidelines document. Type test certificate shall be submitted along with the offer and the same shall not be more than 36 months old at the time of bid submission. Make & type of major components used in the type-tested meter shall be indicated in the QAP.

Further Purchaser shall reserve the right to pick up energy meters at random from the lots offered and get the meter tested at third party lab i.e. CPRI / agencies listed at Appendix-C of Latest – standardization of AC static electrical energy meters – CBIP publication NO.-304/ NPL / COAL/ ERTL / ERDA at the sole discretion of the Purchaser. The supplier has no right to contest the test results of the third party lab or for additional test and has to replace/take corrective action at the cost of the supplier.

20.0 ACCEPTANCE & ROUTINE TESTS

Criteria for selection for such tests and performance requirements shall be as per IS 14697-1999 (reaffirmed 2004)

Additional acceptance shall include Surge withstand (SWC) for 6 kV_p as per IEC 62052-11, Lightning impulse test and HF disturbance test as per IS 14697. One sample meter per order from one of the offered lot shall be subjected to these specific tests. Meters subjected to these tests shall not be used after tests.

Accuracy tests shall be performed at the beginning and at the end of the acceptance tests specified.

21.0 FIXING & CONNECTION ARRANGEMENT

Manufacturer shall ensure following technical points:

- i) Meter shall be suitable for mounting on Simplex type vertical panel with front door; CAT-M4 disconnecting type TBs to be used for Current circuit; Panel wiring to be properly dressed and harnessed; External cables to enter panel from bottom gland plate using double compression glands.
- ii) Meter installation & Inter-connection from existing CT/PT connections to energy meters in the panel shall be in the scope of contractor/bidder. The external cabling from existing CT/PT to Energy Meter panel shall be in the scope of purchaser.
- iii) Energy Meter terminals block shall be adequately sized with regard to maximum conductor dimension, commensurate with current rating of Energy Meter.

Application Guide for users of this specification

1. The specification does not contain constructional details and methods of sealing of the meter COVER and the terminal sizes required for the Purchasers incomer cables. These may be added suitably as per the requirements of individual users. Quantities of meters required with / without meter COVER needs to be specified in the Bill of Quantities in the NIT specifications.