Bidding Documents
For

Volume – I, II & III

Tender No: T14P070076
VOLUME-I

CONDITIONS OF CONTRACT

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SECTION-I

INVITATION FOR BID (IFB)

Bids are invited for Design, Engineering, Manufacture, Transportation to Site, Insurance, Storage, Erection, Testing & Commissioning of 220/66/33kV GIS Substation having 220kV, 66kV & 33kV GIS equipments, 160MVA & 100MVA power transformers and other substation equipments with complete civil works & automation at R.K.Puram, Delhi (India) on turnkey basis.

(International Competitive Bidding)

Date of issuance of IFB : …. (as per web notification and relevant corrigendum).......

Specification No. : DTL/DGM-CONTRACT/GIS/2015/GT-01

1.0 Delhi Transco Limited invites Two Part Bids from eligible bidders for 220/66/33kV GIS Substation having 220kV, 66kV & 33kVGIS equipments, 160MVA & 100MVA power transformers and other substation equipments at R.K.Puram, New Delhi (India) on turnkey basis. The scope of work covered under this package shall include complete Project Management, Design, Engineering, Type Testing, Manufacture, Transportation to Site, Insurance, Storage, Erection, Testing & Commissioning of 220/66/33kV GIS Substation at R.K.Puram, New Delhi (India) on single source responsibility.

The supply of major equipment includes:

i. 160MVA, 220/66kV/11kV, Power Transformers including NIFPES, accessories and first filling of oil.
ii. 100MVA, 220/33kV/11kV, Power Transformers including NIFPES, accessories and first filling of oil.
iii. 220kV, 66kV and 33kV SF6 gas insulated Transformer & Line feeder bay modules comprising of:
   a. SF6 gas insulated Circuit Breaker
   b. Current Transformer
   c. Bus-Bar disconnectors with common grounding switch, safety grounding switches etc.
   d. Surge Arrestor
   e. Voltage Transformers etc.
v. 400KVA, 11/0.433kV L.T. Transformer.
vi. Tertiary Loading Equipments.
viii. Batteries and Battery Chargers.
ix. Fire Protection System.
x. Illumination System.
xi. 250KVA, DG Set.
xii. Power and Control Cables.
xiii. Special Equipments for Testing and Maintenance.
xiv. 220kV SF6 duct, SF6 to Oil interface for making connection between 220kV GIS and power transformer, 66kV XLPE cable/SF6 bus duct for interconnection between 66kV GIS and transformer and 33kV XLPE cable/Bus duct for interconnection between 33kV GIS and transformer.
xv. Support Structures.
xvi. Mandatory Spares for these equipments etc.
xvii. Any equipment required for proper commissioning and functioning of the sub station.
xviii. Associated civil works such as foundation of main and auxiliary structures, soil investigation, construction of cable trenches, roads, storm water drainage, Boundary wall, switchyard fencing alongwith gates, 220kV GIS-cum-Control Room building well furnished (with furniture), 66kV GIS building and 33kV GIS building, support structure for outdoor equipments, gantry structure, DG Set, Transformer oil soak pit & sump pit, Transformer Fire-wall etc.

1.1 The 220/66/33kV GIS and other equipment shall be complete with all fittings and components necessary for its effective working and efficient performance and satisfactory maintenance under the various operating conditions specified. All such parts shall be deemed to be included within
the scope of supply whether specifically included or not in this specification in the tender schedule. The successful tenderer shall not be eligible for extra charges for such accessories.

1.2 A complete set of Bidding Documents may be purchased by any interested eligible Bidder or Bidder’s designated representative, on the submission of a written application to the address below and upon payment (Non-refundable) of Rs.10,000/- towards the cost of the documents, in the form of a Demand Draft payable to Delhi Transco Ltd. on all working days up to .... (as per web notification and relevant corrigendum) .... between 11.00 hours to 16.00 hours.

1.3 The Qualifying Requirements are given in the Bidding Documents of the subject package. The complete Bidding Documents including tender drawings are also available at our website http://www.delhitransco.gov.in. Interested bidders can download the Bidding Documents and commence preparation of bids to gain time. However, they will be required to purchase the Bidding Documents from Delhi Transco Ltd., (for submission of the bid), which will be duly authenticated by the executive issuing the documents. In case of any discrepancy between the documents downloaded by the prospective bidder and the Bidding Documents (hard copy) issued by Delhi Transco Ltd. official, the latter shall prevail.

1.4 All bids must be accompanied by a Bid Security of Indian Rs 2,09,67,396/- only (Rs. Two Crore Nine Lacs Sixty Seven Thousand Three Hundred and Ninety Six Only).

1.5 No margin of preference will be granted to plant & equipment manufactured in employers country.

1.6 A pre-bid conference will be held at the office of Delhi Transco Ltd., New Delhi, India on .... (as per web notification and relevant corrigendum) .... to clarify the Bidders the exact scope of the work, the basic data available and other issues in accordance with relevant clause of the Bidding Documents.

1.7 Bids must be delivered to Delhi Transco Ltd. at the address below, not later than 11.00 hours (IST) on .... (as per web notification and relevant corrigendum) .... and the Techno-Commercial bids (Part-I) shall be opened on .... (as per web notification and relevant corrigendum) .... at 11.30 hours (IST) in the presence of Bidder’s representatives who choose to attend, at the address below:

**DGM (T) Contract,**
**Delhi Transco Limited,**
**Room No.-105, 1st Floor Pre-Fabricated Building,**
**Rajghat Power House,**
**New Delhi-110002 (India),**

The Techno-Commercial bids (Part-I) so opened shall be evaluated & the Price bids (Part-II) of techno- commercially successful bidders shall only be opened thereafter. The date of opening of Part-II of the bids i.e. Price bids shall be communicated to all techno- commercially successful bidders.

1.8 Delhi Transco Ltd. shall not be responsible for any postal delays in respect of request for issuance of Bidding Documents and / or dispatch of Bidding Documents and / or submission of bids.

1.9 Delhi Transco Ltd. 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.

2.0 All correspondences with regard to the above shall be made to the address below by post/ in person:

**DGM (T) Contract,**
**Delhi Transco Limited,**
**Room No.-105, 1st Floor Pre-Fabricated Building,**
**Rajghat Power House,**
**New Delhi-110002 (India),**
**Phone : 23275290**
**Fax No. 011-23275289,**
**Email : dtldgmgcontract@gmail.com**

For more details, please visit our website http://www.delhitransco.gov.in

**NOTE:** Date of Bid submission and Bid opening shall be as per the web notification and subsequent corrigendum, if any.
SECTION – II

Instructions to Bidders (ITB)

A. Introduction

1.0 Eligible Bidders

1.1 This Invitation for Bids, issued by the Employer, is open to all suppliers. Name of the Employer: DELHI TRANSCO LIMITED

1.2 Bidders should not be associated, or have been associated in the past, directly or indirectly, with a firm or any of its affiliates that has been engaged by the Employer, to provide consulting services for the preparation of the design, specifications, and other documents to be used for the procurement of the facilities, to be purchased under this Invitation for Bids.

1.3 Government-owned enterprises in the India may also participate on their own or as members of a joint venture or a consortium, if they are legally and financially autonomous, operate under commercial law, and are not dependent agencies of the Delhi Transco Limited.

1.4 Bidders shall not be under a declaration of ineligibility for corrupt and fraudulent practices in accordance with sub-clause 34.1.

2.0 Eligible Plant, Equipment, and Services

2.1 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 Conditions of Contract.

3.0 Cost of Bidding

3.1 The Bidder shall bear all costs associated with the preparation and submission of its bid, and the Employer will in no case be responsible or liable for these costs, regardless of the conduct or outcome of the bidding process.

B. The Bidding Documents

4.0 Content of Bidding Documents

4.1 The facilities required, bidding procedures, contract terms and technical requirements are prescribed in the bidding documents. The bidding documents include:

Volume - I:  Conditions of Contract

Section I     Invitation for Bids (IFB)
Section II    Instructions to Bidder (ITB)
Section III   Conditions of Contract (CC)
Section IV    Forms and Procedures (F&P)

Volume -II:  Technical Specification

Volume -III:  Bid Form, Attachments, Price Schedules & GTP

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

5.0 Clarification of Bidding Documents

5.1 A prospective Bidder requiring any clarification of the bidding documents may notify the Employer in writing or by electronic media (hereinafter, the term cable is deemed to include Electronic Data Interchange (EDI), or telefax) at the Employer's mailing address indicated below. Similarly, if a Bidder feels that any important provision in the documents, such as those listed in ITB Sub Clause 21, will be unacceptable, such an issue should be raised at this stage. The Employer will respond in writing to any request for clarification or modification of the bidding documents that it receives no later than twenty eight (28) days prior to the deadline for submission of bids prescribed by the Employer. Written copies of the 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.

Address of Employer, telephone, facsimile numbers & E-mail address:

DGM (T) Contract,  
Delhi Transco Limited,  
Room No.-105, 1st Floor Pre-Fabricated Building,  
Rajghat Power House,  
New Delhi-110002 (India),  
Phone : 23275290  
Fax No. 011-23275289,  
Email : dtldgmcontract@gmail.com

5.2 The Bidder is advised to visit and examine the site, where the facilities are to be installed and its surroundings and obtain for itself on its own responsibility, all information that may be necessary, for preparing the bid and entering into a contract for supply and installation of the facilities. The costs of visiting the site shall be at the Bidder's own expense.

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

5.4 The bidder is invited to attend pre-bid conference which will take place at the following address:

Conference Room, 4th Floor,  
Shakti Sadan, Kotla Road  
New Delhi-110002

The purpose of the conference will be to clarify any issues regarding the Bidding Documents in general and the Technical Specifications in particular. The bidder is required to submit questions in writing or by cable to reach the Employer at the address indicated above, two days before the
pre-bid conference i.e. .... (as per web notification and relevant corrigendum) ......

Record notes of conference including the text of the questions raised and responses given will be transmitted without delay to all prospective bidders who have purchased the Bidding Documents. Any modifications of the Bidding Documents which may become necessary as a result of the pre-bid conference shall be made by the Employer exclusively through an amendment pursuant to ITB Clause 6.0 and not through the record notes of the pre-bid conference.

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

6.0 Amendment of Bidding Documents

6.1 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, amend the bidding documents.

6.2 The amendment will be notified in writing or by electronic media to all prospective Bidders that have purchased the bidding documents and will be binding on them. Bidders are required, to immediately acknowledge receipt of any such amendment, and it will be assumed that the information contained therein will have been taken into account by the Bidder in its bid.

6.3 In order to afford prospective Bidders, reasonable time in which to take the amendment into account, in preparing their bid, the Employer may, at its discretion, extend the deadline for the submission of bids, in which case, the Employer will notify all the bidders in writing of the extended deadline.

C. Preparation of Bids

7.0 Language of Bid

7.1 The bid prepared by the Bidder and all correspondence and documents related to the bid exchanged by the Bidder and the Employer shall be written in the English language, provided that any printed literature furnished by the Bidder may be written in another language, as long as such literature is accompanied by a translation of its pertinent passages in the English language, in which case, for purposes of interpretation of the bid, the translation shall govern.

8.0 Documents Comprising the Bid

8.1 The bid submitted by the Bidder shall comprise the following documents:

(a) Bid Form duly completed and signed by the Bidder, together with all Attachments identified in ITB Sub-Clause 8.3 below.

(b) Price Schedules duly completed by the Bidder.

(c) Tender document issued by DTL, duly signed and stamped on each page, by the bidder to confirm that he agrees to terms and conditions of the bid. However, where ever specific deviation has been taken the same must be listed only in attachment 6 and 6A.

8.2 Bidders shall note that, they are entitled to submit an alternative bid. In such cases, Bidders shall
submit full details and justifications, etc., in Attachment 7 to the bid as indicated in ITB Sub-Clause 8.3 (g).

8.3 Each Bidder shall submit with its bid the following attachments:

(a) **Attachment 1 : Bid Security**

A bid security furnished in accordance with ITB Clause 12.

(b) **Attachment 2 : Power of Attorney**

A power of attorney, duly authorized by a Notary Public, indicating that the person(s) signing the bid has the authority to sign the bid and thus that the bid is binding upon the Bidder during the full period of its validity in accordance with ITB Clause 13.

(c) **Attachment 3 : Bidder's Eligibility and Qualifications**

In the absence of prequalification, documentary evidence that the Bidder is eligible to bid in accordance with ITB Clause 1 and is qualified to perform the contract 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 from an eligible source country as defined in ITB Sub-Clause 1.1.

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 financial criteria specified in the Qualifying Requirement and ITB.

A firm can be a partner in only one joint venture or consortium; bids submitted by joint ventures or consortia including the same firm as partner will be rejected.

Qualification requirements for bidders, including members of joint ventures, subcontractors or vendors are enclosed as Annexure-A to the ITB.

(d) **Attachment 4 & 4A: Eligibility and Conformity of the Facilities**

Documentary evidence established in accordance with ITB Clause 2 that the facilities offered by the Bidder in its bid or in any alternative bid (if permitted) 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.

The documentary evidence of the conformity of the facilities to the bidding documents may be in the form of literature, drawings and data, and shall furnish:
(i) a detailed description of the essential technical and performance characteristics of the facilities;

(ii) a list giving full particulars, including available sources, of all spare parts, special tools, etc., necessary for the proper and continuing functioning of the facilities for 15 years, following completion of facilities in accordance with provisions of contract; and

(iii) a commentary on the Employer's Technical Specifications and adequate evidence demonstrating the substantial responsiveness of the facilities to those specifications. Bidders shall note that standards for workmanship, materials and equipment designated by the Employer in the bidding documents are intended to be descriptive (establishing standards of quality and performance) only and not restrictive. The Bidder may substitute alternative standards, brand names and/or catalog numbers in its bid, provided that it demonstrates to the Employer's satisfaction, that the substitutions are substantially equivalent or superior to the standards designated in the Technical Specifications.

(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, 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. 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 Sub-Clause 1.1, and that any plant, equipment or services to be provided by the Subcontractor comply with the requirements of ITB Clause 2.

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, Appendix 5 to the form of Contract Agreement shall be completed, listing the approved Subcontractors for each item.

Qualification requirements for bidders, including members of joint ventures, subcontractors or vendors are enclosed as Annexure-A to the ITB.

(f) Attachment 6 and 6A: Deviations

In order to facilitate evaluation of bids, deviations, if any, from the Terms & Conditions of Technical/ Commercial Specifications shall be listed in Attachment 6 and 6A for Part-I, Techno commercial Bid. The price of withdrawal of these deviations, if any, shall be included in the Part-II Price Bid in Attachment 6 & 6A. However, the attention of the Bidders is drawn to the provisions of ITB Sub-Clause 21.4 regarding the rejection of bids that are not substantially responsive to the requirements of the bidding documents.

(g) Attachment 7: Alternative Bids

(i) Bid with alternative time schedule is not acceptable.
(ii) Except as provided under subparagraph (iii) below, bidders wishing to offer technical alternatives to the requirements of the bidding documents must first price the Employer's design of the facilities as described in the bidding documents, and shall further provide all information necessary for a complete evaluation of the alternatives by the Employer, including drawings, design calculations, technical specifications, break-up of prices, proposed installation methodology and other relevant details. Only the technical alternatives, if any, of the lowest evaluated bidder conforming to the basic technical requirements shall be considered by the Employer. Alternative bid is acceptable.

(iii) When bidders are permitted in the ITB to submit alternative technical solutions for specified parts of the facilities, Technical Specifications and Drawings. Technical alternatives that comply with the performance and technical criteria specified for the facilities shall be considered by the Employer on their own merits, pursuant to ITB Sub-Clause 23.2. Alternative bid is acceptable.

(h) Attachment 8: Deleted (Not applicable)

(i) Attachment 9: Work Completion Schedule.

(j) Attachment 10: Guarantee Declaration.

(k) Attachment 11: Information regarding ex-employees of Employer in Bidder’s firm.

(l) Attachment 12: Unequivocal consent of the proposed Assignee for the purpose of executing the ‘Second Contract’ and/or ‘Third Contract’ as an independent Contractor (Applicable to Foreign Bidders).

(m) Attachment 13: Capacity and Experience of Proposed Assignee (Applicable to Foreign Bidders).

9.0 Bid Form and Price Schedules

9.1 The Bidder shall complete the Bid Form and the appropriate Price Schedules furnished in the bidding documents as indicated therein and in the Subsection Bid Form and Price Schedules of the bidding documents, following the requirements of ITB Clauses 10 and 11.

10.0 Bid Prices

10.1 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 including supply of mandatory spares (if any). 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 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.
10.2 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 and 6A of its bid. The Bidder shall also provide the additional price, if any, for withdrawal of the deviations.

10.3 Bidders shall give a break-up 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 used for each of the following elements. The total amount from each Schedule 1 to 6 shall be summarized in a Grand Summary (Schedule 7) giving the total bid price(s) to be entered in the Bid Form.

Schedule 1  Plant and Equipment (including Mandatory Spares Parts) to be supplied from Abroad, including Type Test to be conducted in Abroad.

Schedule 2  Plant and Equipment (including Mandatory Spares Parts) to be supplied from India, including Type Test to be conducted in India.

Schedule 3  Local Transportation, Insurance and other Incidental Services (including port clearance etc.).

Schedule 4  Installation Charges.

Schedule 5a  Break-up of Type Test Charges for Type Tests to be conducted abroad.

Schedule 5b  Break-up of Type Test Charges for Type Tests to be conducted in India.

Schedule 6a  Training charges for training to be imparted Abroad (Shall be inclusive).

Schedule 6b  Training charges for training to be imparted in India (Shall be inclusive).

Schedule 7  Grand Summary of the Quoted Bid Price.


Schedule 9  Minimum value of bought-out items for the purpose of sales tax declaration forms.

Schedule 10  Details of recommended spare parts & recommended test equipment (in line with Technical specifications).

Bidder shall note that the plant and equipment included in schedule No. 1 and 2 above exclude materials used for civil, building and other construction works. All such materials shall be included and priced under schedule No. 4 – Installation services.

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

(a) Plant and equipment including mandatory spares to be supplied from abroad (Schedule 1) and type test charges for type test to be conducted abroad shall be quoted on a CIF port-of-entry basis. In addition, the FOB price shall also be indicated.

(b) Plant and equipment including mandatory spares manufactured or fabricated within the Employer's country (Schedule 2) including type test charges for type test to be conducted in India shall be quoted on an EXW (ex factory, ex works, ex warehouse or off-the-shelf, as applicable) basis, and shall be inclusive of all costs as well as duties and taxes paid or payable on components and raw materials incorporated or to be incorporated in the facilities. Sales Tax, VAT, local Tax and other levies in respect of direct transaction between the Employer and the Contractor and 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-vender's works to the Employer's site (sale-in-transit) shall not be included in the EXW price but shall be quoted separately in Schedule 8.
(c) Local transportation, insurance, port handling and custom clearance and port charges and other local costs incidental to delivery of the Plant and Equipment including mandatory spares shall be quoted separately (Schedule 3). The Employer shall be responsible and be liable only for payment of custom duty on CIF component of the Plant and equipment including mandatory spares to be supplied from abroad. However, the Employer, as an importer, shall furnish promptly necessary clarifications and documents as may be required to be furnished by the importer for the purpose of customs clearance.

(d) Installation/Erection Charges shall be quoted separately (Schedule 4) 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. The expatriate supervision charges shall be included in the charges for installation services.

(e) The break-up of Type test charges shall be furnished separately in Schedule 5a for the tests to be conducted abroad and in schedule 5b for the tests to be conducted in India. Similarly break-up of Training Charges shall be furnished separately in Schedule 6a for the training to be imparted abroad and in Schedule 6b for the training to be imparted in India.

(f) 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 the portion of supply of the materials in Employer's country, as applicable in their quoted bid 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 Deducted at Source (TDS) Certificate to the bidder.

(g) Owner would not bear any liability on account of Service Tax. In case the service tax on transactions between owner and the contractor is covered under the Reverse Charge provisions of service tax law and the full service tax (i.e. including both for service provider and service receiver) is to be included in the quoted prices/bid, the necessary deductions relatable to the service tax liability of Receiver of services to be deposited with Service Tax Deptt.

(h) Recommended Spare parts and Recommended Test equipment shall be quoted separately (Schedule 10) as specified in either sub-paragraph (a) or (b) above in accordance with the origin of the spare parts and test equipment.

10.4.1 **Deemed Export Benefits**
There will be no Deemed Export Benefits.

10.5 The terms EXW, CIF, CIP, etc., shall be governed by the rules prescribed in the current edition of Incoterms, published by the International Chamber of Commerce, 38 Cours Albert 1er, 75008 Paris, France.

10.6 The prices shall be as follows:

**Fixed Price:** Prices quoted by the bidder shall be fixed during the Bidder's Performance of the Contract and not subject to variation on any account except for Power Transformer and Civil Works. A bid submitted with an adjustable price quotation will be treated as non-responsive and rejected, except for Power Transformer and Civil Works.

**Variable Prices:** 160MVA and 100MVA Power Transformer shall be governed by latest IEEMA (Indian Electrical & Electronic Manufacturers Association) formula as per Appendix 2 of Form of Contract Agreement, Section Forms & Procedures, Volume-I.

The cost of Civil Works as per approved indices of CPWD where completion period is less than eighteen months due to increase/decrease in price of cement and steel reinforcement bars after receipt of tender shall be calculated as per Appendix 2 of Form of Contract Agreement, Section Forms & Procedures, Volume-I.
10.7 It is obligatory that the Bidders shall avail centralized shipping arrangements through the 'Chartering Wing viz., 'TRANSCHART' of Ministry of Surface Transport, Govt. of India or otherwise the Bidders shall obtain on their own 'No objection Certificate' from Ministry of Surface Transport, Govt. of India well in advance. However, DTL shall not be responsible for any delay whatsoever on this account.

11.0 Bid Currencies

11.1 Prices shall be quoted in Indian currency i.e. INR only.

12.0 Bid Security

12.1 The bidder shall furnish, as a part of its bid, a bid security in the amount and currency as stipulated below

   Amount of Bid Security: Indian Rs 2,09,67,396/- only (Rs. Two Crore Nine Lacs Sixty Seven Thousand Three Hundred and Ninety Six Only). The bid security must be submitted in the form provided in the bidding document.

12.2 The bid security shall, at the Bidder's option, be in the form of a crossed bank draft/pay order/banks certified cheque /irrevocable letter of credit or a bank guarantee issued either:

   (a) by a reputed bank located in the country of Employer and acceptable to the Employer, or
   (b) by a foreign bank confirmed by either its correspondence bank located in the country of Employer which should be reputed and acceptable to the Employer, or;
   (c) By a Public Sector Bank in the country of Employer.

   The format of the bank guarantee shall be in accordance with the form of bid security included in the bidding documents. Bid security shall remain valid for a period of forty-five (45) days beyond the original bid validity period, and beyond any extension subsequently requested under ITB Sub-Clause 13.2.

12.3 Any bid not accompanied by an acceptable bid security shall be rejected by the Employer as being non-responsive. The bid security of a joint venture must be in the name of all the partners in the joint venture submitting the bid.

12.4 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.

12.5 The bid security of the successful bidder will be returned when the bidder has signed the Contract Agreement, pursuant to ITB Clause 31, and has furnished the required performance security, pursuant to ITB Clause 32.

12.6 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; or
(c) If the bidder does not accept the correction of its Bid Price pursuant to ITB Sub-Clause 21.2; or

(d) If, as per the Qualifying Requirements the Bidder has 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 executants(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

(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 31, or
   (ii) To furnish the required performance security, in accordance with ITB Clause 32.”

12.7 In case the Bid is submitted by a Joint Venture, the Bid Security shall be in the name of the Joint Venture covering all partners of the Joint Venture and not in the name of the Lead Partner or any partner(s) of the Joint Venture alone.

13.0 Period of Validity of Bid

13.1 Bids shall remain valid for 180 days after the date of opening of bids (excluding the date of Bid Opening) pursuant to ITB Sub-Clause 16.1. A bid valid for a shorter period shall be rejected by the Employer as being non responsive.

13.2 In exceptional circumstances, the Employer may solicit the Bidders’ consent to an extension of the bid validity period. The request and responses thereto shall be made in writing or by cable. 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 nor permitted to modify its bid.

14.0 Format and Signing of Bid

14.1 The Bidder shall prepare an original and two copies/sets of the bid, clearly marking each one as "Original Bid," "Copy NO. 1", "Copy NO. 2", etc as appropriate. In the event of any discrepancy between them, the original shall govern.

14.2 The original and all copies of the bid, each consisting of the documents listed in ITB Sub-Clause 8.1, 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 8.3. All pages of the bid, except for un-amended printed literature, shall be initialed by the person or persons signing the bid.

14.3 Any interlineations, erasures or overwriting shall only be valid if they are initialed by the signatory (ies) to the bid.

D. Submission of Bids

15.0 Sealing and Marking of Bids

15.1 The Bidder shall submit the sealed bids in Two Part i.e. PART-I (TECHNO-COMMERCIAL BID)” and PART-II (PRICE BID) each in separate envelope. The Bidder shall seal the original and each
copy of the bid(s) in separate envelopes duly marking the envelopes as "ORIGINAL BID" and "COPY NO. [Number]". Bid security in the amount stipulated in the ITB shall be submitted in a separate sealed envelope having marking as “Bid Security”. The separate envelopes containing original & copies of PART-I (TECHNO-COMMERCIAL BID)”, “PART-II (PRICE BID) and Bid Security shall then be sealed in an outer envelope.

15.2 The inner and outer envelopes shall

(a) be addressed to the Employer at the address given in the ITB,

In Person or by post:

DGM (T) Contract,
Delhi Transco Limited,
Room No.-105, 1ST Floor Pre-Fabricated Building,
Rajghat Power House,
New Delhi-110002 (India),
Phone : 23275290
Fax No. 011-23275289,
Email : dtldgmcontract@gmail.com

and

(b) bear the contract name indicated in the ITB, the Invitation for Bids title and number indicated in the ITB., and the statement "DO NOT OPEN BEFORE [date],"{except on the envelope containing Part-II(Price bid)} to be completed with the time and date specified in the ITB, pursuant to ITB Sub-Clause 16.1.

BID TITLE:
Specification No.: DTL/DGM-CONTRACT/GIS/2015/GT-01

Do not open before 11.30 Hrs on… (as per web notification and relevant corrigendum)…..

Bid guarantees in original shall be submitted in a separate envelope on which the contents shall be super scribed.

The Bid Forms and Price Schedules shall be enclosed in separate envelope on which the contents shall be super scribed.

15.3 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."

15.4 If the outer envelope is not sealed and marked as required by ITB Sub-Clause 15.2 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.

15.5 Bid should be submitted in Bound Form and each page of bid should be signed.

16.0 Deadline for Submission of Bids
16.1 Bids must be received by the Employer at the address specified under ITB Sub Clause 15.2 no later than the time and date stated in the ITB. 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. Dead line for submission of Bid and its modification and withdrawal, if any:

Date: …. (as per web notification and relevant corrigendum)…. Time: Upto 11.00 Hrs (IST).

16.2 The Employer may, at its discretion, extend this deadline for submission of bids by amending the bidding documents in accordance with ITB Sub-Clause 6.3, in which case all rights and obligations of Employer and Bidders will thereafter be subject to the deadline as extended.

17.0 Late Bids

17.1 Any bid received by the Employer after the bid submission deadline prescribed by the Employer, pursuant to ITB Clause 16, will be rejected and returned unopened to the Bidder.

18.0 Modification and Withdrawal of Bids

18.1 The Bidder may modify or withdraw its bid after submission, provided that written notice of the modification or withdrawal is received by the Employer prior to the deadline prescribed for bid submission.

18.2 The Bidder's modifications shall be prepared, sealed, marked and dispatched as follows:

(a) The Bidders shall provide an one original and two copies of any modifications to its bid in two parts as provided in ITB clause 15, clearly identified as such, in two inner envelopes duly marked "Bid Modifications-Original" and "Bid Modifications-Copies." The inner envelopes shall be sealed in an outer envelope, which shall be duly marked "Bid Modifications." One (1) original and two (2) copies.

(b) Other provisions concerning the marking and dispatch of bid modifications shall be in accordance with ITB Sub-Clauses 15.2, 15.3 and 15.4.

18.3 A Bidder wishing to withdraw its bid shall notify the Employer in writing prior to the deadline prescribed for bid submission. The notice of withdrawal shall

(a) be addressed to the Employer at the address named in the ITB, 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.

Deadline for submission of Bid, its modification and withdrawal, if any :

Date: …. (as per web notification and relevant corrigendum)....... Time upto 11:00hrs

18.4 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 13 Withdrawal of a bid during this interval may result in the Bidder's forfeiture of its bid security, pursuant to ITB Sub-Clause 12.6.
E. **Bid Opening and Evaluation**

19.0 **Opening of Bids by Employer**

The bids submitted by the bidders shall be opened in two phases. In the first phase, the techno commercial bid (Part-I) shall be opened and the bids of the bidders found techno commercially successful after detailed evaluation shall be opened in the second phase.

19.1 The Employer will open the bids including withdrawals and modifications made pursuant to ITB Cl. 19, in the presence of bidder’s designated representative who chooses to attend the opening at the time, on the date and at the place specified in the ITB. Bidders’ representatives shall sign a register as proof of their attendance.

“In the event of the specified date of bid opening being declared a holiday for the Employer, the bids shall be opened at the appointed time and location on the next working day.”

Bid Opening (Techno-commercial part-I):

DGM (T) Contract,
Delhi Transco Limited,
Room No.-105, 1ST Floor Pre-Fabricated Building,
Rajghat Power House,
New Delhi-110002 (India),
Phone : 23275290
Fax No. 011-23275289,
Email : dtldgmcontract@gmail.com

Date: …. (as per web notification and relevant corrigendum).....and Time: at 11.30 Hrs (IST).

19.2 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 18 shall not be opened.

19.3 The bidders’ names, deviations, bid modifications and withdrawals, the presence (or absence) of bid security, 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 17. At the time of opening of price bids the bid prices, including any alternative bid prices or deviations, any discounts, and any such other details as the employer may consider appropriate, will also be announced by the employer.

19.4 The Employer will prepare minutes of the bid opening, including the information disclosed to those present in accordance with ITB Sub-Clause 19.3.

19.5 Bids not opened and read out at the time of techno commercial bid opening in part – I shall not be considered for further evaluation, irrespective of the circumstances.

20.0 **Clarification of Bids**

20.1 During evaluation of bid i.e Part-I and Part-II, the Employer may, at its discretion, ask the Bidder(s) for a clarification of its bid. 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.

21.0 **Preliminary Examination of Bids**

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

21.2 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, or between subtotals and the total price, the unit or subtotal price shall prevail, and the total price shall be corrected. If there is a discrepancy between words and figures, the amount in words will prevail. If the Bidder does not accept the correction of errors, its bid will be rejected and the bid security will be forfeited in accordance with ITB Sub-Clause 12.6 (c).”

21.3 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 and 6A 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 Clauses 23 and 24.

21.4 Prior to the detailed evaluation of PART-I (TECHNO-COMMERCIAL BID), the Employer will determine whether each bid is of acceptable quality, is generally complete and is substantially responsive to the bidding documents. 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. The PART-II (PRICE BID) shall be opened only of those bidders whose TECHNO-COMMERCIAL BID bids are of acceptable quality.

21.4.1 “Bids containing deviations from critical provisions relating to (i) to (vi) below will be considered as non responsive:

(i) Appendix 2 to the Form of Contract Agreement (Price Adjusment): Clause No. 10.6 ITB
(ii) Bid Security: Clause No. 12.1, 12.2 ITB.
(iii) Performance Security: Clause 13.3 CC
(iv) Liquidated Damages & (Functional Guarantee): Clause 28 & 28.5 CC
(v) Defect Liability: Clause No. 27 CC
(vi) Payment: Clause No.12 CC
(vii) Time Schedule Appendix-IV

However, the bidders wishing to propose deviations to any of the above provisions must provide in the Attachment - 6A of the bid, the cost of withdrawal of such deviations. If the deviation to any of these provisions is not priced, the bid will be rejected. The evaluated cost of the bid shall include, in addition to the costs described in ITB Clause 24, the cost of withdrawal of the deviations from the above provisions to make the bid fully compliant with these provisions.

At the time of Award of Contract, if so desired by the Employer, the bidder shall withdraw these deviations listed in Attachment 6 and Attachment 6A 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.”

21.5 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 & compliance of the complete provisions of TECHNO-COMMERCIAL bid itself without recourse to extrinsic evidence.

22.0 DELETED

23.0 Detailed Technical & Commercial Evaluation (Part-I)

23.1 The Employer will carry out a detailed evaluation of the Techno-Commercial (Part-I) offer to determine whether the technical/Commercial aspects are in accordance with the requirements set forth in the bidding documents. In order to reach such a determination, the Employer will examine and compare the technical/commercial aspects of the bids on the basis of the information supplied by the bidders, taking into account the following factors:

(a) overall completeness and compliance with the Techno-Commercial Specifications and Drawings; deviations from the Technical Specifications as identified in Attachment 6 to the bid; 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 & Qualifying requirements as provided in Annexure-A of ITB. The evaluation will also take into account the Bidder’s financial, technical and production capabilities.

(c) type, quantity and long term availability of mandatory and recommended spare parts and maintenance services.

(d) any other relevant factors, if any, listed in the ITB, or that the Employer deems necessary or prudent to take into consideration.

23.2 When alternative technical sections have been permitted and offered in Attachment 7 to the bid, the Employer will make similar evaluation of the alternatives, which will be treated in the technical and commercial evaluations as if they were base bids. Where alternatives are not permitted, but have in any event been offered, they shall be ignored.

24.0 Evaluation of Price Bids (Part-II)

24.0 Evaluation and Comparison of Bids

24.1 The Employer will evaluate and compare the Bids previously determined to be substantially responsive, pursuant to ITB Clause 21.

24.2 The Employer’s evaluation of Bid will exclude and not take into account any allowance for price adjustment during the period of execution of the Contract, if provided in the Bidding Documents.

24.3 The comparison shall be of ex-works price of the goods offered from within India, such price shall include all costs as well as duties and taxes paid or payable on components and raw-materials incorporated or to be incorporated in the goods and the CIF Port-of-Entry price of the goods offered from outside India.
24.4 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, or between subtotals and the total price, the unit or subtotal price shall prevail, and the total price shall be corrected. If there is a discrepancy between words and figures, the amount in words will prevail. If the Bidder does not accept the correction of errors, its bid will be rejected.

24.5 The Employer's evaluation of Bid will take into account, in addition to the Ex-works/CIF bid price, the following factors.

(a) For goods offered from within India.

(i) Cost of inland transportation, insurance of finished goods.
(ii) Cost of installation services viz., unloading, storage, handling at site, insurance, installation including associated civil works, testing & commissioning of equipment/material, as specified.
(iii) Excise duty, sales tax and other duties/levies such as octroi duty/entry tax payable on all goods including bought out items except service tax which is to be included by the bidder as per clause ref No. 10.4(g)
(iv) The cost of incidental services.
(v) Performance and productivity of the equipment offered.
(vi) Cost of Withdrawal of Deviations (Attachment 6 & 6AVol III)
(vii) Time Schedule

(b) For goods offered from abroad.

(i) Cost of inland transportation & insurance including charges for port clearance/port handling.
(ii) Cost of installation viz., unloading, storage, handling at site, insurance, installation including associated civil works, testing & commissioning of equipment/materials to be supplied.
(iii) Indian customs duty and any other similar import taxes which may be levied for importation of the goods.
(iv) The cost of incidental services.
(v) Octroi duty/entry tax which is incidental to the delivery of goods at the final destination site except service tax which is to be included by the bidder as per the clause ref no. 10.4(g)
(vi) Performance and productivity of the equipment offered.
(vii) Cost of withdrawal of Deviation (Attachment 6 & 6A Vol-III.)
(viii) Time Schedule

The method will be followed in respect of the following:

24.6 (a) Inland Transportation, ex-factory or from Port of Entry, Insurance and Incidental:

Bidder shall quote separately for inland transportation (including port handling & port clearance for goods offered from abroad) insurance charges and other incidental costs for delivery of goods to the Final Destination Site. The Bidders shall be required to assess the distance of the site from Ex-factory/Port of Entry to India and shall quote a composite and uniform unit rate for each equipment and also the total price for inland transportation & insurance charges for the package.

(b) Cost of Installation services

i) The cost of services for unloading, storage, handling at site, insurance installation including associated civil works, testing & commissioning of equipment/material shall be quoted by the Bidder in the manner indicated in price schedule.

ii) Total charges of expatriate personnel of a Foreign Bidder and imported equipment, is deemed to be included in the cost of installation services (including all foreign and Indian travel expenses, boarding and lodging charges, all tax liabilities and other incidental expenses).
(c) Contractual and Commercial Deviations

A. Bids containing deviations from critical provisions relating to the following clauses will be considered as non-responsive:

(i) Appendix 2 to the Form of Contract Agreement (Price Adjustment): Clause No. 10.6 ITB
(ii) Bid Security: Clause No. 12.1, 12.2 ITB.
(iii) Performance Security: Clause 13.3 CC
(iv) Liquidated Damages & (Functional Guarantee): Clause 28 & 28.5 CC
(v) Defect Liability: Clause No. 27 CC
(vi) Payment: Clause No.12 CC
(vii) Time Schedule: Appendix-4

However, the Bidders, wishing to propose deviations to any of the above provisions, must provide the cost of withdrawal of such deviations in Attachment 6A Volume-III of the Bidding Documents.

The cost of withdrawal of other Technical and Commercial deviations, if any, be given in Attachment 6 of bidding document Vol-III.

If the deviation to any of the provisions is not priced, the bid will be rejected.

At the time of award of contract, if so desired by the Employer, the Bidder shall withdraw the deviations listed in Deviation Schedules of Bid Form, Price and Other Schedules in their bid 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.

B. The evaluation shall be based on the evaluated cost of fulfilling the Contract with all commercial, contractual and technical obligations under the Bidding Documents. In arriving at the evaluated cost, the price of withdrawal of deviations as mentioned above, shown in the relevant schedule of Bid Form, price and other schedules, will be used.

(d) Cost of incidental services

The bidders are required to quote for these incidental services i.e. Type Test, Training etc. and these shall be included in the bid price. However, In case, the type test is waived off subsequent to the award of the work on the request of vendor and accepted by DTL and if it changes the merit order position of the vendor from Lowest bidder to second lowest, then an amount equivalent to the extent that it does not change its Lowest position plus the type test charges quoted by the vendor shall be deducted.

(e) Performance & productivity of the Equipment

(i) Bidder shall state the guaranteed performance or efficiency in response to the Technical Specifications. Plant & Equipment offered shall have minimum performance specified in Technical Specification to be considered responsive. Bids offering Pant and Equipment with a performance less that the specified may be rejected.

(ii) For the purpose of evaluation, the adjustment on the basis of per unit of differential loss in terms of Indian Rupees indicated in Clause 28.5 of Conditions of Contract will be added to the bid price.
The best parameter of loss quoted for the equipment by any technically responsive bidder shall be taken as basis and that quoted by the particular bidder shall be used to arrive at differential price to be applied for the bid.

(f) No credit will be given for the earlier delivery/completion and offers with delivery/completion beyond the completion period i.e. 12 months will be treated as unresponsive.

24.7 Bidder has to quote for the complete scope of work for subject package as stated in Section-Technical Specification, Vol.-II & Section I Vol.- I of the Bidding Documents. Bids covering partial scope of the work as specified in Technical Specification will be treated as incomplete and shall be rejected.

24.8 Conditional discount/rebate, if any, offered by the bidder shall not be taken into consideration for evaluation. It shall, however, be considered in case of award.

Discount(s)/rebate(s) offered by the bidder shall be indicated as a percentage of price component(s) and not as a lump sum amount. Bidder shall also indicate in his bid, the price component(s) on which the percentage discount is to be applied. In case the price component(s) on which the percentage discount is applicable is not indicated in the bid, then the discount will be adjusted in 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 adjusted in full from the ex-works price component (by proportionately reducing ex-works price of individual items), in case of award.

24.9 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 shall remain unaltered.

25.0 No margin of preference will be granted to plant & equipment manufactured in employers country.

26.0 Contacting the Employer

26.1 From the time of the opening of bids to the time the contract is awarded if any bidder wishes to contact the Employer on any matter related to the bid, it should do so in writing.

26.2 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.

F. Award of Contract

27.0 Post-Qualification

27.1 The Employer will determine to its satisfaction whether the Bidder selected as Techno-Commercially qualified & having submitted the lowest evaluated responsive bid is qualified to satisfactorily perform the contract in terms of the qualifying requirements stipulated in the ITB 8.3 (c) and (e).

27.2 The determination will take into account the Bidder's financial, technical and production capabilities, in particular its contract, work in hand, future commitments and current litigation. 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.

27.3 An affirmative determination will be a prerequisite for award of the contract to the Bidder. A negative determination will result in rejection of the Bidder's bid, in which event the Employer will
proceed to the next lowest evaluated bid to make a similar determination of that Bidder's capabilities to perform satisfactorily.

27.4 The capabilities of the vendors and subcontractors proposed in Attachment 5 to the bid to be used by the lowest evaluated Bidder will also be evaluated for acceptability. Their participation should be confirmed with a letter of intent between the parties, as needed. Vendor or subcontractor 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.

28.0 Award Criteria

28.1 Subject to ITB Clause 29, the Employer will award the contract to the successful 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 to perform the contract satisfactorily.

28.2 The Employer may request the Bidder to withdraw any of the deviations listed in Attachment 6 and 6A to the winning bid, at the price shown for the deviation in Attachment 6 and 6A to the bid. Bidder would be required to comply with all other requirements of the Bidding Documents except for those deviations which are accepted by the Employer."

28.3 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.*

28.4 The mode of contracting with the successful bidder will be as per stipulation outlined in CC and briefly indicated below:

In the case of successful Indian Bidder, the award shall be made as follows:

(i) First Contract: For Ex-Works supply and CIF supply, if any, of all equipments and materials including mandatory spares identifying separately the CIF and EXW components of the Supply.

(ii) Second Contract: For providing all services i.e. inland transportation for delivery at Site, unloading storage, handling at Site, installation, Testing and Commissioning including performance testing in respect of all the equipments 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.

In the case of successful foreign Bidder, the award shall be made as follows:

(i) First Contract: For CIF supply of all offshore equipments and materials including mandatory spares.

(ii) Second Contract: For Ex-Works supply of all equipments and materials including mandatory spares and

(iii) Third Contract: For providing all services i.e. port handling and custom clearance for the imported goods, further loading and inland transportation for delivery at Site, unloading, storage, handling at Site, installation, testing and commissioning including performance
testing in respect of all the equipment supplied under the First and Second Contracts and

All the three contracts will contain a cross fall breach clause specifying that breach of one will constitute breach of the others. The foreign bidder, however, has the option, to be exercised as a part of his bid proposal, to propose an Assignee to execute the Second and/or Third Contract.

It is our understanding that as per extant provisions, Indian Income Tax is not payable on sale of goods, if contract is on Principal-to-Principal basis and the title of goods passes to the Employer outside India as in the proposed First Contract. The bidders are, however, advised to check the position from their own sources.

29.0 Employer’s Right to Accept Any Bid and to Reject Any or All Bids

29.1 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. DELHI TRANSCO LIMITED reserves the right to waive minor deviations if they do not materially affect the capability of the Bidder to perform the contract.”

30.0 Notification of Award

30.1 Prior to the expiration of the period of bid validity, the Employer will notify the successful Bidder in writing by registered letter or by cable, to be confirmed in writing by registered letter, that its bid has been accepted. The notification of award will constitute the formation of the contract.

30.2 Upon the successful Bidder’s furnishing of the performance security pursuant to ITB Clause 32, the Employer will promptly notify each unsuccessful Bidder and will discharge its bid security, pursuant to ITB Sub-Clause 12.4.

31.0 Signing the Contract Agreement

31.1 At the same time as the Employer notifies the successful Bidder that its bid has been accepted, the Employer will send the Bidder the Contract Agreement provided in the bidding documents, incorporating all agreements between the parties.

31.2 Within twenty-eight (28) days of receipt of the Contract Agreement, the successful Bidder shall sign and date the Contract Agreement and return it to the Employer.

32.0 Performance Security

32.1 Within twenty-eight (28) days after receipt of the notification of award, the successful Bidder shall furnish the performance security 10% (Ten percent) of the contract price in the form provided in the section "Sample Forms and Procedures" of the bidding documents or in another form acceptable to the Employer. The performance security of a joint venture shall be in the name of joint venture.

32.2 Failure of the successful Bidder to comply with the requirements of ITB Clause 31 or Clause 32 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.

33.0 Adjudicator

33.1 No provision for adjudicator.
34.0  **Corrupt or Fraudulent Practices**

34.1 The DTL requires that Bidders/Suppliers/Contractors, observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, the DTL:

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

(i) "corrupt practice" means the offering, giving, receiving or soliciting of any thing of value to influence the action of a public official in the procurement process or in contract execution; and

(ii) "fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Borrower, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Borrower of the benefits of free and open competition;

(b) will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question;

(c) will declare a firm ineligible, either indefinitely or for a stated period of time, if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing this contract.

34.2 Furthermore, Bidders shall be aware of the provision stated in sub-clause 42.2 of the Conditions of Contract.

35.0 After award of Contract, the contractor shall be solely responsible for RBI permissions for foreign bidders, if required, for opening Project office and project account in Delhi for execution of contract.
Qualification Requirement

Qualification of bidder will be based on meeting the minimum pass/fail criteria specified in Part-A below, regarding the Bidder's technical experience and financial position as demonstrated by the Bidder's responses in the corresponding Bid Schedules. The bidder shall also be required to furnish the information specified in Part-B in their Bid. Technical experience and financial resources of any proposed subcontractor(s) (except as specified in Part-A below) shall not be taken into account in determining the Bidder's compliance with the qualifying criteria. The bid can be submitted by an individual firm or a Joint Venture of two or more firms or by a firm having foreign collaboration.

PART-A

1.1 Eligible Bidders:

(a) Manufacturers of GIS who have the experience of manufacture, supply, erection, testing and commissioning of the GIS as per the criteria/conditions mentioned for Manufacturing and Erection in clause no. 1.1.1 & 1.1.2 respectively below.

OR

(b) Manufacturers of GIS who have the experience of manufacture and supply mentioned in clause no. 1.1.1 below and the Erection, Testing & Commissioning of GIS is carried out through an erector as a sub-contractor, who has the experience as per the criteria/conditions mentioned in 1.1.2 below. The bid shall include consent letter (as per format Annexure-D1) from the proposed Erector.

OR

(c) Erectors who have the experience as per the criteria/conditions mentioned in 1.1.2 below and supply GIS from such manufacturer(s) who fulfils the criteria mentioned at 1.1.1 below. The bid shall include consent letter (as per format Annexure-D2) from the proposed GIS manufacturer stating that the manufacturer shall furnish an additional performance guarantee for an amount of 10% of the cost of such GIS. This performance guarantee shall be in addition to the Contract Performance Guarantee to be submitted by the bidder.

OR

(d) A joint venture firm consisting of two or more partners each of whom shall be:

i. Either the Manufacturers of GIS meeting the technical experience as mentioned in clause no. 1.1.1 below or/and

ii. Erectors having technical experience as mentioned in clause no. 1.1.2 below.

Each of the Partners of the Joint Venture must meet the minimum qualifying requirements given under clause 1.1.1 and/or 1.1.2. However, all the partners of Joint Venture shall meet collectively, the requirements of Clauses 1.1.1 and 1.1.2 below. The Techno-commercial and legal arrangement between the Joint Venture partners shall be in line with the clause 1.1.3 below. All the documents/evidences as required should be submitted along with the Part-I, Techno-Commercial bid.

OR

(e) Indian manufacturers who have Technical Collaboration with a foreign firm(collaborator) or the GIS manufacturers who have established production line in India for these equipment(s) based on technological support of their parent company/ principal provided the said Collaborator or the said Parent company/Principal meet the experience as mentioned in
clause no. 1.1.1 below and erection, testing and commissioning of GIS is carried out by either such manufacturer himself meeting criteria in clause 1.1.2 or through an erector meeting criteria at clause 1.1.2. The Techno-commercial and legal arrangement between them shall be as per clause 1.1.4 below. All the documents/evidences as required in this regard should be submitted along with the Part-I, Techno-Commercial bid.

1.1.1 Experience for GIS Manufacturer(s):

GIS Manufacturer(s) as referred in clause no.1.1 above should:

a. Have experience in manufacturing and supplying of 220 kV or higher voltage class GIS for at least last five years as on the date of bid opening and

b. Have designed, manufactured, supplied, erected, tested as per IEC or equivalent standard and commissioned not less than two (2) GIS installations having cumulatively at least 14(fourteen) 220 kV or higher voltage Circuit Breaker bays of 40kA or higher short circuit level, and the same should have been in successful operation for last two(2) years as on the date of bid opening, and

c. Have designed, manufactured, type tested and supplied 220 kV or higher voltage class Power Transformers which must be in satisfactory operation for last 2 (two) years, as on the date of bid opening or supply the said power transformer from such manufacturers who have designed, manufactured, type tested, and supplied 220 kV or higher voltage class Power Transformers which must be in satisfactory operation for last 2 (two) years, as on the date of bid opening.

1.1.2 Experience for Erection, Testing & Commissioning:

The Erectors for Erection, Testing & Commissioning of GIS should be:

Manufacturer(s) of 220 kV or higher class GIS who have successfully erected, tested and commissioned not less than two (2) GIS installations having cumulatively at least 14(fourteen) 220 kV or higher voltage Circuit Breaker bays and the same should have been in successful operation for at least two(2) years, as on the date of bid opening,

OR

The Erectors who have successfully erected, tested and commissioned not less than two (2) GIS installations having cumulatively at least 14(fourteen) 220 kV or higher voltage Circuit Breaker bays and the same should have been in successful operation for at least two(2) years, as on the date of bid opening, provided

OR

The erectors have successfully Erected, Tested & Commissioned not less than two (2) Outdoor Substations or Switchyards having cumulatively at least 2X100 MVA Transformers and 14(fourteen) 220 kV or higher voltage Circuit Breaker bays and the same should have been in successful operation for at least two (2) years, as on the date of bid opening, provided the Erection, testing and commissioning of 220 kV class GIS is executed under the supervision of the GIS manufacturer.

1.1.3 Techno-Commercial and Legal Arrangement of Joint Venture:

In case of Joint Venture, the following conditions shall also apply:

i. The bid, and in case of successful bid, the specified Form of Agreement shall be signed so as to be legally binding on all partners (Form enclosed).
ii. Each of the Partners of the Joint Venture must meet the minimum qualifying requirements given under clause 1.1.1 and/or 1.1.2. However, all the partners of Joint Venture shall meet collectively, the requirements of Clauses 1.1.1 and 1.1.2 above.

iii. One of the partners shall be nominated as Lead Partner, and the Lead Partner 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 shall be done with the Lead Partner and payment under the contract shall be received by the Lead Partner on behalf of the Joint Venture as per Power conferred to him in the Power of Attorney. The authorization shall be evidenced by submitting a Power of Attorney signed by legally authorized signatory of all the partners as per Performa in section IV, Forms & Procedure of Conditions of Contract, Vol-I. The payment under the Contract can also be received by other partner(s) based on authorization of Lead Partner.

iv. All the partners of the joint venture shall be liable jointly and severally for the execution of the Contract in accordance with the Contract terms, and a statement of this effect shall be included in the authorization mentioned under (iii) above as well as in the Bid Form and in the Contract Form (in case of a successful bid);

v. Agreement entered into by the Joint Venture partners shall be submitted with the bid.

1.1.4 Techno-Commercial and Legal Arrangement For Indian Manufacturer with Foreign firm for Foreign Collaboration and for Foreign Firm establishing plant in India with their Parent Company:

1. The Foreign Collaborators and the foreign manufacturers who have established production line in India for GIS, as referred in para 1.1(e) above should have requisite experience as provided in clause 1.1.1 and 1.1.2 for complete design, manufacture, erection, testing & commissioning of 220 kV or above voltage class GIS. Indian GIS manufacturers referred in para 1.1.1(e) above shall enter into Technical Collaboration agreement with the aforesaid foreign firm for complete design, manufacture, engineering and testing of 220 kV and above voltage class GIS.

2. Such Indian GIS manufactures shall have to submit the Type Test Reports for GIS identically manufactured by the Collaborator/Parent Company/Principals for 220 kV class or above GIS and furnish certificate to this effect from the Collaborator/Parent Company/Principals that since manufacturing procedure is same, the tests are applicable to product manufactured in India under phased manufacturing programme. Also the material for GIS should be similarly certified by the Collaborator.

3. The Indian GIS manufacturer shall furnish a legally enforceable undertaking (jointly with Parent Company/Principals or Collaborator) to guarantee quality, timely supply, performance and warranty obligations and be responsible under the contract in accordance with the requirement of the contract.

4. The Collaborator/Parent Company/Principal should undertake backup support for 5 years for successful operation of the offered GIS.

5. Such Indian GIS manufacturer should be duly authorized by the Collaborator/Parent Company/Principals to supply and/or install the GIS in the owner’s country.

6. A confirmation letter from the Collaborator/Parent Company/Principals along with the bid stating that Collaborator/Parent Company/Principals shall furnish an additional performance guarantee for an amount of 10% of the cost of such GIS to guarantee their obligations toward the owner as referred hereinbefore or elsewhere in the NIT conditions. This performance guarantee shall be in addition to the Contract Performance Guarantee to be submitted by the bidder. Notwithstanding the aforesaid confirmation the bidder shall be responsible as a condition of
contract for the performance guarantee of their Collaborator or as the case may be of their parent company/Principal.

7. All the above documents shall be submitted by the bidder along with the bid.

8. The above Contract Performance Guarantee from the Collaborator/Parent Company/Principals shall be submitted in favour of owner as provided in Form 6A.

1.1.5 General Requirements

1. The bidder shall furnish documentary evidence in support of the qualifying requirement stipulated as above along with the bid.

2. All the Bidders shall submit the proof of work executed by them along with the Performance Certificates in support of their qualification.

3. The bidder shall have a project manager with 15 years experience in executing such contract of comparable nature including not less than five years as manager.

4. The bidder should have adequate after sales support facility or shall establish the same in India for GIS so as to attend warrantee provisions under this contract.

5. For the purpose of qualifying requirement, one no. of circuit breaker bay shall be considered as a bay, used for controlling a line or a transformer or a bus coupler and comprising of at least one circuit breaker, two disconnectors and three nos. of single phase CTs/ Bushing CTs.

1.2 Financial Position:

1.2.1 Individual Firms:

For the purpose of this particular bid, bidders shall meet the following minimum criteria:

a) Minimum Average Annual Turnover (MAAT) of the bidder for the best three years out of last five financial years as annualised should be:

\[
\text{MAAT (INR)} = \frac{1.5 \times \text{Estimated Cost}}{\text{completion period in years}}
\]

b) Bidder shall have Liquid Assets (LA) and/or evidence of access to or availability of credit facilities of not less than:

\[
\text{LA (INR)} = \frac{3 \times \text{estimated cost}}{\text{completion period in months}}
\]

In case bidder is a holding company, MAAT & LA referred to in clause 1.2.1 (a) & (b) above shall be, that of holding company only (i.e. excluding its subsidiary / group companies). In case bidder is a subsidiary of a holding company, MAAT & LA referred to in clause 1.2.1 (a) & (b) above shall be that of subsidiary company only (i.e. excluding its holding company).

Note: In case completion period is less than one (1) year, the denominator to calculate MAAT and LA shall be considered as one (1) and twelve (12) respectively.

1.2.2 Joint Venture Firms:

The figures for each of the partners of the joint venture shall be added together to determine the bidder’s compliance with the minimum qualifying criteria set out in Clause 1.2.1 (a) & (b) above. However, in order for a joint venture to qualify, partners of the joint venture must meet the following minimum criteria:

The lead partner shall meet, not less than 40% of the minimum criteria given at Para 1.2.1 (a) & (b) above.
Section - II Instruction to Bidder (ITB)                                                                                                                Page 26 of 33

1.2.3 Indian Manufacturers with Foreign Collaboration:

The Indian manufacturer should meet the minimum financial qualifying criterion as mentioned in Clause 1.2.1 above.

PART-B

1.1 Financial & Capacity Requirements

1.1.1 Bidder shall be financially sound.

i. Bidder shall submit a certificate from their Banker(s) as per format (as per appendix-I to annexure (ITB) of Conditions of Contract, Vol-I) 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.

ii. Bidder shall submit a monthly cash flow projection for execution of the contract having regard to implementation schedule. Bidder should indicate how funding gap in each month is proposed to be met.

iii. Bidder shall submit the complete Annual reports together with Audited statement of accounts of the company for last five years.

1.1.2 The Bidder shall submit the audited balance sheet and income statement of its own (separate) for the last 5 years (five years) and must demonstrate the soundness of their financial position showing long term profitability. Wherever necessary the Employer may make enquiries with the Bidder's bankers.

1.1.3 In the event the Bidder (being a company registered/ incorporated outside India or otherwise) is not able to furnish the above information of its own (separate), being a subsidiary company and the accounts are being consolidated with their Group/ Holding/ Parent company, the Bidder should submit the balance sheet, income statement, other information as required, of its own (separate), (not of its Group/ Holding/ Parent company) duly certified by:

   i. Their statutory Auditor; or

   ii. A Certified Public Accountant; or

   iii. Their Company Secretary certifying that it is based on audited accounts, as the case may be.

Similarly, if the Bidder happens to be a Group / Holding / Parent company, the Bidder should submit the above information of its own (separate), exclusive of its Subsidiaries, duly certified by:

   i. Their statutory Auditor; or

   ii. A certified Public Accountant; or

   iii. Their Company Secretary certifying that it is based on audited accounts, as the case may be.

1.2 GIS Manufacturer shall have adequate GIS sub-station Design infrastructure and capacity & procedures including quality control. Erector shall have adequate erection facilities and capacity & procedures including quality control.

2.0 To be qualified for award, bidders shall provide evidence satisfactory to the Employer of their capability and adequacy of resources to carry out the Contract effectively. Bids shall include the following information:
a. Copies of original documents defining the constitution or legal status, place of Registration and principal place of business; written power of attorney of the Signatory of the bid to commit the bidder;

b. The qualification and experience of key personnel, proposed for carrying out the work;

c. Proposal for subcontracting elements of the supply of materials amounting to more than 10% of the Bid Price for each element;

d. Litigation History: Information regarding any current litigation in which the bidder is involved, the parties concerned and disputed amount;

3.0 Bids submitted by a joint venture of firms as partners shall comply with following requirements.

   a. The bid shall include all the information listed in sub clause 2.0 (a) to (d) of PART - B above for each joint venture partner

   b. The bid, and in case of successful bid, the Form of Agreement shall be signed, so as to be legally binding on all partners;

4.0 No margin of preference will be granted to plant & equipment manufactured in employers country.

5.0 Public Sector Companies

   Majority publicly owned enterprises domiciled in India may be eligible to qualify if, in addition to meeting all the above requirements, they also;

   a. are commercially oriented legal entities, distinct from the Employer, and are not a government department;

   b. are financially autonomous, as demonstrated by requirements in their constitutions to provide separate audited accounts, and return on capital, powers to raise loans and obtain revenues, through the sale of goods or services; and

   c. are managerially autonomous.

6.0 Notwithstanding anything stated above the Employer reserves the right to assess the bidder's capability and capacity to perform the contract, should the circumstances warrant such assessment in the over all interest of the Employer.
CONSENT LETTER FROM ERECTOR TO BE FURNISHED BY THE GIS MANUFACTURER
(To be submitted on the letterhead of the company)

To
Delhi Transco Ltd.
Shakti Sadan, Kotla Road
New Delhi-110002.

Dear Sir,

The undersigned on behalf of M/s…………….having its registered office at…………… wish to confirm as under:

1. That, we shall carry out erection, testing & commissioning of GIS equipments for M/s ………… meeting the technical specification as specified in Delhi Transco Limited said Tender No T14P070076.

2. That, we as a Erector meet the qualifying criteria as specified in Clause 1.1.2 of part-A, Annexure A, ITB, Vol-I of the said Tender No. T14P070076.

3. That, we shall carry out erection, testing & commissioning of GIS equipments in line with the agreed Time Schedule between Delhi Transco Limited and M/S…………..

4. That, documentation in respect of our qualification and experience is enclosed with this consent letter as per the requirement of Tender Specifications.

That, Undersigned is authorized to submit this consent/confirmation letter on behalf of M/s…………..(Authorization letter enclosed).

For and on behalf of M/s………

Signature:………
Name:…………
Designation:……
Seal:…………
CONSENT LETTER FROM GIS MANUFACTURER TO BE FURNISHED BY THE ERECTOR
(To be submitted on the letterhead of the company)

To

Delhi Transco Ltd.
Shakti Sadan, Kotla Road
New Delhi-110002.

IN RESPECT OF TURNKEY PACKAGE FOR DESIGN, ENGINEERING, MANUFACTURE, TRANSPORTATION TO SITE, INSURANCE, STORAGE, ERECTION, TESTING & COMMISSIONING OF 220/66/33KV GIS SUBSTATION HAVING 220KV, 66KV & 33KV GIS EQUIPMENTS, 160MVA & 100MVA POWER TRANSFORMERS AND OTHER SUBSTATION EQUIPMENTS AT R.K.PURAM, NEW DELHI (INDIA) ON TURNKEY BASIS,
TENDER NO. T14P070076.

Dear Sir,

The undersigned on behalf of M/s…………….having its manufacturing units at ………………. and registered office at…………… wish to confirm as under:

1. That, we shall supply GIS equipments to M/s …………. meeting the technical specification as specified in Delhi Transco Limited said Tender No T14P070076..

2. That, we as a GIS Manufacturer meet the qualifying criteria as specified in Clause 1.1.1 of part-A, Annexure A, ITB, Vol-I of the said Tender No. T14P070076..

3. That, we shall supply the GIS equipments in line with the agreed Time Schedule between Delhi Transco Limited and M/S…………..

4. That, we shall undertake supervision of erection, testing & commissioning in case of award of contract to M/s……………..(To be submitted by an erector who is not having GIS experience as provided in Cl. 1.1.2)

5. That, documentation in respect of our qualification and experience is enclosed with this consent letter as per the requirement of Tender Specifications.

6. That, we shall furnish an additional performance guarantee (unconditional) for an amount of 10% of the cost of GIS equipments as per NIT.

That, Undersigned is authorized to submit this consent/confirmation letter on behalf of M/s……………..(Authorization letter enclosed).

For and on behalf of M/s………

Signature:………
Name:…………
Designation:……
Seal:………
FORMAT FOR EVIDENCE OF ACCESS TO OR AVAILABILITY OF CREDIT FACILITIES

BANK CERTIFICATE

This is to certify that M/s .............................................................. (Full Name & Address) .............................................................. Who are submitting their bid to Delhi Transco Ltd. as sole bidder* /partner of JV*# against their tender specification vide Ref. No. ............................... & date ................. is our Customer for the past ......................... years.

Their financial transactions 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:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Type of Facility</th>
<th>Sanctioned Limit as on Date</th>
<th>Utilization as on Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This letter is issued at the request of M/s. ____________________________

Sd/-
Name of Bank _____________________
Name of Authorised Signatory _____________________
Designation _____________________
Phone No. _____________________
Fax No. _____________________

SEAL OF THE BANK:

Note:
* Strike out whichever is not applicable.
# Separate details to be furnished by different partners of JV.
SECTION - III

Condition of Contract (CC)

A. Contract and Interpretation:

1.0 Definitions:

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

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


"Day" means calendar day of the Gregorian Calendar.

"Month" means calendar month of the Gregorian Calendar.

"Employer" means the person named as below and includes the legal successors or permitted assigns of the Employer.

Delhi Transco Ltd.
Shakti Sadan
New Delhi-110002
Fax No. – 011-23234640
Tel. No. -011-23231748/23215198

"Project Manager" means the person appointed by the Employer in the manner provided in CC Sub-Clause 17.1 (Project Manager) hereof and named as such in the CC to perform the duties delegated by the Employer.

The Project Manager is: [Name, address, telephone, cable and facsimile numbers]

"Contractor" means the person(s) whose bid to perform the Contract has been accepted by the Employer and is named as such in the Contract Agreement, and includes the legal successors or permitted assigns of the Contractor.

The Contractor is: [Name, address, telephone, cable and facsimile numbers]

"Contractor's Representative" means any person nominated by the Contractor and named as such in the CC and approved by the Employer in the manner provided in CC Sub-Clause 17.2 (Contractor's Representative and Construction Manager) hereof to perform the duties delegated by the Contractor.

The Contractor's Representative is: [Name, address, telephone, cable and facsimile numbers]

"Subcontractor," including vendors, means any person to whom execution of any part of the Facilities, including preparation of any design or supply of any Plant and Equipment, is subcontracted directly or indirectly by the Contractor, and includes its legal successors or permitted assigns.

"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 CC Sub-Clause 6.2 (Arbitrator) hereof.

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

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

"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 CC Sub-Clause 7.3 hereof), but does not include Contractor's Equipment.

"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, Precommissioning, commissioning, operations, maintenance, the provision of operations and maintenance manuals, training, etc.

"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.

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

“Effective Date” means the date from which the Time for Completion shall be determined as stated in Article 3 (Effective Date for Determining Time for Completion) of the form of Contract Agreement.

“Time of completion” means the time within which completion of the Facilities as whole (or of a part of the Facilities where a separate Time for completion of such part has been prescribed) and “Operational Acceptance” (Taking Over) by the employer is to be attained in accordance with the stipulations in the CC and the relevant provisions of the Contract.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Activities</th>
<th>Duration in months from the effective date of contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Operational Acceptance by the Employer upon successful completion of: 220/66/33kV GIS Substation at R.K.Puram, New Delhi</td>
<td>12 months</td>
</tr>
</tbody>
</table>

The successful Bidder shall be required to prepare detailed Network(s) and project implementation plans & programmes and finalize the same with the Employer as per requirement specified in Technical Specifications, which shall form a part of the Contract.

Note: No credit will be given for the earlier delivery/completion and offers with delivery/completion beyond the completion period i.e. 12 months will be treated as unresponsive.

"Completion" means that the Facilities (or a specific part thereof where specific parts are specified in the CC) have been completed operationally and structurally and put in a tight and clean condition, and that all work in respect of Precommissioning of the Facilities or such specific part thereof has been completed and commissioning has been attained as per Technical Specifications.

"Precommissioning" 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 CC Clause 24 (Completion) hereof.
"Commissioning" means operations of the facilities or any part thereof to be carried out by the Contractor as provided in CC Sub-Clause 25.1 (commissioning) hereof, for the purpose of carrying out Guarantee Test(s).

"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 CC Sub-Clause 25.2 (Guarantee Test) hereof.

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

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

2. Contract Documents

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

3. Interpretation

3.1 Language

3.1.1 Unless the Contractor is a national of the Employer's country and the Employer and the Contractor agree to use the local language, all Contract Documents, all correspondence and communications to be given, and all other documentation to be prepared and supplied under the Contract shall be written in English, and the Contract shall be construed and interpreted in accordance with that language.

3.1.2 If any of the Contract Documents, correspondence or communications are prepared in any language other than the governing language under CC Sub Clause 3.1.1 above, the English translation of such documents, correspondence or communications shall prevail in matters of interpretation.

3.2 Singular and Plural

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

3.3 Headings

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

3.4 Persons

Words importing persons or parties shall include firms, corporations and government entities.

3.5 Incoterms

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

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

3.7 **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.

3.8 **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.

3.9 **Joint Venture or Consortium**

If the Contractor is a joint venture or consortium 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 or consortium. The composition or the constitution of the joint venture or consortium shall not be altered without the prior consent of the Employer.

3.10 **Non-Waiver**

3.10.1 Subject to CC Sub-Clause 3.10.2 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.

3.10.2 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.

3.11 **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.

3.12 **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.

4. **Notices**
4.1 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, airmail post, special courier, cable, telegraph, telex, facsimile or Electronic Data Interchange (EDI) to the address of the relevant party set out in the Special Conditions of Contract, with the following provisions.

Employer’s address for notice purposes: [Name, address and telephone, cable and facsimile numbers]

Contractor’s address for notice purposes: [Name, address and telephone, cable and facsimile numbers]

4.1.1 Any notice sent by cable, telegraph, telex, facsimile or EDI shall be confirmed within two (2) days after despatch by notice sent by airmail post or special courier, except as otherwise specified in the Contract.

4.1.2 Any notice sent by airmail post or 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 despatch, 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 airmail or special courier.

4.1.3 Any notice delivered personally or sent by cable, telegraph, telex, facsimile or EDI shall be deemed to have been delivered on date of its despatch.

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

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

5. Governing Law

5.1 The Courts at Delhi shall have the exclusive jurisdiction on all matters. The contract shall be governed and interpreted in accordance with the laws of the employer’s country, i.e. India.

6. Settlement of Disputes

6.1 Adjudicator

Not applicable.

6.2.1 Arbitration

If at any time any question, dispute or difference shall arise between the Employer and the Contractor in connection with or arising out of the Contract or the carrying out of the Works either party shall be entitled to refer the matter to be finally settled by arbitration in accordance with the following provisions:

6.2.2 In the event of the Contractor being an Indian party, that is to say a citizen and/or a permanent resident of India, a firm or company duly registered or incorporated in India, 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 as an umpire 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.

6.2.3 The arbitration shall be conducted in accordance with the provisions of the Indian Arbitration & Conciliation Act, 1996 or any statutory modification thereof. The venue of arbitration shall be New Delhi, India.

6.2.4 In the event of foreign Contractor, the arbitration shall be conducted in accordance with the Rules of Conciliation and Arbitration of the International Chamber of Commerce by three
arbitrators, one each to be appointed by the Employer and the Contractor and the third to be appointed by the Court of Arbitration of the International Chamber of Commerce, in accordance with the said "Rules". The arbitration shall be conducted at New Delhi, India. The language of arbitration shall be English.

6.2.5 The Arbitrator(s) shall have full power to open up review and revise:

   a) Any decision of the Employer referred to arbitration, and
   b) Any certificate of the Employer related to the dispute.

6.2.6 The award given by the Arbitrator(s) under the Sub-clauses 6.2.1 & 6.2.3 shall be a speaking award.

6.2.7 Works to Continue

Performance of the Contract shall continue during arbitration proceedings unless the Employer shall order suspension. If any such suspension is ordered the reasonable costs incurred by the Contractor and occasioned thereby shall be added to the Contract Price. No payments due or payable by the Employer shall be withheld on account of pending reference to arbitration.

6.2.8 Time Limit for Arbitration

Formal notice of arbitration must be given to the other party, and where required to the appropriate arbitration body no later than 90 days after the issue of the Final Certificate of Payment.

6.2.9 Law and Procedure

6.2.9.1 Applicable Law

The law, which is to apply to the Contract and under which the Contract is to be construed, shall be Indian law.

6.2.9.2 Procedural Law

The law governing the procedure and administration of any arbitration instituted pursuant to Clause 6.0 shall be Indian law.

B. Subject Matter of Contract

7. Scope of Facilities

7.1. Unless otherwise expressly limited in the Technical Specifications, the Contractor’s obligation cover 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, Precommissioning 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 CC sub-clause 7.3 below) and accessories, Contractor's Equipment; construction utilities and supplies, temporary materials, structures and facilities, transportation (including without limitation, unloading and hauling to, from and at the Site); and storage except for those supplies, works and services that will be provided or performed by the Employer, as set forth in Appendix-6 (Scope of Works and Supply by the Employer) to the Contract Agreement.

7.2 The Contractor shall, unless specifically excluded in the Contract, perform all such work and/or supply all such items and materials not specifically mentioned in the Contract but that can be reasonably inferred from the Contract as being required for attaining Completion of the Facilities as if such work and/or items and materials were expressly mentioned in the Contract.

7.3 In addition to the supply of Mandatory Spare Parts included in the Contract, the Contractor agrees to supply spare parts required for the operation and maintenance of the Facilities for the
period specified in the CC. However, the identity, specifications and quantities of such spare parts and the terms and conditions relating to the supply thereof are to be agreed between the Employer and the Contractor, and the price of such spare parts shall be that given in Price Schedules, which shall be added to the Contract Price. The price of such spare parts shall include the purchase price thereof and other costs and expenses (including the Contractor's fees) relating to the supply of spare parts.

The Contractor shall ensure the availability of spare parts for the supplied items for a minimum period of fifteen (15) years from operational acceptance by the Employer.

7.4 The Contractor shall carry sufficient inventories to ensure an ex-stock supply of consumable spares for the plant and equipment. Other spare parts and components shall be supplied as promptly as possible, but at the most within six (6) months of placing the order and opening the letter of credit.

7.5 In the event of termination of production of spare parts:

(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 specifications of the spare parts, if requested.

8. Time for Commencement and Completion

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

The contractor shall commence work on the facilities from the Effective Date of Contract for determining Time for completion as specified in the contract.

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

The Operational Acceptance of the Facilities shall be attained within 12 (twelve) months from the Effective Date of Contract.

9. Contractor's Responsibilities

9.1 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.

9.2 The Contractor confirms that it has entered into this Contract on the basis of a proper examination of the data relating to the Facilities (including any data as to boring tests) provided by the Employer, and on the basis of information that the Contractor could have obtained from a visual inspection of the Site (if access thereto was available) and of other data readily available to it relating to the Facilities as at 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.

9.3 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 CC Sub-Clause 10.3 hereof and that are necessary for the performance of the Contract.
9.4 The Contractor shall comply with all laws in force in the country where the Facilities are installed and where the Installation Services are carried out. The laws will include all national, provincial, municipal 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 CC Sub-Clause 10.1 hereof.

9.5 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 CC Clause 1 (Country of Origin).

9.6 The Contractor shall permit the Bank to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the Bank, if so required by the Bank.

10. **Employer’s Responsibilities**

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

10.2 The Employer shall be responsible for acquiring and providing legal and physical possession of the Site and access thereto, and for providing possession of and access to all other areas reasonably required for the proper execution of the Contract, including all requisite rights of way, as specified in 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 Appendix 6.

10.3 The Employer shall acquire and pay for all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the site is located which 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.

10.4 If requested by the Contractor, the Employer shall use its best endeavors to assist the Contractor in obtaining in a timely and expeditious manner all permits, approvals and/or licenses necessary for the execution of the Contract from all local, state or national government authorities or public service undertakings that such authorities or undertakings require the Contractor or Subcontractors or the personnel of the Contractor or Subcontractors, as the case may be, to obtain.

10.5 Unless otherwise specified in the Contract or agreed upon by the Employer and the Contractor, the Employer shall provide sufficient, properly qualified operating and maintenance personnel, shall supply and make available all raw materials utilities, lubricants, chemicals, catalysts, other materials and facilities, and shall perform all works and services of whatsoever nature, to enable the Contractor to properly carry out Pre-commissioning, Commissioning and Guarantee Tests, 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 CC Sub-Clause 18.2 (Program of Performance) hereof and in the manner thereupon specified or as otherwise agreed upon by the Employer and the Contractor.

10.6 The Employer shall be responsible for the continued operation of the facilities after Operational Acceptance, in accordance with CC 25.3

10.7 All costs and expenses involved in the performance of the obligations under this CC Clause 10 shall be the responsibility of the Employer, save those to be incurred by the Contractor with respect to the performance of Guarantee Tests, in accordance with CC Sub-Clause 25.2.
11. **Contract Price**

11.1 The Contract Price shall be as specified in Article 2 (Contract Price and Terms of Payment) of the Form of Contract Agreement.

11.2 The Contract Price shall be on lump sum basis. The Contract price shall be adjusted on account of variation in quantity in accordance with clause 39 CC. Further the CIF/Ex-works price component and installation price component shall also be subject to price adjustment in line with the provisions of Appendix 2 to Form of Contract Agreement.

11.3 Subject to CC Sub-Claus 9.2, 10.1 and 35 (Unforeseen Conditions) hereof, the Contractor shall be deemed to have satisfied itself as to the correctness and sufficiency of the Contract Price, which shall, except as otherwise provided for in the Contract, cover all its obligations under the Contract.

12. **Terms of Payment**

12.1 The Contract Price shall be paid as specified in Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement. The procedures to be followed in making application for and processing payments shall be those outlined in the same Appendix 1.

12.2 No payment made by the Employer herein shall be deemed to constitute acceptance by the Employer of the Facilities or any part(s) thereof.

12.3 All payments shall be made in Indian currency i.e. INR only.

13. **Securities**

13.1 **Issuance of Securities**

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

13.2 **Advance Payment Security**

13.2.1 The Contractor shall, within 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 Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement, and in the same currency or currencies with a validity of up to ninety (90) days beyond the date of Completion of the Facilities in accordance with CC Clause 24.

13.2.2 The Security shall be in the form provided in the bidding documents or in another form acceptable to the Employer. The security shall be discharged after completion of the facilities or relevant party thereof.

Procedure for effective reduction in the Advance Payment Security:

The advance Payment Security shall be allowed to be reduced every three (3) months after First Running Account Bill/ Stage payment under the Contract. The cumulative amount of reduction at any point of time shall not exceed seventy five percent (75%) of the advance corresponding to cumulative value of the Facilities completed as per a certificate to be issued by the Project Manager. It should be clearly understood that reduction in the value of security for advance shall not in any way dilute the Contractor's responsibility and liabilities under the Contract including in respect of the Facilities for which reduction in the value of security is allowed.
13.3 **Performance Security**

13.3.1 The Bidder shall submit performance guarantee of 10% of the contract value within twenty eight (28) days of the notifications of award, valid for 12 Months from operational acceptance. Then this performance guarantee shall be renewed periodically every year for next four years. Every renewal of performance guarantee shall be done by the contractor one month prior to the expiry date.

The bidder will submit an undertaking to the owner with a copy to the banker issuing the performance bank guarantee that the bidder will renew and submit the bank guarantee within thirty days before the expiry of bank guarantee failing which it shall be encashed and credited in favour of DTL automatically by the banker without waiting for any instructions from DTL.

13.3.2 The performance security shall be in the form of unconditional Bank Guarantee attached hereto in the Section IV - Sample Forms and Procedures.

13.3.3 Reduction in the security pro rata to the Contract Price of any part of the Facilities is not admissible since separate time for Completion of part of the facilities is not applicable. However, if the Defects Liability Period has been extended on any part of the Facilities pursuant to CC sub-clause 27.8 hereof, the Contractor shall issue an additional security in an amount proportionate to the Contract Price of that part. The Security shall be returned to the Contractor immediately after its expiration, provided, however, that if the Contractor pursuant to CC Sub-Clause 27.10, is liable for an extended warranty obligation, the performance security shall be extended for the period and up to the amount specified in the CC clause 27.

13.3.4 In case of award of the contract to a Joint Venture, the performance security and the Bank Guarantee for advance payment shall be submitted in the name of the Joint Venture and not in the name of the Lead Partner or any Partner(s) of the Joint Venture alone.

13.4 **Issuing Banks**

The Advance Payment Security and Performance Security are to be provided by the Contractor in the form of ‘Bank Guarantee’ which should be issued either:

(a) by a reputed bank located in the country of Employer and acceptable to the Employer, or

(b) by a foreign bank confirmed by either its correspondence bank located in the country of Employer which should be reputed and acceptable to the Employer, or

(c) by a Public Sector Bank in the country of Employer.

All banks shall be nationalized and scheduled banks operating in India.

14. **Taxes and Duties**

14.1 For CIF Contract, the Contractor shall be entirely responsible for payment of all taxes, stamp duties, license fees and other such levies imposed out-side the employer’s country.

14.2 In case of Contract for domestic supplies and services, the Contractor shall be entirely responsible for payment of all taxes, duties, licence 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 owner a certificate for the same shall be issued to the Contractor.

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

14.4 In case of CIF Contracts, any Indian Customs duties or levies including the Stamp Duty and Import License Fee levied by the Government of India or any State Government in India on the
equipment and materials covered in the Contract to be imported in to India against employer’s Import License and which will become the property of the Employer under the Contract, shall be to the Employer’s account and shall be paid directly by the Employer to Government of India or concerned authorities. In the event a contractor is required by law to pay such levies in India, the same shall be reimbursed by the Employer to the Contractor in Indian Rupees, upon presentation of satisfactory documentary evidence for having made such payments. The successful bidder shall submit a comprehensive list of all the goods to be imported in to India under the Contract to enable the Employer to obtain the Import License endorsement of Project Imports for availing concessional rate of customs and import duties. However, the successful bidder shall arrange to get equipment assessed under ‘Project Rate’ or ‘merit rate’ of custom duty whichever is less as permitted under relevant notification for the type of Project. Any additional liabilities of customs and import duties or penalty thereon, due to discrepancy in the said list of goods or any other lapse of the Contractor, shall be to the account of the Contract. As of now, there is no sales tax or excise duty applicable in respect of the transaction between the Employer and the Contractor in respect of supplies from abroad.

14.5 In respect of direct transaction between the Employer and the Contractor, the EXW price is inclusive 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 /incorporated or to be incorporated in the Plants & Equipments and other final goods to be supplied by the contractor under the proposed contract.

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 owners 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 owner subject to furnishing of documentary proof.

Owner would not bear any liability on account of Service Tax. In case the service tax on transactions between owner and the contractor is covered under the Reverse Charge provisions of service tax law and the full service tax (i.e. including both for service provider and service receiver) is to be included in the quoted prices/bid, the necessary deductions relatable to the service tax liability of Receiver of services to be deposited with Service Tax Deptt.

14.6 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 EXW price. These amounts will be payable (along with subsequent variation if any) on the supplies made by the Contractor, subject to submission of the documentary evidence indicating the said taxes payable by the contractor. But the amount of said taxes shall be limited to the tax liability on the transaction between the Owner and the Contractor. Owner shall, however, issue requisite sales tax declaration forms for the reduced CST or otherwise required for the aforesaid sale transactions.

14.7 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 owner would not bear any liability on this account. owner shall, however, deduct such taxes at source as per the rules and issue Tax Deduction at Source (TDS) and issue Certificate to the Contractor as per the said rules.

14.8 For payment in respect of dispatches made directly from Contractor's works, invoices raised by the Contractor shall be accepted as documentary evidence and for payment 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. However, the owner from time to time may also verify the payment / deposit of various taxes by the contractor, which the later has already claimed and charged in the previous invoices from the owner against the aforesaid direct transaction between owner and the contractor.

14.9 In respect of bought-out finished items, which shall be dispatched directly from the sub-vendor's works to the owner's site (sale-in-transit), the price is inclusive of all costs 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 owner. Employer, shall, however, issue requisite sales tax declaration forms for reduced CST and such other declaration forms as may be applicable under
the VAT / CST Act for the aforesaid sale transactions.

14.10 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 inclusive of duties, levies and charges prevailing at the date seven (07) days prior to the last date of bid submission If any rates of Tax are increased or decreased or , a new Tax is introduced, or/an existing Tax is abolished 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 take into account any such change by addition to the Contract price or deduction therefrom, as the case may be (changes in law & regulations) hereof. However, these adjustments would be restricted to direct transactions between the owner 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 owner or 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.

14.11 Further, the EXW price of (i) imported Equipments/items offered as ‘Off the Shelf’ or dispatched directly from the Indian Port of disembarkation and/or (ii) bought-out finished Equipments/items as ‘Off the Shelf’ items or dispatched directly from the Contractor’s works are inclusive 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

D. Intellectual Property

15. Copyright

15.1 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, document and other material furnished to the Employer for all purpose of the Contract including, if required, for operation and maintenance.

16. Confidential Information

16.1 The Employer and the Contractor shall keep confidential and shall not, without the written consent of the other party hereto, divulge to any third party any documents, data or other information furnished directly or indirectly by the other party hereto in connection with the Contract, whether such information has been furnished prior to, during or following termination of the Contract. Notwithstanding the above, the Contractor may furnish to its Subcontractor(s) such documents, data and other information it receives from the Employer to the extent required for the Subcontractor(s) to perform its work under the Contract, in which event the Contractor shall obtain from such Subcontractor(s) an undertaking of confidentiality similar to that imposed on the Contractor under this CC Clause.16.

16.2 The Employer shall not use such documents, data and other information received from the Contractor for any purpose other than the operation and maintenance of the Facilities. Similarly, the Contractor shall not use such documents, data and other information received from the Employer for any purpose other than the design, procurement of Plant and Equipment, construction or such other work and services as are required for the performance of the Contract.
16.3 The obligation of a party under CC Sub-Claus 16.1 and 16.2 above, however, shall not apply to that information which

(a) now or hereafter enters the public domain through no fault of that party

(b) can be proven to have been possessed by that party at the time of disclosure and which was not previously obtained, directly or indirectly, from the other party hereto

(c) otherwise lawfully becomes available to that party from a third party that has no obligation of confidentiality

16.4 The above provisions of this CC Clause 16 shall not in any way modify any undertaking of confidentiality given by either of the parties hereto prior to the date of the Contract in respect of the Facilities or any part thereof.

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

E. Execution of the Facilities

17. Representatives

17.1 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.

17.2 Contractor's Representative & Construction Manager

17.2.1 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 therefore, then the Contractor shall appoint a replacement within fourteen (14) days of such objection, and the foregoing provisions of this CC Sub-Clause 17.2.1 shall apply thereto.

17.2.2 The Contractor's Representative shall represent and act for the Contractor at all times during the 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 CC Sub-Clause 17.2.1.

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

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

17.2.3.1 Notwithstanding any thing stated in CC sub-Clause 17.1 and 17.2.1 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.

17.2.4 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.

17.2.5 The Employer may by notice to the Contractor object to any representative or person employed by the Contractor in the execution of the Contract who, in the reasonable opinion of the Employer, may behave inappropriately, may be incompetent or negligent, or may commit a serious breach of the Site regulations provided under CC Sub-Clause 22.3. The Employer shall provide evidence of the same, whereupon the Contractor shall remove such person from the Facilities.

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

18.   Work Program

18.1 Contractor's Organization

The Contractor shall supply to the Employer and the Project Manager a chart showing the proposed organization to be established by the Contractor for carrying out work on the Facilities. 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.

18.2 Program of Performance

The form of the program of performance of the Contract shall be in the form of the Critical Path Method (CPM), the PERT network, or other internationally used programs.

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, made in the form specified in the CC and showing the sequence in which it proposes to design, manufacture, transport, assemble, install and pre-commission the Facilities, as well as the date by which the Contractor reasonably requires that the Employer shall have fulfilled its obligations under the Contract so as to enable the Contractor to execute the Contract in accordance with the program and to achieve completion, commissioning and Acceptance of the Facilities in accordance with the Contract. The program so submitted by the Contractor shall accord with the Time Schedule included in 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 given in the CC and any extension granted in accordance with CC Clause 40, and shall submit all such revisions to the Project Manager.
18.3 Progress Report

The Contractor shall monitor progress of all the activities specified in the program referred to in CC Sub-Clause 18.2 (Program of Performance) above, and supply a progress report to the Project Manager every month.

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

18.4 Progress of Performance

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

18.5 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.

19. Subcontracting

19.1 Appendix 5 (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.

19.2 The Contractor shall select and employ its Subcontractors for such major items from those listed in the lists referred to in CC Sub-Clause 19.1.

19.3 For items or parts of the Facilities not specified in Appendix 5 (List of Approved Subcontractors) to the Contract Agreement, the Contractor may employ such Subcontractors as it may select, at its discretion.

Application of this provision by the Contractor for selection of sub-Contractors shall be limited to a threshold value of equivalent ----------- including provisions stipulated in Quality Plan(s).

20. Design and Engineering

20.1 Specifications and Drawings

20.1.1 The Contractor shall execute the basic and detailed design and the engineering work in compliance with the provisions of the Contract, or where not so specified, in accordance with good engineering practice.
The Contractor shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and other technical documents that it has prepared, whether such specifications, drawings and other documents have been approved by the Project Manager or not, provided that such discrepancies, errors or omissions are not because of inaccurate information furnished in writing to the Contractor by or on behalf of the Employer.

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

20.2 Codes and Standards

Wherever references are made in the Contract to codes and standards in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards current at the date 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 CC Clause 39.3 (Changes Originating from Contractor).

20.3 Approval/Review of Technical Documents by Project Manager

20.3.1 The Contractor shall prepare (or cause its subcontractors to prepare) and furnish to the Project Manager the documents listed in 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 CC sub-Clause 18.2 (Program of Performance).

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

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

20.3.2 Within twenty one (21) days after receipt by the Project Manager of any document requiring the Project Manager's approval in accordance with CC Sub-Clause 20.3.1, the Project Manager shall either return one copy thereof to the Contractor with its approval endorsed thereon or shall notify the Contractor in writing of its disapproval thereof and the reasons therefore and the modifications that the Project Manager proposes.

20.3.3 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.

20.3.4 If the Project Manager disapproves the document, the Contractor shall modify the document and resubmit it for the Project Manager's approval in accordance with CC sub-Clauses 20.3.2. If the Project Manager approves the documents subject to modification(s), the Contractor shall make 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.

20.3.5 If any dispute or difference occurs between the Employer and the Contractor in connection with or arising out of the disapproval by the Project Manager of any document and/or any modification(s) thereto that cannot be settled between the parties within a reasonable period, then such dispute or difference may be referred to an Arbitration for determination in accordance with CC Sub Clause 6.2 (Arbitration) hereof. If such dispute or difference is referred to Arbitration, 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 Arbitration upholds the Contractor's view on the dispute and if the Employer has not given notice under CC Sub Clause 6.2 (arbitration), 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 Arbitration shall decide, and the Time for Completion shall be extended accordingly.
20.3.6 The Project Manager's approval, with or without modification of the document furnished by the Contractor, shall not relieve the Contractor of any responsibility or liability imposed upon it by any provisions of the Contract except to the extent that any subsequent failure results from modifications required by the Project Manager.

20.3.7 The Contractor shall not depart from any approved document unless the Contractor has first submitted to the Project Manager an amended document and obtained the Project Manager's approval thereof, pursuant to the provisions of this CC Sub-Clause 20.3. If the Project Manager requests any change in any already approved document and/or in any document based thereon, the provisions of CC Clause 39 (Change in the Facilities) shall apply to such request.

21. Procurement

21.1 Plant and Equipment

Subject to CC Sub-Clause 14.2, the Contractor shall manufacture or procure and transport all the Plant and Equipment in an expeditious and orderly manner to the Site.

21.2 Employer-Supplied Plant, Equipment, and Materials

If 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:

21.2.1 The Employer shall, at its own risk and expense, transport each item to the place on or near the Site as agreed upon by the parties and make such item available to the Contractor at the time specified in the program furnished by the Contractor, pursuant to CC Sub-Clause 18.2 (Program of Performance), unless otherwise mutually agreed.

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

21.2.3 The foregoing responsibilities of the Contractor and its obligations of care, custody and control shall not relieve the Employer of liability for any undetected shortage, defect or default, nor place the Contractor under any liability for any such shortage, defect or default whether under CC Clause 27 (Defect Liability) or under any other provision of Contract.

21.3 Transportation

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

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

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

21.3.4 The Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the 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.

21.4 Customs Clearance

The Contractor shall, at its own expense, handle all imported Plant and Equipment and Contractor’s Equipment at the point(s) of import and shall handle any formalities for customs clearance including liabilities for port charges if any, subject to the Employer’s obligations under CC sub-Clause 14.4, provided that if applicable laws or regulations require any application or act to be made by or in the name of the employer, the employer shall take all necessary steps to comply with such laws or regulations. In the event of delays in customs clearance due to the fault of the employer, the Contractor shall be entitled to an extension in the Time for Completion, pursuant to CC Clause 40.

21.5 Delivery and Documents

21.5.1 For Imported Goods

Upon shipment, the Contractor shall notify the Employer and the Insurance company by cable or telex of the full details of the shipment including Contract number, description of goods, quantity, the vessel, the bill of lading/Airway Bill number and date, port of loading, date of shipment, port of discharge, etc. The Contractor shall mail the following documents to the Employer, with a copy to the Insurance Company:

1) Copies of the Contractor’s invoice showing Contract Agreement reference, goods description, quantity, unit price, total amount;

2) Original (3/3) and six copies of the negotiable, clean on-board bill of lading/Airway Bill marked freight prepaid and six copies of non negotiable bill of lading / Airway Bill;

3) Copies of packing list identifying contents of each package (6 copies);

4) Original insurance policy certification (3 copies);

5) Manufacture’s / Contractor’s guarantee certificate of Quality;

6) Material Inspection & Clearance Certificate (MICC) for dispatch, issued by the Employer’s representative and the Contractor’s factory inspection report, test certificates (3 copies); and

7) Certificate of origin.

The above documents shall be air mailed/faxed by the Contractor to reach the Employer within one week from date of shipment to enable the Employer to make progressive payment to the Contractor and also make necessary arrangement for payment of custom duties etc. The Contractor will be responsible for any consequent expenses due to delay in furnishing the above documentation.

21.5.2 For Domestic Goods

Upon shipment, the Contractor shall notify the employer and the Insurance Company by cable or telex of the full details of the dispatch including Contract number, description of goods, quantity, R/R or L/R number and date, place of loading, date of dispatch etc. The Contractor shall mail the following documents to the Employer, with a copy to Insurance Company:

1) Copies of the Contractor’s invoice showing Contract Agreement reference, goods description, quantity, unit price, total amount (6 copies);

2) Copies of packing list identifying contents of each package (6 copies);

3) Railway receipt / Receipted LR ;

4) Manufacturer’s / Contractor’s guarantee certificate of Quality.
5) Material Inspection & Clearance Certificate (MICC) for dispatch issued by the Employer’s representative and the Contractor’s factory inspection report & test certificate (3 copies) and insurance certificate (3 copies); and

6) Certificate of origin.

21.6 Packing

21.6.1 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.

21.6.2 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.

21.7 Indemnity Bond

For the equipment/material to be provided by the Contractor, it will be the responsibility of the Contractor to take delivery, unload and store the material at Site and execute an Indemnity Bond and obtain authorization letter from Employer as per proforma given at Section-IV in favour of the Employer against loss, damager and any risks involved for the full value of the material. This Indemnity Bond shall be furnished by the Contractor before commencement of the supplies and shall be valid till the scheduled date of Operational Acceptance of the equipment by the Employer.

22. Installation

22.1 Setting Out/Supervision/Labour

22.1.1 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.

22.1.2 Contractor’s Supervision:

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

22.1.3 Labour:

(a) The Contractor shall provide and employ on the Site in the installation of the Facilities such skilled, semi-skilled and unskilled labour as is necessary for the proper and timely execution of the Contract. The Contractor is encouraged to use local labour that has the necessary skills.

(b) Unless otherwise provided in the Contract, the Contractor shall be responsible for the recruitment, transportation, accommodation and catering of all labour, local or expatriate, required for the execution of the Contract and for all payments in connection therewith.
(c) The Contractor shall be responsible for obtaining all necessary permit(s) and/or visa(s) from the appropriate authorities for the entry of all labour and personnel to be employed on the Site into the country where the Site is located.

(d) The Contractor shall at its own expense provide the means of repatriation to all of its and its Subcontractor’s personnel employed on the Contract at the Site to their various home countries. It shall also provide suitable temporary maintenance of all such persons from the cessation of their employment on the Contract to the date programmed for their departure. In the event that the Contractor defaults in providing such means of transportation and temporary maintenance, the Employer may provide the same to such personnel and recover the cost of doing so from the Contractor.

(e) 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 labour of its Subcontractors.

(f) The Contractor shall, in all dealings with its labour and the labour 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 labour.

22.2 Contractor’s Equipment

22.2.1 All Contractors’ Equipment brought by the Contractor onto the Site shall be deemed to be intended to be used exclusively for the execution of the Contract. The Contractor shall not remove the same from the Site without the Project Manager’s consent that such Contractor's Equipment is no longer required for the execution of the Contract.

22.2.2 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.

22.2.3 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.

22.3 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.

22.3.1 Compliance with Labour Regulations

22.3.1.1 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 there under, regulations notifications and bye laws of the State or Central Government or local authority and any other labour law (including rules), regulations, bye 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 not case shall be treated as the employees of the Employer at any point of time.

22.3.1.2 The Contractor shall keep the employer indemnified in case any action is taken against the employer by the competent authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments.

22.3.1.3 If the Employer is caused to pay under any law as principal employer such amounts as may be necessary to cause or as 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 Employer shall have the right to deduct any money due to the Contractor under this contract or any other contract with employer including his amount of performance security for adjusting the aforesaid payment. The Employer 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 Employer.

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

a) Workmen Compensation Act 1923: 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: 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 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: The Act provides for monthly contribution by the employer plus workers @ 10% or 8.33%. The benefits under the Act are:

1) Pension or family pension on retirement or death, as the case may be.
2) Deposit linked insurance on death in harness of the worker.
3) Payment of P.F. accumulation on retirement/death etc.

d) Maternity Benefit Act 1951: 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: 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 labour contract labour.

f) Minimum Wages Act 1948: The Employer 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: It lays down as to by what date the wages are to paid, when it will be paid and what deductions can be made from the wages of the workers.

h) Equal Remuneration Act 1979: 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: 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.

j) Industrial Dispute Act 1947: 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: 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 on matters provided in the Act and get the same certified by the designated Authority.

l) Trade Unions Act 1926: The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.


n) Inter-State Migrant workmen’s (Regulation of Employment & Conditions of Service) Act 1979: 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 and the Cess Act of 1996: 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 Employer of the establishment is required to provide safety measures at the 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 Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the government.

p) Factories Act 1948: The Act lays down the procedure for approval at plans before setting up a factory, heath 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.

22.3.2 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, 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 of 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, 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, 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: 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 or matters connected herewith or incidental thereto.

Hazardous substance means any substance or preparation which is defined as hazardous substance under Environment (Protection) Act, 1986, and exceeding such quantity as be specified by notification by the Central Government.

22.4 Opportunities for Other Contractors

22.4.1 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.

22.4.2 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.

22.4.3 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.

22.4.4 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.

22.5 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 therefore. If the work done or caused to be done by the Employer is work that the Contractor was liable to do at its own expense under the Contract, the reasonable costs incurred by the Employer in connection therewith shall be paid by the Contractor to the Employer. Otherwise, the cost of such remedial work shall be borne by the Employer.

22.6 Site Clearance

22.6.1 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.
22.6.2 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.

22.7 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.

22.8 Work at Night and on Holidays

22.8.1 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 CC Sub-Clause 22.8.1 shall not apply to any work which is customarily carried out by rotary or double-shifts.

22.8.2 Notwithstanding CC Sub-Clauses 22.8.1 or 22.1.3, 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.

23. Test and Inspection

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

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

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

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

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

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

23.6 If any Plant 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 CC Sub-Clause 23.3. If the inspection is not materialized due to the reasons attributable to contractor then all the expenses including to & fro airfare and TA, DA shall be to the account of the contractor.
23.7 If any dispute or difference of opinion shall arise between the parties in connection with or arising out of the test and/or inspection of the Plant 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 Arbitration for determination in accordance with CC Sub-Clause 6.2

23.8 The Contractor shall afford the Employer and the Project Manager, at the Employer's expense, access at any reasonable time to any place where the Plant 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.

23.9 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 CC Sub-Clause 23.4, shall release the Contractor from any other responsibilities under the Contract.

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

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

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

24. Completion of the Facilities

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

24.2 Within seven (7) days after receipt of the notice from the Contractor under CC Sub-Clause 24.1, the Employer shall supply the operating and maintenance personnel specified in Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement for Precommissioning of the Facilities or any part thereof.

Pursuant to Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement, the Employer shall also provide, within the said seven (7) day period, the raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters required for Precommissioning of the Facilities or any part thereof.

24.3 As soon as reasonably practicable after the operating and maintenance personnel have been supplied by the Employer and the raw materials, utilities, lubricants, chemicals, catalysts, facilities, services and other matters if so specified in Appendix-6 (scope of works and supply by the Employer) have been provided by the Employer in accordance with CC Sub-Clause 24.2, the Contractor shall commence Precommissioning of the Facilities or the relevant part there of in preparation for Commissioning.

24.4 As soon as all works in respect of Precommissioning are completed and in the opinion of the Contractor, the facilities or any part thereof is ready for commissioning, the contractor shall commence Commissioning as per procedures stipulated in Technical Specification and as soon
as Commissioning is satisfactorily completed, the Contractor shall so notify the Project Manager in writing. (Also refer CC 25.2.3)

24.5 The Project Manager shall, within fourteen (14) days after receipt of the Contractor's notice under CC Sub-Clause 24.4, either issue a Completion Certificate in the form specified in the Forms and Procedures section in the bidding documents, stating that the Facilities or that part thereof have reached Completion as at the date of the Contractor's notice under CC Sub-Clause 24.4, or notify the Contractor in writing of any defects and/or deficiencies.

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

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

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

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

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

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

25. Commissioning and Operational Acceptance

25.1 Commissioning

25.1.1 Commissioning of the Facilities or any part thereof shall be completed by the Contractor as per procedures detailed in Technical Specifications.

If any Plant and Equipment or any part of the Facilities fails during Commissioning, the Contractor shall either rectify (if fault is minor) or replace such Plant and Equipment or part of the Facilities.

25.1.2 The Employer shall unless otherwise specified in Technical Specifications supply the operating and maintenance personnel and all raw material, utilities, lubricants, chemicals, catalysts, facilities, service and other matters required for Commissioning.

25.2 Guarantee Test

25.2.1 The Guarantee Test (and repeats thereof) shall be conducted by the Contractor after commissioning of the Facilities or the relevant part thereof to ascertain whether the Facilities or the relevant part can attain the Functional Guarantees specified in the Contract Documents. The Contractor's and Project Manager's advisory personnel shall attend the Guarantee Test. The Employer shall promptly provide the Contractor with such information as the Contractor may reasonably require in relation to the conduct and results of the Guarantee Test (and any repeats thereof).
25.2.2 If for reasons not attributable to the Contractor, the Guarantee Test of the Facilities or the relevant part thereof cannot be successfully completed within the period from the date of Completion specified in the CC or any other period agreed upon by the Employer and the Contractor, the Contractor shall be deemed to have fulfilled its obligations with respect to the Functional Guarantees, and CC Sub-Claususes 28.2 and 28.3 shall not apply.

The Guarantee Test of the Facilities shall be successfully completed within twenty-six weeks from the date of Completion.

25.2.3 Completion - Guarantee test - acceptance

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

25.2.3.1 When the Contractor is notified by the Project Manager that he will be unable to proceed with the activities and obligations pursuant to above Sub-Clause CC 25.2.3, 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 CC Sub-Clause 26.2.

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 subject activities, shall be released to the Contractor against submission of a security in the form of a bank guarantee of equivalent amount acceptable to the Employer, and which shall become null and void when the Contractor will have complied with its obligations regarding these payments, subject to the provisions of Sub-Clause CC 25.2.3.2 below.

c) the expenses toward the 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.

d) the additional charges toward the care of the Facilities pursuant to CC Sub-Clause 32.1 shall be reimbursed to the Contractor by the Employer for the period between the notification mentioned above and the notification mentioned in Sub-Clause CC 25.2.3.3 below. The provisions of CC sub-Clause 33.2 shall apply to the Facilities during the same period.

25.2.3.2 In the event that the period of suspension under Sub-Clause CC 25.2.3 actually exceeds one hundred eighty (180) days, the Employer and the Contractor shall mutually agree to any additional compensation payable to the Contractor.

25.2.3.3 When the Contractor is notified by the Project Manager that the Facilities are ready for Precommissioning, the Contractor shall proceed without delay in performing all activities and obligations under the Contract.

25.3 Operational Acceptance

25.3.1 Subject to CC Sub-Clause 25.4 (Partial Acceptance) below, Operational Acceptance shall occur in respect of the Facilities or any part thereof when

(a) the Guarantee Test has been successfully completed and the Functional Guarantees are met; or

(b) the Guarantee Test has not been successfully completed or has not been carried out for reasons not attributable to the Contractor within the period from the date of Completion
specified in the CC or any other agreed upon period as specified in CC Sub-Clause 25.2.2 above but successful completion of the facilities has been achieved; or

(c) the Contractor has paid the liquidated damages specified in CC Sub Clause 28.3 hereof; and

(d) any minor items mentioned in CC Sub-Clause 24.7 hereof relevant to the Facilities or that part thereof have been completed.

(e) as built drawings, and operating and maintenance manuals and CD’s etc. as per Technical Specifications of the Bidding Documents are furnished.

25.3.2 At any time after any of the events set out in CC Sub-Clause 25.3.1 have occurred, the Contractor may give a notice to the Project Manager requesting the issue of an Operational Acceptance Certificate in the form provided in the Bidding Documents or in another form acceptable to the Employer in respect of the Facilities or the part thereof specified in such notice as at the date of such notice.

25.3.3 The Project Manager shall, after consultation with the Employer, and within twenty-one (21) days after receipt of the Contractor’s notice, issue an Operational Acceptance Certificate.

25.3.4 If within twenty one (21) 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.

25.4 Partial Acceptance

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

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

F. Guarantees and Liabilities

26. Completion Time Guarantee

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

26.2 If the Contractor fails to comply with the Time for Completion in accordance with Clause CC 26 for the whole of the facilities, then the Contractor shall pay to the Employer a sum equivalent to half percent (0.5%) of the Contract Price 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 Operational Acceptance Certificate of the whole of the work subject to the limit of 5% of Contract Price. 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.

For the application of liquidated damages, the schedule date for Operational Acceptance of the entire system shall be the basis, and not intermediate schedule milestone.
26.3 No bonus will be given for earlier Completion of the Facilities or part thereof.

27. Defect Liability

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

27.2 The Defect Liability Period shall be five years from the date of Operational Acceptance of the 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.

27.3 The Contractor's obligations under this CC Clause 27 shall not apply to

(a) any materials that are supplied by the Employer under CC Sub-Clause 21.2 (Employer-Supplied Plant, Equipment and Materials), 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 CC Sub-Clause 27.7.

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

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

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

If such part fails the tests, the Contractor shall be carry out further repair, replacement or making good (as the case may be) until that part of the Facilities passes such tests.

The tests in character shall in any case be not less than what has already been agreed by the employer and the Contractor for the original equipment/part of the Facilities.

27.7 If the Contractor fails to commence the work necessary to remedy such defect or any damage to the Facilities caused by such defect within a reasonable time (which shall in no event be considered to be less than 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 amount due the Contractor or claimed under the Performance Security.
27.8 If the facilities or any part thereof cannot be used by reason of such defect and/or making good of such defect, the Defect Liability Period of the Facilities or such part, as the case may be, shall be extended by a period equal to the period during which the Facilities or such part cannot be used by the Employer because of any of the aforesaid reasons.

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 of Sixty (60) months from the time such replacement/repair of the facilities or any part thereof.

27.8.1 At the end of 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 five (5) 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 CC Clause 27, but later.

27.9 Except as provided in CC Clauses 27 and 33 (Loss of or Damage to Property/ Accident or Injury to Workers/Indemnification), 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 operational acceptance or any part thereof, except where such defects are the result of the gross negligence, fraud, criminal or willful action of the Contractor.

27.10 In addition, the Contractor shall also provide an extended warranty for any such component of the Facilities and during the period of time as may be specified in the CC. Such obligation shall be in addition to the defect liability specified under CC Sub-Clause 27.2.

28. Functional Guarantee

28.1 The Contractor guarantees that during the Guarantee Test, the Facilities and all parts thereof shall attain the Functional Guarantees specified in Appendix 8 (Functional Guarantees) to the Contract Agreement, subject to and upon the conditions therein specified.

28.2 If, for reasons attributable to the Contractor, the minimum level of the Functional Guarantees specified in Appendix 8 (Functional Guarantees) to the Contract Agreement are not met either in whole or in part, the Contractor shall at its cost and expense make such changes, modifications an/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 CC Sub-Clause 42.2 and recover the payments already made to the Contractor.

28.3 If, for reasons attributable to the Contractor, the Functional Guarantees specified in Appendix 8 (Functional Guarantees) to the Contract Agreement are not attained either in whole or in part, but the minimum level of the Functional Guarantees specified in Appendix 8 (Functional Guarantees) to the Contract Agreement is met, the Contractor shall, at the Employer'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 Appendix 8 (Functional Guarantees) to the Contract Agreement.

28.4 In case the Employer exercises its option to accept the equipment after levy of liquidated damages, the payment of liquidated damages under CC sub clause 28.3, up to the limitation of liability specified in the Appendix-8 (Functional Guarantees) to the Contract Agreement, shall completely satisfy the Contractor's guarantees under CC Sub clause 28.3, and the Contractor shall have not 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.
28.5 Functional Guarantees, Liquidated Damages for Non-Performance
(Applicable for power transformer & Auxiliary transformer)

28.5.1 The bidder shall guarantee that the equipment offered shall meet the rating and performance requirements stipulated for various equipment covered in this specification. The bidder shall also furnish a declaration in the manner prescribed and included in the relevant schedule of Bid Form & Price Schedules for guarantees, which shall attract levy of liquidated damages for non-performance.

28.5.2 If the guarantees are not established at factory tests in case of power transformer & auxiliary transformer then the Employer at his discretion may reject or accept the equipment after assessing the liquidated damages as per table below in Clause 28.5.4 against the Contract and such amounts shall be deducted from the Contract Price or otherwise recovered from the Contractor.

28.5.3 In case of power Transformer and auxiliary Transformer, the measured loss for each equipment shall be corrected in accordance with IEC-289 & IEC-76 for the purpose of comparison of guaranteed losses with measured losses for levy of liquidated damages. However power Transformer and auxiliary Transformer under no circumstances shall be accepted if the measured losses are more than +15 percent of the guaranteed losses at rated voltage quoted by the bidders.

28.5.4 Differential Price Factors for Evaluation and Liquidated Damages

(a) The factors and the respective Indian Rupees value per unit of differential loss for the purpose of calculation of differential price for the bid evaluation as specified in 24.6 (e) of ITB and Liquidated Damages shall be as stipulated below:-

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Equipment</th>
<th>Parameter to be taken for applying differential price factor (F)</th>
<th>Value of F in Indian Rupees per unit of parameter differential per kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>A)</td>
<td>160 MVA Power transformer</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Differential copper loss (kw)</td>
<td>@ Rs.69900/-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Differential iron loss (kw)</td>
<td>@ Rs.171300/-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Differential Cooler loss (kw)</td>
<td>@ Rs.68500/-</td>
</tr>
<tr>
<td>B)</td>
<td>100 MVA Power transformer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td></td>
<td>Differential copper loss (kw)</td>
<td>@ Rs.69900/-</td>
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<tr>
<td>b)</td>
<td></td>
<td>Differential iron loss (kw)</td>
<td>@ Rs.171300/-</td>
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<td>c)</td>
<td></td>
<td>Differential Cooler loss (kw)</td>
<td>@ Rs.68500/-</td>
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<tr>
<td>C)</td>
<td>Auxiliary Transformer</td>
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<tr>
<td>a)</td>
<td></td>
<td>Differential copper loss (kw)</td>
<td>@ Rs.69900/-</td>
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<tr>
<td>b)</td>
<td></td>
<td>Differential iron loss (kw)</td>
<td>@ Rs.171300/-</td>
</tr>
</tbody>
</table>

(b) For bid evaluation, the best parameter of loss quoted at rated voltage, rated frequency, rated current and at 75°C by any technical responsive bidder shall be taken as basis and that quoted by the particular bidder shall be used to arrive at differential price to be applied for the bid.

29. Patent Indemnity

29.1 The Contractor shall, subject to the Employer's compliance with CC SubClause 29.2, indemnify and hold harmless the Employer and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Employer may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract by reason of: (a) the installation of the Facilities by the Contractor or the use of the Facilities in the country where the Site is located; and (b) the sale of the products produced by the Facilities in any country.

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

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

30. Limitation of Liability

30.1 Except in cases of criminal negligence or willful misconduct,

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

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

G. Risk Distribution

31. Transfer of Ownership

31.1 Ownership of the plant and equipment (including spare parts) to be imported into the country where the site is located shall be transferred to the Employer upon loading on to the mode of transport to be used to convey the Plant and Equipment from the country of origin to that country and upon endorsement of the dispatch documents in favour of Employer.

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

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

31.4 Ownership of any Plant 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.

31.5 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 CC Clause 32 (Care of Facilities) hereof until Completion of the Facilities or the part thereof in which such Plant and Equipment are incorporated.

32. Care of Facilities

32.1 The Contractor shall be responsible for the care and custody of the Facilities or any part thereof until the date of Completion of the Facilities pursuant to CC Clause 24 (Completion of the Facilities) 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 CC Clause 27 (Defect Liability). Notwithstanding the foregoing, the Contractor shall not be liable for any loss or damage to the Facilities or that part thereof caused by reason of any of the matters specified or referred to in paragraphs (a), (b) and (c) of CC SubClauses 32.2 and 38.1.

32.2 If any loss or damage occurs to the Facilities or any part thereof or to the Contractor's temporary facilities by reason of

(a) (insofar as they relate to the country where the Site is located) nuclear reaction, nuclear radiation, radioactive contamination, pressure wave caused by aircraft or other aerial objects, or any other occurrences that an experienced contractor could not reasonably foresee, or if reasonably foreseeable could not reasonably make provision for or insure against, insofar as such risks are not normally insurable on the insurance market and are mentioned in the general exclusions of the policy of insurance, including War Risks and Political Risks, taken out under CC Clause 34 (Insurance) hereof

(b) any use or occupation by the Employer or any third party (other than a Subcontractor) authorized by the Employer of any part of the Facilities

(c) any use of or reliance upon any design, data or specification provided or designated by or on behalf of the Employer, or any such matter for which the Contractor has disclaimed responsibility herein. The Employer shall pay to the Contractor all sums payable in respect of the Facilities executed, notwithstanding that the same be lost, destroyed or damaged, and will pay to the Contractor the replacement value of all temporary facilities and all parts thereof lost, destroyed or damaged. If the Employer requests the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Contractor shall make good the same at the cost of the Employer in accordance with CC Clause 39 (Change in the Facilities). If the Employer does not request the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Employer shall either request a change in accordance with CC Clause 39 (Change in the Facilities), excluding the performance of that part of the Facilities thereby lost, destroyed or damaged, or, where the loss or damage affects a substantial part of the Facilities, the Employer shall terminate the Contract pursuant to CC SubClause 42.1 (Termination for Employer's Convenience) hereof, except that the Contractor shall have no entitlement to profit under paragraph (e) of CC Sub Clause 42.1.3 in respect of any unexecuted Facilities as at the date of termination.

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

32.4 With respect to any loss or damage caused to the Facilities or any part thereof or to the Contractor's Equipment by reason of any of the matters specified in CC Sub-Clause 38.1, the provisions of CC Sub-Clause 38.3 shall apply.
33. Loss of or Damage to Property; Accident or Injury to Workers; Indemnification

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

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

If the Contractor fails to notify the Employer within 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.

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

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

34. Insurance

34.1 To the extent specified in 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) Cargo Insurance During Transport

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

(b) Installation All Risks Insurance

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

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

(d) Automobile Liability Insurance

Covering use of all vehicles used by the Contractor or its Subcontractors (whether or not owned by them) in connection with the execution of the Contract.

(e) Workers' Compensation

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

(f) Employer's Liability

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

(g) Other Insurances

Such other insurances as may be specifically agreed upon by the parties hereto as listed in the said Appendix 3.

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

34.3 The Contractor shall, in accordance with the provisions of 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.

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

34.5 The Employer shall at its expense take out and maintain in effect during the performance of the Contract those insurances specified in 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 CC Sub-Clause 34.5.

34.6 If the Contractor fails to take out and/or maintain in effect the insurances referred to in CC Sub-Clause 34.1, the Employer may take out and maintain in effect any such insurances and may from time to time deduct from any amount due the Contractor under the Contract any premium that the Employer shall have paid to the insurer, or may otherwise recover such amount as a
debt due from the Contractor. If the Employer fails to take out and/or maintain in effect the
insurances referred to in CC 34.5, the Contractor may take out and maintain in effect any such
insurances and may from time to time deduct from any amount due the Employer under the
Contract any premium that the Contractor shall have paid to the insurer, or may otherwise
recover such amount as a debt due from the Employer. If the Contractor fails to or is unable to
take out and maintain in effect any such insurances, the Contractor shall nevertheless have no
liability or responsibility towards the Employer, and the Contractor shall have full recourse
against the Employer for any and all liabilities of the Employer herein.

34.7 Unless otherwise provided in the Contract, the Contractor shall prepare and conduct all any
claims made under the policies effected by it pursuant to this CC Clause 34, and the monies
payable by any insurers under all the insurance except Third Party Liability Insurance, Workers'
Compensation, and Employer's Liability, shall be paid to the joint account of the Employer and
the Contractor 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.

35. Unforeseen Conditions

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

(a) the physical conditions or artificial obstructions on the Site that could not have been
reasonably foreseen
(b) the additional work and/or Plant and Equipment and/or Contractor's Equipment required,
including the steps which the Contractor will or proposes to take to overcome such
conditions or obstructions
(c) the extent of the anticipated delay
(d) the additional cost and expense that the Contractor is likely to incur.

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

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

35.3 If the Contractor is delayed or impeded in the performance of the Contract because of any such
physical conditions or artificial obstructions referred to in CC Sub-Clause 35.1, the Time for
Completion shall be extended in accordance with CC Clause 40 (Extension of Time for
Completion).
36. Change in Laws and Regulations

36.1 If, after the date twenty-eight (28) days prior to the date of Bid submission, in the country where the Site is located, any law, regulation, ordinance, order or by-law having the force of law is enacted, promulgated, abrogated or changed (which shall be deemed to include any change in interpretation or application by the competent authorities) that subsequently affects the costs and expenses of the Contractor and/or the Time for Completion, the Contract Price shall be correspondingly increased or decreased, and/or the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been affected in the performance of any of its obligations under the Contract. 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. Further, no adjustment of the Contract Price shall be made on account of variation in deemed export benefits. 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.

37. Force Majeure

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

(a) war, hostilities or warlike operations (whether a state of war be declared or not), invasion, act of foreign enemy and civil war

(b) rebellion, revolution, insurrection, mutiny, usurpation of civil or military government, conspiracy, riot, civil commotion and terrorist acts

(c) confiscation, nationalization, mobilization, commandeering or requisition by or under the order of any government or de jure or de facto authority or ruler or any other act or failure to act of any local state or national government authority

(d) strike, sabotage, lockout, embargo, import restriction, port congestion, lack of usual means of public transportation and communication, industrial dispute, shipwreck, shortage or restriction of power supply, epidemics, quarantines and plague

(e) earthquake, landslide, volcanic activity, fire, flood or inundation, tidal wave, typhoon or cyclone, hurricane, storm, lightning, or other inclement weather condition, nuclear and pressure waves or other natural or physical disaster

(f) shortage of labour, materials or utilities where caused by circumstances that are themselves Force Majeure.

37.2 If either party is prevented, hindered or delayed from or in performing any of its obligations under the Contract by an event of Force Majeure, then it shall notify the other in writing of the occurrence of such event and the circumstances thereof within fourteen (14) days after the occurrence of such event.

37.3 The party who has given such notice shall be excused from the performance or punctual performance of its obligations under the Contract for so long as the relevant event of Force Majeure continues and to the extent that such party's performance is prevented, hindered or delayed. The Time for Completion shall be extended in accordance with CC Clause 40 (Extension of Time for Completion).

37.4 The party or parties affected by the event of Force Majeure shall use reasonable efforts to mitigate the effect thereof upon its or their performance of the Contract and to fulfill its or their obligations under the Contract, but without prejudice to either party's right to terminate the Contract under CC Sub Clauses 37.6 and 38.5.

37.5 No delay or nonperformance by either party hereto caused by the occurrence of any event of Force Majeure shall
(a) constitute a default or breach of the Contract

(b)(subject to CC Sub-Clauses 32.2, 38.3 and 38.4) give rise to any claim for damages or additional cost or expense occasioned thereby if and to the extent that such delay or nonperformance is caused by the occurrence of an event of Force Majeure.

37.6. If the performance of the Contract is substantially prevented, hindered or delayed for a single period if more than sixty (60) days or an aggregate period of more than one hundred and twenty (120) days on account of one or more events of Force Majeure during the currency of the Contract, the parties will attempt to develop a mutually satisfactory solution, failing which the dispute will be resolved in accordance with CC Clause 6.

37.7. Notwithstanding CC Sub-Clause 37.5, Force Majeure shall not apply to any obligation of the Employer to make payments to the Contractor herein.

38. War Risks

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

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

(a) destruction of or damage to Facilities, Plant & Equipment, or any part thereof

(b) destruction of or damage to property of the Employer or any third party

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

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

(a) any part of the Facilities or the Plant and Equipment so destroyed or damaged (to the extent not already paid for by the Employer)

(b) replacing or making good any Contractor's Equipment or other property of the Contractor so destroyed or damaged,

(c) replacing or making good any such destruction or damage to the Facilities or the Plant and Equipment or any part thereof so far as may be required by the Employer, and as may be necessary for completion of the facilities.

If the Employer does not require the Contractor to replace or make good any such destruction or damage to the Facilities, the Employer shall either request a change in accordance with CC Clause 39 (Change in the Facilities), excluding the performance of that part of the Facilities thereby destroyed or damaged or, where the loss, destruction or damage affects a substantial part of the Facilities, shall terminate the Contract, pursuant to CC Sub-Clause 42.1 (Termination for Employer's Convenience).

38.4 Notwithstanding anything contained in the Contract, the Employer shall pay the Contractor for any increased costs or incidentals to the execution of the Contract that are in any way attributable to, consequent on, resulting from, or in any way connected with any War Risks, provided that the Contractor shall as soon as practicable notify the Employer in writing of any such increased cost.
38.5 If during the performance of the Contract any war risks shall occur that financial or otherwise materially affect the execution of the Contract by the Contractor with due and proper consideration given to the safety of its and its Subcontractors personal engaged in the work on the facilities, provided, however, that if the execution of the work on the facilities becomes impossible or is substantially prevented for a single period of more than sixty (60) days or an aggregate period of more than the one hundred and twenty (120) days on account of any war Risks, the parties will attempt to develop a mutually satisfactory solution, failing which the dispatch will be resolved in accordance with CC Clause 6.

38.6 In the event of termination pursuant to CC Sub Clause 38.3, the rights and obligation of the employer and the Contractor shall be specified in CC Sub-Clause 42.1.2 and 42.1.3, except that the Contract shall have no entitlement to profit under paragraph (e) of CC Sub Clause 42.13 in respect of any unexecuted facilities as of the date of termination.

H. Change in Contract Elements

39. Change in the Facilities

39.1 Introducing a Change

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

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

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

39.1.4 The procedure on how to proceed with and execute Changes is specified in CC Sub-Clauses 39.2 and 39.3, and further details and sample forms are provided in the Sample Forms and Procedures section in the bidding documents.

39.2 Changes Originating from Employer

39.2.1 If the Employer proposes a Change pursuant to CC Sub-Clause 39.1.1, it shall send to the Contractor a "Request for Change Proposal," requiring the Contractor to prepare and furnish to the Project Manager as soon as reasonably practicable a "Change Proposal," which shall include the following:

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

39.2.2 Prior to preparing and submitting the "Change Proposal," the Contractor shall submit to the Project Manager an "Estimate for Change Proposal," which shall be an estimate of the cost of preparing and submitting the Change Proposal. Upon receipt of the Contractor's Estimate for Change Proposal, the Employer shall do one of the following:
(a) accept the Contractor's estimate with instructions to the Contractor to proceed with the preparation of the Change Proposal

(b) advise the Contractor of any part of its Estimate for Change Proposal that is unacceptable and request the Contractor to review its estimate

(c) advise the Contractor that the Employer does not intend to proceed with the Change.

39.2.3 Upon receipt of the Employer's instruction to proceed under CC Sub-Clause 39.2.2 (a), the Contractor shall, with proper expedition, proceed with the preparation of the Change Proposal, in accordance with CC Sub-Clause 39.2.1.

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

39.2.5 If before or during the preparation of the change proposal it becomes apparent that the aggregate effect of compliance therewith and with all other change orders that have already become binding upon the contractor under this CC Clause 39 would be increase or decrease the contractor price as originally set forth in Article- 2 (Contract price and Terms of payment) of the contract agreement by more than fifteen (15) percent, the Contract may given a written notice of objection there to prior to furnish the change proposal as aforesaid. If the employer accept the contractors objection, the employer and the contractor shall agree on specific rates for valuation of the change.

The Contractor failure to so object shall neither affect its right to object to any subsequent requested change or change orders herein, nor affect its right to taken into account, when making such subsequent objection, the percentage increase or decrease in the contract price that any change not objected to by the contractor represents.

39.2.6 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. Upon receipt of the change proposal, the employer and the contract shall mutually agree upon all matters therein contained. With in fourteen (14) days after such agreement, the employer shall, if it intends to proceed with change, issue the contractor with a change order.

If the employer is unable to reach a decision within fourteen (14) days, it shall notify the contractor with details of when the contractor can expect a decision.

If the employer decides not to proceed with the change for whatever reason, it shall, with in the said period of fourteen (14), notify the contractor accordingly. Under such circumstances, the contractor shall be entitled to reimbursement of all costs reasonably incurred by it in the preparation of the change proposal, provided that these do not exceed.

The amount given by the Contract in its estimate for charge proposal submitted in accordance with CC Sub – Clause 39.2.2.

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

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

If the parties cannot reach agreement within sixty (60) days from the date of issue of the Pending Agreement Change Order, then the matter may be referred to the Arbitration in accordance with the provisions of CC Sub-Clause 6.2 (Arbitration).
39.3 Changes Originating from Contractor

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

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

39.4 The scope of work under the package(s) shall be as per the Technical Specification, Vol - II of bidding Documents. The quantity variation applicable for the existing scope shall be generally as per the following.

a) The employer reserves the right to increase or decrease the quantity of different items of the specified goods and services to the extent of fifteen percent (15%) of the contract prices, by way of suitable amendment to the contract, without any change in unit rate/price and/or other terms and conditions of the contract. However, the quantities of individual items of goods and services may vary up to any extent.

b) The contract price for (i) items for which quantities have been indicated as lumpsum / lot/ set (ii) items for which quantities were to be estimated by the bidder, including additional items (falling under (i) and/or (ii)) considered necessary by the bidder for successful completion of the works as per TS and indicated by him in his bid, shall remain constant unless there is change made in the scope of work by the employer. The quantities and unit prices (a) subsequently arrived while approving the bill of quantities (BOQ)/ billing breakup of lumpsum/lot/set quantities and/or (b) quantities estimated by the bidder /contractor shall be for on account payment purpose only. In case additional quantities, over and above the quantities in BOQ/ billing break up and/or estimated by the bidder/contractor are required for the successful completion of the scope of work as per technical specification, the contractor shall execute additional quantities of these items for which no additional payments 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 property of the contractor and than shall be allow 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 break up and/or estimated by the bidder/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 bidder to pay all statutory taxes, duties and levies to the concerned authority’s surplus material which would otherwise have been, lawfully payable. The bidder shall submit an indemnity bond to keep the employer harmless from any liability, before release to such material to the bidder by the employer.

c) The quantity variation from the existing scope shall be notified to the contractor within four months from the date of Letter of Award.

40. Extension of Time for Completion

40.1 The Time(s) for Completion specified in the CC 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 CC Clause 39 (Change in the Facilities)

(b) any occurrence of Force Majeure as provided in CC Clause 37 (Force Majeure), unforeseen conditions as provided in CC Clause 35 (Unforeseen Conditions), or other occurrence of any of the matters specified or referred to in paragraphs (a), (b) and (c) of CC Sub-Clause 32.2

(c) any suspension order given by the Employer under CC Clause 41 (Suspension) hereof or reduction in the rate of progress pursuant to CC Sub-Clause 41.2 or
(d) any changes in laws and regulations as provided in CC Clause 36 (Change in Laws and Regulations) or

(e) any default or breach of the Contract by the Employer, specifically including failure to supply the items listed in Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement, or any activity, act or omission of any other contractors employed by the Employer or

(f) 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.

40.2 Except where otherwise specifically provided in the Contract, the Contractor shall submit to the Project Manager a notice of a claim for an extension of the Time for Completion, together with particulars of the event or circumstance justifying such extension as soon as reasonably practicable after the commencement of such event or circumstance. As soon as reasonably practicable after receipt of such notice and supporting particulars of the claim, the Employer and the Contractor shall agree upon the period of such extension. In the event that the Contractor does not accept the Employer's estimate of a fair and reasonable time extension, the Contractor shall be entitled to refer the matter to an Arbitration, pursuant to CC Sub-Clause 6.2 (Arbitration).

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

41. Suspension

41.1 The Employer may request the Project Manager, by notice to the Contractor, to order the Contractor to suspend performance of any or all of its obligations under the Contract. Such notice shall specify the obligation of which performance is to be suspended, the effective date of the suspension and the reasons thereof. 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 CC Clause 39 (Change in the Facilities), 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 CC Clause 39 (Change in the Facilities) or, where it affects the whole of the Facilities, as termination of the Contract under CC Sub-Clause 42.1 (Termination for Employer's Convenience).

41.2 In case,

(a) the Employer has failed to pay the Contractor any sum due under the Contract within the specified period, has failed to approve any invoice or supporting documents without just cause pursuant to Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement, or commits a substantial breach of the Contract, the Contractor may give a notice to the Employer that requires payment of such sum, with interest thereon as stipulated in CC Sub-Clause 12.3, requires approval of such invoice or supporting documents, or specifies the breach and requires the Employer to remedy the same, as the case may be. If the Employer fails to pay such sum together with such interest, fails to approve such invoice or supporting documents or give its reasons for withholding such approval, or fails to remedy the breach or take steps to remedy the breach within fourteen (14) days after receipt of the Contractor's notice or
(b) the Contractor is unable to carry out any of its obligations under the Contract for any reason attributable to the Employer, including but not limited to the Employer's failure to provide possession of or access to the Site or other areas in accordance with CC Sub-Clause 10.2, or failure to obtain any governmental permit necessary for the execution and/or completion of the Facilities; then the Contractor may by fourteen (14) days' notice to the Employer suspend performance of all or any of its obligations under the Contract, or reduce the rate of progress.

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

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

42. Termination

42.1 Termination for Employer's Convenience

42.1.1 The Employer may at any time terminate the Contract for any reason by giving the Contractor a notice of termination that refers to this CC Sub-Clause 42.1.

42.1.2 Upon receipt of the notice of termination under CC Sub-Clause 42.1.1, 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 CC SubClause 42.1.3, 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 at 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.

42.1.3 In the event of termination of the Contract under CC Sub-Clause 42.1.1, 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. The 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 CC Sub-Clause 42.1.2

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.

42.2 Termination for Contractor's Default

42.2.1 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 therefore to the Contractor, referring to this CC Sub-Clause 42.2:

(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 CC Clause 43 (Assignment).

(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.

For the purpose of this sub-clause :

"corrupt practice" means the offering, giving, receiving or soliciting of any thing of value to influence the action of a public official in the procurement process or in contact execution.

"fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Borrower, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Borrower of the benefits of free and open competition”.

42.2.2 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 CC Sub-Clause 41.2) 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 labour to execute and complete the Facilities in the manner specified in the program furnished under CC Clause 18.2 (Program of Performance) 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 CC SubClause 42.2

42.2.3 Upon receipt of the notice of termination under CC Sub-Clauses 42.2.1 or 42.2.2, 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 Works and to the Plant and Equipment as at 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 at the date of termination in connection with the Facilities.

42.2.4 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.

42.2.5 Subject to CC Sub-Clause 42.2.6, the Contractor shall be entitled to be paid the Contract Price attributable to the Facilities executed as at 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 CC SubClause 42.2.3. Any sums due 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.

42.2.6 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 CC SubClause 42.2.5, plus the reasonable costs incurred by the Employer in completing the Facilities, exceeds the Contract Price, the Contractor shall be liable for such excess.

If such excess is greater than the sums due the Contractor under CC SubClause 42.2.5, the Contractor shall pay the balance to the Employer, and if such excess is less than the sums due the Contractor under CC Sub-Clause 42.2.5, the Employer shall pay the balance to 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.

42.3 Termination by Contractor

42.3.1 If
(a) The Employer has failed to pay the Contractor any sum due under the Contract within the specified period, has failed to approve any invoice or supporting documents without just cause pursuant to Appendix 1 (Terms and Procedures of Payment) of the Contract Agreement, or commits a substantial breach of the Contract, the Contractor may give a notice to the Employer that requires payment of such sum, with interest thereon as stipulated in CC Sub-Clause 12.3, requires approval of such invoice or supporting documents, or specifies the breach and requires the Employer to remedy the same, as the case may be. If the Employer fails to pay such sum together with such interest, fails to approve such invoice or supporting documents or give its reasons for withholding such approval, fails to remedy the breach or take steps to remedy the breach within fourteen (14) days after receipt of the Contractor's notice, or

(b) The contractor is unable to carry out any of its obligations under the contract for any reason attributable to the employer, including but not limited to the employer's failure to provide possession of or access to the site or other areas or failure to obtain any governmental permit necessary for the execution and/or completion of the Facilities, which the employer is required to obtain as per provision of the contract as per relevant applicable laws of the country.

then the Contractor may give a notice to the Employer thereof, and if the Employer has failed to pay the outstanding sum, to approve the invoice or supporting documents, to give its reasons for withholding such approval, or to remedy the breach within twenty-eight (28) days of such notice, or if the Contractor is still unable to carry out any of its obligations under the Contract for any reason attributable to the Employer within twenty-eight (28) days of the said notice, the Contractor may by a further notice to the Employer referring to this GCC Sub-Clause 42.3.1, forthwith terminate the Contract.

42.3.2 The Contractor may terminate the Contract forthwith by giving a notice to the Employer to that effect, referring to this CC Sub-Clause 42.3.2, if the Employer becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, being a corporation, if 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 Employer takes or suffers any other analogous action in consequence of debt.

42.3.3 If the Contract is terminated under CC Sub-Clauses 42.3.1 or 42.3.2, then the Contractor shall immediately

(a) cease all further work, except for such work as may be necessary for the 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 and repatriate the Contractor's and its Subcontractor's personnel from the Site

(d) In addition, the Contractor, subject to the payment specified in CC SubClause 42.3.4, 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 drawings, specifications and other documents prepared by the Contractor or its Subcontractors as of the date of termination in connection with the Facilities.

42.3.4 If the Contract is terminated under CC Sub-Clauses 42.3.1 or 42.3.2, the Employer shall pay to the Contractor all payments specified in CC Sub-Clause 42.1.3, and reasonable compensation for all loss or damage sustained by the Contractor arising out of, in connection with or in consequence of such termination.
42.3.5 Termination by the Contractor pursuant to this CC Sub-Clause 42.3 is without prejudice to any other rights or remedies of the Contractor that may be exercised in lieu of or in addition to rights conferred by CC Sub-Clause 42.3.

42.4 In this CC Clause 42, the expression "Facilities executed" shall include all work executed, Installation Services provided, and 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.

42.5 In this CC Clause 42, 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 Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement.

43. Assignment

43.1 Neither the Employer nor the Contractor shall, without the express prior written consent of the other (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.

44 Construction of the contract

44.1 The contracts to be entered into with the successful bidder shall be as under.

For Foreign bidder:

--- "First contract" for CIF supply of all equipment and materials including mandatory spares:

--- “Second Contract” for Ex-works supply of all equipment and materials including mandatory spares:

--- “Third contract” for providing all services i.e. port handling and custom clearance for the imported goods, further loading and inland transportation for delivery at site, unloading, storage handling at site, installation, testing and commissioning including performance testing in respect of all the equipments supplied under both “First contract” and “Second Contract” and any other services specified in the contract documents.

For Domestic Bidder:

--- “First contract” for Ex-works supply and CIF supply, if any of all equipment and materials including mandatory spares identifying separately the CIF and Ex-works components of the supply.

--- “Second Contract” for providing all services i.e. inland transportation for delivery at site, unloading, storage handling at site, installation, testing and commissioning including performance testing in respect of all the equipments supplied under “First contract” and any other services specified in the contract documents.

44.2 The award of 2/3 separate contract (in case of foreign bidder) /two separate contracts (in case of domestic bidder) shall not in any way dilute the responsibility of the contractor for the successful completion if the facility as per specification and breach in one contract shall automatically be construed as a breach of the others contracts which will confer a right on the employer to terminate the others contracts also at the risk and the cost of the contractor.

44.3 If the foreign bidder has proposed an assignee in his bid to execute the second and / or Third contact and has also furnished written unequivocal consent of the proposed Assignee to work as independent contractor on the terms offered by the bidder and the employer is satisfied with experience/qualification of the proposed Assignee, the employer will enter in to the Second Contractor and/ or “Third Contract” with the said Assignee. Further, the said Assignee, in addition to the contract performance security o be provided by the contractor for ten percent (10%) of the value of all three contract i.e. first contract, second contract and third contract, shall provide with in twenty-eight (28) days of the notification of Contract award, Contract
performance security equivalent to ten (10%) of the value of the second contract and/or Third Contract for the due performance of Contract with a validity up to sixty (60) days beyond the defect liability period. It is expressly understood and agreed that all the three Contract shall contain the aforesaid cross fall clause.

44.4 It is further expressly understood and agreed that in case the option is not exercised by the bidder or the Assignee fails to enter in to the second Contractor and/ or third contract with the employer or if the employer in its judgment does not fined acceptance of the proposed assignee as its Contractors, then the bidder shall obliged to enter in to and execute all the three contracts with the employer and all the three Contracts shall contain the aforesaid cross fall breach clause.

44.5 In case of two/ three contracts entered into as above or where the employer hands over his equipment to the contractor for executing the contract than the contractor shall at the time of taking delivery of equipment through bill of lading 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 purposed of the said Contract. Samples of Performa for the Trust receipt and Indemnity bond are enclosed under Section IV (Sample forms and procedures). The employer shall also issue separate authorization letter to the Contract to enable him to take physical delivery of plant, equipment and materials from the employer as per Performa enclosed under Section IV (sample forms and procedures).

44.6 The Contract will be signed in two original and the contractor shall be provided with one signed original and the rest will be retained by the employer.

44.7 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.

44.8 Subsequent to signing of the contract, the contractor at his own cost shall provide the employer with at least fifteen (15) true copies of contract agreement within thirty (30) days after signing of the contract.

45. Specific Requirement

The bidder shall be responsible for safety of human and equipment during the working. It will be the responsibility of the Contractor to co-ordinate and obtain clearance from Electrical Inspectors (Govt. of NCT of Delhi) before commissioning. Any additional items, modification due to observation of such statutory authorities shall be provided by the Contractor at no extra cost to the Employer. However the necessary fee of the Inspector shall be reimbursed by DTL.
1. BID FORM

Please Refer Volume III
2. BID SECURITY FORM

Date: .............
IFB No.: ...........

Name of Contract:...........................

To: (Name and Address of Employer)

WHEREAS ..................................(name of Bidder) (hereinafter called "the Bidder") has submitted its Bid dated ...................................(date of bid) for the performance of the above-named Contract (hereinafter called "the Bid")

KNOW ALL PERSONS by these present that WE....................................(name of bank) of.................. (address of bank) (hereinafter called "the Bank"), are bound unto...............................(name of Employer) (hereinafter called "the Employer") in the sum of: ................................................ 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; or

(3) If the bidder does not accept the correction of its Bid Price pursuant to ITB Sub Clause 21.2; or

(4) If, as per the Qualifying Requirements the Bidder has 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 31, or
   (ii) to furnish the required performance security, in accordance with ITB Clause 32.

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 (the date 45 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)

in the capacity of

..........................

Common Seal of the Bank

Note: 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.
3a. FORM OF NOTIFICATION BY THE EMPLOYER TO THE BIDDER

M/s................

Ref.: Your proposal against our IFB
No.................................................................Forfeiture of Bid Guarantee amount.

Dear Sirs,

Whereas you have furnished as a part of your proposal the Bid Guarantee in the form of irrevocable and confirmed Letter of Credit No..........................................................dated.................. opened by ......................... ..................for a sum of ..........................................................

(Bank's name)

..........................................................payable to .................................................Name of the Employer) on demand without any reservation, demur or protest, contest and recourse at..........................(Name and place of Bank).

In terms of the aforesaid Bid Guarantee, we do hereby forfeit the Guarantee amount.

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

(AUTHORISED SIGNATORY)

N.B. The Letter of Credit should not stipulate any other proforma of notification different from this format. No change whatsoever in the said proforma is acceptable to the Employer.
3b. FORM OF SIGHT DRAFT

Drawn under L.C.
No.......................................................dated.................................of......................................................
.................................................................................................................................................................
(Name of Bank that opened the L.C.)

At sight promptly pay to..................................................................................................................................
.................................................................................................................................................................
(Name of the Bank at which L.C. is negotiable)

or order sum of.......................................................................................(for payment to the Employer) for value
received...................................................................................................(Amount of L.C.)

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

(AUTHORISED SIGNATORY)

To,

(Name and Address of the Bank which opened L.C.)
4a. FORM OF NOTIFICATION OF AWARD OF CONTRACT FOR SUPPLY OF PLANT AND EQUIPMENT

NOTE: INSTRUCTIONS INDICATED IN ITALICS IN THIS NOTIFICATION OF AWARD ARE TO BE TAKEN CARE OF BY THE ISSUING AUTHORITY.

Ref. No.: 
Date: 
…..(Contractor's Name & Address)…..

Attn: Mr.………..

Sub: Notification of Award of Contract for Supply of.......................................................... (Package Name) ........................................ as per Specification No.………………

Dear Sir,

1.0 This has reference to the following:

(i) Our Invitation for Bids (IFB) No. ………………………………… dated ……………

(ii) Bidding Documents for the subject package issued to you vide our letter no. ………… dated……………………..comprising the following:

…………………… (List out all the Sections/Volumes of the Bidding Documents along with Tender Drawings etc. as issued to the bidder) ……………………………………………

Errata/Amendment No……………… to……………… (Name of Section/Volume of the Bidding Documents to which Errata/Amendment pertains)............... issued to you vide our letter no……………… dated…………………….

(Applicable only if any Errata/Amendment to the Bidding Documents has been issued subsequently)

(iii) Clarifications furnished to you on the Bidding Documents vide our letter no………………..dated ……..based on the query raised by you/one of the prospective bidders. (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)

(iv) Your Proposal for the subject package submitted vide your letter No. ……………………….. dated…………………………and its modification vide letter no……………… dated ………………

(Delete if not applicable).


(Applicable only if any extension has been sought subsequently)

(INCLUDE AS FURTHER SUB-PARAGRAPHS ANY OTHER CORRESPONDENCE MADE TO
OR BY THE BIDDER AFTER BID OPENING)

(vi) Our Fax message/letter No…………………….dated……………………………….. inviting you for post bid discussions.

(vii) Post bid discussions and meetings we had with you from……………………..to ……………….. resulting into the following Minutes of Meeting enclosed herein with this Notification of award:

(a) Minutes of Meeting regarding Commercial issues (APPENDIX - ....)
(b) Minutes of Meeting on Technical issues (APPENDIX - ....)
(c) Minutes of Meeting regarding Work Schedule (APPENDIX - ....)
(d) Minutes of Meeting regarding Quality Assurance Aspects (APPENDIX- ......)

2.0 We confirm having accepted your proposal submitted vide letter no. ………………. dated ...............and its modification vide letter no……………..dated (Delete if not applicable) read in conjunction with all the specifications, terms & conditions of the Bidding Documents, Your subsequent letters (Use if relevant) and agreed Minutes of Meeting referred to in para 1.0 above and award on you the Contract for the work of ............................(Indicate brief Scope of Work)………………………………………………...(Name of Package) ………………………... for ……………(Name of project) …………………..…as per Specification No. : ……………..(hereinafter referred to as the 'First Contract').

3.0 We have also notified you vide our Notification of Award No........……….... dated ................ for award of another Contract on you for the work of .................... (Indicate brief scope of work of the Second Contract) .............. of the equipment/materials to be supplied by you under this 'First Contract' including Performance and Guarantee test for complete ..............(Name of Package)............... for ..............(Name of Project)............... as per Specification No..............(hereinafter referred to as the 'Second Contract').

You shall also be fully responsible for the works to be executed under the 'Second Contract' and it is expressly understood and agreed by you that any breach under the 'Second Contract' shall automatically be deemed as a breach of this 'First Contract' and vice-versa and any such breach or occurrence or default giving us a right to terminate the 'Second Contract' and/or recover damages thereunder, shall give us an absolute right to terminate this Contract and/or recover damages under this 'First Contract' as well and vice-versa. However, such breach or default or occurrence in the 'Second Contract' shall not automatically relieve you of any of your responsibility/obligations under this 'First Contract'. It is also expressly understood and agreed by you that the equipment/materials to be supplied by you under this 'First Contract' when installed and commissioned under the 'Second Contract' shall give satisfactory performance in accordance with the provisions of the Contract.

4.0 The total Contract Price for the entire scope of work under the Contract shall be ........(Specify the amount in INR)................................ as per the following break up:

(i) Ex-manufacturing works/place ..........................................................
of despatch price (both in India)/ CIF/CIP port of entry price
(Use as Applicable)
for Main Equipment

(ii) Ex-manufacturing works/place ..........................................................
of despatch price (both in India)/ CIF/CIP port of entry price
(Use as Applicable)
for Mandatory Spares
(iii) Type test charges ..........................................................................................................................................
(Delete if not applicable)

TOTAL (i + ii + iii)

(.................. (Specify the total amount in words).........................)

5.0 You shall prepare and finalise the Contract Documents for signing of the formal Contract Agreement and shall enter into the Contract Agreement with us, as per the proforma enclosed with the Bidding Documents, on non-judicial stamp paper of appropriate value within.................(Specify)............days from the date of this Notification of Award.

6.0 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 all the enclosed Appendices, by the authorised signatory of your company as a proof of your acknowledgement and confirmation.

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)

Encl. : As above.
4b. FORM OF 'NOTIFICATION OF AWARD OF CONTRACT' FOR INSTALLATION OF PLANT AND EQUIPMENT

NOTE: INSTRUCTIONS INDICATED IN ITALICS IN THIS NOTIFICATION OF AWARD ARE TO BE TAKEN CARE OF BY THE ISSUING AUTHORITY.

Ref. No. :
Date :

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

Attn : Mr.---------

Sub : Notification of Award of Contract for Installation, testing and commissioning of .......... (Package Name) ............... as per Specification No. ..................

Dear Sir,

1.0 This has reference to the following:

(i) Our Invitation for Bids (IFB) No. .......................... dated ...........

(ii) Bidding Documents for the subject package issued to you vide our letter no. .......... dated.......................... comprising the following:

............................................(List out all the Sections/Volumes of the Bidding Documents along with Tender Drawings etc. as issued to the bidder)................................................................. Errata/Amendment No............. to...........................(Name of Section/Volume of the Bidding Documents to which Errata/Amendment pertains) ............issued to you vide our letter no. .......... dated.............

(Applicable only if any Errata/Amendment to the Bidding Documents has been issued subsequently)

(iii) Clarifications furnished to you on the Bidding Documents vide our letter no........... dated ................. based on the query raised by you/one of the prospective bidders (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)


(Applicable only if any extension has been sought subsequently)

(INCLUDE AS FURTHER SUB-PARAGRAPHS ANY OTHER CORRESPONDENCE MADE TO OR BY THE BIDDER AFTER BID OPENING)

(vi) Our Fax message/letter No. ............... dated ............... inviting you for post bid discussions.
Post bid discussions and meetings we had with you from ............to ........... resulting into the following Minutes of Meeting enclosed herein with this Notification of Award:

(a) Minutes of Meeting regarding Commercial issues (APPENDIX - ....)
(b) Minutes of Meeting on Technical issues (APPENDIX - ....)
(c) Minutes of Meeting regarding Work Schedule (APPENDIX - ....)
(d) Minutes of Meeting regarding Quality Assurance Aspects (APPENDIX - ....)

2.0 We confirm having accepted your proposal submitted vide letter no. .................dated............... and its modification vide letter no. .................dated .................(Delete if not applicable) read in conjunction with all the specifications, terms & conditions of the Bidding Documents, Your subsequent letters (Use if relevant) and agreed Minutes of Meeting referred to in para 1.0 above and award on you the Contract for the work of ............(Indicate brief Scope of Work)................. of .................(Name of Package) ................. for .................(Name of project) ................. as per Specification No.: .................(hereinafter referred to as the 'Second Contract').

3.0 We have also notified you vide our Notification of Award No. .................dated................. for award of another Contract on you for the work of ............(Indicate brief scope of work of the First Contract) ................. of the equipment/ materials to be supplied by you under the 'First Contract' including Performance and Guarantee Test for complete .................(Name of Package) ................. for .................(Name of Project) ................. as per Specification No.: .................(hereinafter referred to as the 'First Contract'). You shall also be fully responsible for the works to be executed under the 'First Contract' and it is expressly understood and agreed by you that any breach under the 'First Contract' shall automatically be deemed as a breach of this 'Second Contract' and vice-versa and any such breach or occurrence or default giving us a right to terminate the 'First Contract' and/or recover damages there-under, shall give us an absolute right to terminate this Contract and/or recover damages under this 'Second Contract' as well and vice-versa. However, such breach or default or occurrence in the 'First Contract' shall not automatically relieve you of any of your responsibility/obligations under this 'Second Contract'. It is also expressly understood and agreed by you that the equipment/materials to be supplied by you under the 'First Contract' when erected and commissioned under this 'Second Contract' shall give satisfactory performance in accordance with the provisions of the Contract.

4.0 The total Contract Price for the entire scope of work under the Contract shall be ..............(Specify the amount in INR) .............. as per the following break up:

(i) Inland transportation and inland transit insurance charges including port clearance, port handling and port charges (Delete if not applicable) for Main Equipment: ..............................................................

(ii) Inland transportation and inland transit insurance charges including port clearance, port handling and port charges (Delete if not applicable) for Mandatory Spares: ..............................................................

(iii) Unloading and handling at site, storage, erection, testing and commissioning including performance testing and insurance covering all the activities: ..............................................................

TOTAL (i + ii + iii) ..............................................................

.....................................................................................................(Specify the total amount in words)
5.0 You shall prepare and finalize the Contract Documents for signing of the formal Contract Agreement and shall enter into the Contract Agreement with us, as per the proforma enclosed with the Bidding Documents, on non-judicial stamp paper of appropriate value within ................. ...(Specify)......... ...days from the date of this Notification of Award.

6.0 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 all the enclosed Appendices, by the authorized signatory of your company as a proof of your acknowledgement and confirmation.

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)
5. FORM OF CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT is made the ……………............... day of ............, 20………..

BETWEEN

(1) .................................................................a corporation incorporated under the laws
(Name of Employer)
of ..................................................................and having its principal place of business
(law of country of Employer)
at.....................................................(Address of Employer) (hereinafter called "the Employer")

and

(2) ..........................................................., a corporation incorporated under the laws of
(Name of Contractor)
…………………………………………….. and having its principal place of business
(Country of Contractor)
at ………………………………..… (Address of Contractor) (hereinafter called "the Contractor")

WHEREAS the Employer desires to engage the Contractor to design, manufacture, test, deliver, install,
complete and commission certain Facilities, viz.

……..........................................................................................("the Facilities") and the
(List of Facilities)
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 CC Clause 2)

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

(1) This Contract Agreement and the Appendices hereto

(2) Notification of Award.

(3) Conditions of Contract

(4) Technical Specifications and Drawings

(5) The Bid and Price Schedules submitted by the Contractor

(6) Procedures (as listed)

(7) Any other documents shall be added here

1.2 Order of Precedence (Reference CC 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 CC Clause 1)

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

Article 2. Contract Price and Terms of Payment

2.1 Contract Price (Reference CC Clause 11)

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 INR in words)
- ………………………………………………………………………………………………………………….. (amount in figures)

or such other sums as may be determined in accordance with the terms and conditions of the Contract.

2.2 Terms of Payment (Reference CC Clause 12)

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 CC Clause 1)

The Time of Completion of Facilities shall be determined from the date of the Notification of Award provided all of the following conditions have been fulfilled within a period of two (2) months from the date of said Notification of Award:

(a) This Contract Agreement has been duly executed for and on behalf of the Employer and the Contractor;

(b) The Contractor has submitted to the Employer the Performance Security and the Advance Payment Guarantee;

(c) The Employer has paid the Contractor the Advance Payment.

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

3.2 If the Conditions listed under 3.1 are not fulfilled within two (2) months from date of Notification of Award because of reasons attributable to the Employer, the contract would become effective only from the date of fulfillment of the above conditions and, the parties shall discuss and agree on an equitable adjustment to the Contract Price and the time for completion and/or other relevant conditions of the Contract. The Contractor shall not however, benefit (in reckoning the Time for Completion) on account of its delay in providing the Performance Security or the Bank Guarantee
Article 4. It is expressly understood and agreed by and between the Contractor and the Employer that the Employer is entering into this Agreement solely on its own behalf and not on behalf of any other person or entity. In particular it is expressly understood and agreed that the Government of India (GoI) is not a party to this Agreement and has no liabilities, obligations or rights hereunder. It is expressly understood and agreed that the Employer is an independent legal entity with power and authority to enter into contracts solely on its own behalf under the applicable laws of India and the general principals of Contract Law. The Contractor expressly agrees, acknowledges and understands that the Employer is not an Agent, Representative or Delegate of the GoI. It is further understood and agreed that the GoI is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the Contract. Accordingly, the Contractor expressly waives, releases and foregoes any and all actions or claims, including cross claims, impleader claims or counter claims against the GoI arising out of this Contract and covenants not to sue the GoI as to any manner, claim, cause of action or thing whatsoever arising of or under this Agreement.

Article 5. Appendices

The Appendices listed in the attached List of Appendices 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.

Article 6. Notwithstanding the award of contract under two/three separate contracts, any breach under one contract shall be deemed to be a breach of the other contract(s).

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

CONTRACT AGREEMENT
dated the ................................................. day of ............................ 20.....

BETWEEN

("the Employer")

and

("the Contractor")

(Separate Contract Agreements shall be executed by the Employer and the Contractor in accordance with
the Construction of the Contract stipulated at *clause 28.4 of ITB*. The forms of Contract would be similar except for necessary changes required to suit the individual Contracts).

**APPENDICES**

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In accordance with the provisions of CC Clause 12 (Terms of Payment), the Employer shall pay the Contractor in the following manner and at the following times, on the basis of the Price Break-up given in the section on price schedules. Payments will be made in Indian currency i.e. INR. The Contractor may make applications for payment in respect of part deliveries as work proceeds.

1. **TERMS OF PAYMENT**

1.1 In addition to the Conditions stipulated under CC Clause 12, the following terms & Conditions will apply.

**Supply Portion**

1.2 **Advance Payment:** 10% (Ten percent) of the CIF/Ex-works price component (inclusive of mandatory spares) of the Contract price shall be paid as * interest bearing advance after signing the Contract Agreement and on submission of:

- i) unconditional acknowledgement of LOA by the contractor
- ii) Contractor's detailed invoice
- iii) unconditional and irrevocable Advance Bank Guarantee** for 110% of the advance amount
- iv) Performance Security
- v) Detailed BAR CHART and its approval by DTL
- vi) Execution of Contract Agreement.

Note:
* This payment is an optional payment. The Contractor has the option of taking the interest bearing initial advance or otherwise. In case, the Contractor opts for this interest bearing initial advance, the same shall be paid to the Contractor on fulfillment of above conditions and an interest on monthly outstanding amount will be charged at the rate of SBI PLR +1% at the time of disbursement of advance. The monthly outstanding amount for the purpose of calculating the interest shall be worked out at the end of each calendar month considering proportionate adjustment of advance against dispatch payment. In case, the Contractor opts not to take interest bearing advance as above, it would be mandatory for him to submit the documents listed at S. No.(i), (iv) and (v) above within thirty (30) days of issuance of LOA.

** In case the Contract is awarded to a Joint Venture, the Advance Bank Guarantee shall be in the name of the Joint Venture covering all partners of the Joint Venture and not in the name of the lead partner or any partner(s) of the Joint Venture alone.
The bank guarantee(s) for advance shall be kept valid till 90 days after issuance of Operational Acceptance Certificate. Recovery of the advance amount shall be made from each running bill proportionately.

1.3 **Progressive Payment**

1.3.1 Thirty percent (30%)^ of the CIF/Ex-Works price component of Equipment/Materials (including Mandatory Spares) shall be paid progressively through irrevocable Letter of Credit (L/C) establish in favour of the Contractor after dispatch of the Equipment/Materials and on submission of documents indicated herein under:

- (a) Evidence of despatch
- (i) Rail Receipt or Lorry Receipt for goods supplied from within India
(ii) Original (3/3) of the negotiable clean on-board bill of lading/Air way Bill marked freight prepaid and non-negotiable bill of lading/Air way bill for goods supplied from abroad.

(b) Contractor’s detailed invoice & packing list identifying contents of each shipment.

(c) Insurance policy/certificate

(d) Manufacturer’s/Contractor’s guarantee certificate of Quality.

(e) Material Inspection Clearance Certificate (MICC) for despatch issued by the Employer’s representative as applicable.

(f) Test certificate

(g) Certificate of Origin

^ In case, the Contractor opts not to take interest bearing initial advance then this payment shall be 40% instead of 30%.

Further, Twenty five percent (25%) of the CIF / Ex-Works price (inclusive of mandatory spares) of each item shipped shall be paid after receipt and storage of material at site and on physical verification by the Employer.

Further twenty percent (20%) of the CIF / Ex-works price component (inclusive of mandatory spares) shall be paid progressively after successful erection of the equipments/materials at site and duly verified by site incharge of Employer.

1.4 Final Payment

The final fifteen percent (15%) of the CIF / Ex-Works price component (inclusive of mandatory spares) of the equipment shall be paid on final issuance of Operational Acceptance Certificate after successful completion of erection, testing and commissioning, proof of submission of the required no. of reproducible, O&M manuals, approved drawings, data sheets, test reports, pamphlets and manual of spares, maintenance & testing equipment etc.

1.5 Price Component for Installation (including Civil Works) and Services

(a) Advance

Ten percent (10%) of the total Contract Price for services viz. installation (including civil works) component except inland transportation (including port handling) & inland insurance shall be paid as * interest bearing initial advance on establishment of Contractor’s Site office and submission of a bank guarantee* of equivalent amount valid till 90 days after issuance of Operational Acceptance Certificate.

*This payment is an optional payment. The Contractor has the option of taking the interest bearing advance or otherwise.

In case, the Contractor opts for this interest bearing advance, the same shall be paid to the Contractor on fulfillment of above conditions and an interest on monthly outstanding amount will be charged at the rate of SBI PLR +1% at the time of disbursement of advance. The monthly outstanding amount for the purpose of calculating the interest shall be worked out at the end of each calendar month against the progressive payment for the work done.

In case, the Contractor opts not to take interest bearing advance as above, it would be mandatory for him to submit the documents listed at S. No.(i), (iv) and (v) above within thirty (30)days of issuance of LOA.

*In case the Contract is awarded to a Joint Venture, the Advance Bank Guarantee shall be in the name of the Joint Venture covering all partners of the Joint Venture and not in the name of the lead partner or any partner(s) of the Joint Venture alone.
(b) Progressive Payment

i) Seventy percent (70%) of the total installation (including civil works) component of the Contract price (In case the contractor opts not to take interest bearing advance as above) or Sixty percent (60%) of the total installation (including civil works) component of the Contract price (In case the contractor opts to take interest bearing advance as above) shall be paid on certification by employer representative for the successful completion of installation services based on milestone.

ii) The further fifteen percent (15%) payment shall be paid after successful testing & commissioning.

iii) The balance fifteen percent (15%) of the total installation (including civil works) price components of contracts price shall be paid on final issuance of Operational Acceptance Certificate after successful completion of erection, testing and commissioning, proof of submission of the required no. of reproducible, O&M manuals, approved drawings, data sheets, test reports, pamphlets and manual of spares, maintenance & testing equipment etc.

iv) Hundred percent (100%) of inland transportation (including port handling) and inland insurance charges shall be paid to the Contractor pro-rata to the value of the equipment received at site and on production of invoices by the Contractor. The aggregate of all such pro-rata payments shall, however, not exceed the total amount quoted by the bidder in his proposal and incorporated in the Contract.

1.6 Taxes & Duties

Taxes & Duties in respect of transaction between Employer and the Contractor and octroi/entry tax as applicable for destination site/state on all items of supply including bought-out finished items (as identified in the Contract), which shall be dispatched directly from the sub-vendor’s works to the Employer’s site (sale-in-transit) will be paid after each shipment against documentary evidence. This payment shall be released by Employer directly to the Contractor against invoices to be submitted by the Contractor.

1.7 Type Test Charges

The type test charges shall be paid on successful completion of all type tests specified and on approval of the test results by the employer. In case, the type test is waived off subsequent to the award of the work on the request of vendor and accepted by DTL and if it changes the merit order position of the vendor from Lowest bidder to second lowest, then an amount equivalent to the extent that it does not change its Lowest position plus the type test charges quoted by the vendor shall be deducted.

1.8 Training Charges

Contractor shall organize and conduct complete & thorough Training programme (to be conducted in English language) providing necessary training material at no extra cost to the employer. However, the travelling and living expenses of owner’s engineers, if any, shall be borne by the owner. The training shall be carried out at site for 120 mandays to cover testing, operation & maintenance aspects so as to ensure the complete adequacy of the programme.
2. PAYMENT PROCEDURES

2.1 Method of Payment

The Employer shall make payments promptly within thirty (30) days of submission of an invoice/claim by the Contractor. All the payment shall be released to the Contractor directly except the payment due on shipment, which shall be paid through irrevocable confirmed Letter of Credit. The Letter of Credit shall be established by the Employer in time for shipments to be made as scheduled.

Note: Pro-rata shall refer to functionally complete part(s) of the facilities, for which unit rates are identified in the contract.
APPENDIX 2

PRICE ADJUSTMENT

The prices are to remain FIRM and FIXED for the duration of the Contract except for Power Transformer and Civil Works.

1. Price adjustment for 160/100MVA Power Transformer

The price variation as per latest IEEMA (Indian Electrical & Electronic Manufacturers Association) formula shall be applicable for power transformer as given below:

PRICE VARIATION CLAUSE FOR POWER TRANSFORMERS COMPLETE WITH ALL ACCESSORIES AND COMPONENTS
(of ratings above 10 MVA or voltage above 33 KV)
supplied against domestic contracts

This price variation clause is applicable for ‘Power Transformers’ of all type including Auto, Generating Transformers etc. with either rating of above 10 MVA or voltages above 33 KV. The clause is to be used for domestic contracts. A separate price variation clause IEEMA/PVC/POWER/DE/2003 has been evolved for above types of Transformers supplied against export/deemed export contract against duty free inputs under special imprest licensing scheme.

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

\[ P = \frac{P_o \left(13 + 23 \frac{C}{Co} + 28 \frac{ESo}{ES} + 7 \frac{ISo}{IS} + 7 \frac{IMo}{IM} + 7 \frac{TBo}{TB} + 15 \frac{Wo}{W} \right)}{100} \]

Wherein,

- \( P \) = Price payable as adjusted in accordance with the above formula.
- \( P_o \) = Price quoted/confirmed.
- \( Co \) = Average LME settlement price of copper wire bars (refer notes)
  This price is as applicable for the month, two months prior to the date of tendering.
- \( ESo \) = C&F price of CRGO Electrical Steel Sheets (refer notes)
  This price is as applicable on the 1st working day of the month, one month prior to the date of tendering.
- \( ISo \) = Wholesale price index number for ‘Iron & Steel(Base:1993-94=100)’ (refer notes).
  This index number is as applicable for the week ending 1st Saturday of the month, three months prior to the date of tendering.
- \( IMo \) = Price of insulating Materials (refer notes)
  This price is as applicable on the 1st working day of the month, one month prior to the date of tendering.
- \( TBo \) = Price of Transformer Oil Base Stock (refer notes)
  This price is as applicable on the 1st working day of the month, two month prior to the date of tendering.
- \( Wo \) = All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Govt. of India (Base 1982 = 100)
  This index number is as applicable on the 1st working day of the month, three months prior to the date of tendering.
For example, if date of tendering falls in May 2004, the applicable prices of Copper Wire Bars (Co) and Transformer Oil Base Stock (TBo) should be for the month March 2004, where as the applicable price of CRGO Steel Sheets (ESo), insulating material (Imo) should be as on 1st April 2004 and Wholesale price index number for ‘Iron & Steel’ (ISo) should be for the week ending first Saturday of February 2004 and all India average consumer price index no. (Wo) should be for the month of February 2004.

The above prices and indices are as published by IEEMA vide circular reference number IEEMA(PVC)/TRF/-/- prevailing as on first working day of the month ........... i.e., one month prior to the date of delivery.

\[ C = \text{Average LME settlement price of copper wire bars (refer notes)} \]
This price is as applicable for the month, four months prior to the date of delivery.

\[ ES = \text{C&F price of CRGO ‘MOH’ grade Electrical Steel Sheets (refer note)} \]
This price is as applicable on the 1st working day for the month, three months prior to the date of delivery.

\[ IS = \text{Wholesale price index number for ‘Iron & Steel (Base 1993-94=100’) (refer notes)} \]
This index number is as applicable for the week ending 1st Saturday of the month, three months prior to the date of delivery.

\[ IM = \text{Price of insulating Materials (refer notes)} \]
This price is as applicable on the 1st working day of the month, three months prior to the date of delivery.

\[ TB = \text{Price of Transformer Oil Base Stock (refer notes)} \]
This price is as applicable on the 1st working day of the month, two months prior to the date of delivery.

\[ W = \text{All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Govt. of India (Base 1982 = 100)} \]
This index number is as applicable on the first working day of the month, three months prior to the date of delivery.

For example, if date of delivery in terms of clause given below falls in December 2004, the applicable prices of Copper Wire Bars (C) and Transformer Oil Base Stock (TB) should be for the months August2004 and October 2004 respectively; where as the applicable prices of CRGO Steel Sheets (ES), insulating material (IM) should be as on 1st September 2004 and Wholesale price index number for ‘Iron & Steel’ (IS) should be for the week ending first Saturday of September 2004 and all India average consumer price index no. (W) should be for the month of September 2004.

The date of delivery is the date on which the transformer is notified as being ready for inspection/despatch (in the absence of such notification, the date of manufacturer’s despatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

Note:

(a) All prices of raw materials are exclusive of modvatable excise/CV duty amount and exclusive of other central, state or local taxes, octroi etc. transformers manufactures import major raw materials like per, CRGO Steel Sheets, TOBS and insulating pressboards etc. The landed cost of these imported raw erials includes applicable custom duty but exclusive of countervailing duty.

(b) All prices are as on first working day of the month.

(c) The details of prices are as under.

1) The LME price of Copper Wire Bars (in Rs./MT) is the LME average settlement price of Copper Wire Bars for one month prior to the month of the circular converted into Indian Rupees with applicable exchange rates prevailing as on 1st working day of the subsequent month. This price is the landed cost, inclusive of applicable customs duty only but exclusive of countervailing duty.

2) The price of CRGO MOH grade Electrical Steel sheets (in Rs./MT) is the average C&F price in US $ per MT converted into Indian Rupees with applicable exchange rate prevailing as on 1st working
day of the month, as quoted by primary producers. This price is the landed cost, inclusive of applicable customs duty only but exclusive of countervailing duty.

3) The wholesale price index number for ‘Iron & Steel’ is as published by the Office of Economic Advisor Ministry of Industry, Govt. of India, New Delhi with base 1993-94=100. This wholesale price index number is being published weekly on provisional basis. However, the same gets finalized after eight weeks and is normally available after two months. Therefore, we are considering in our calculations this final index for the first Saturday of the months two months prior to the date of which the prices of other raw materials such as Al. IM are published for the corresponding month.

4) The price of insulating materials (in Rs./Kg) of pre-compressed pressboards of size 10 mm. thick, 3200 mm x 4100mm. is the average C&F price in free currency per MT converted into Indian Rupees with applicable exchange rates prevailing as on 1st working day of the month as quoted by primary suppliers. This price is the landed cost, inclusive of applicable customs duty only but exclusive of countervailing duty.

5) The price of TOBS is C&F price (in Rs./K Ltr) for N-50 grade Oil as published in ICIS-LOR bulletin for the 1st week of the previous month. This price is normally published in US$ per US Gallon, which is converted in Rs./K Ltr with applicable exchange rate prevailing on 1st working day of the subsequent month. This price is the landed cost, inclusive of applicable customs duty only but exclusive of countervailing duty.

2. Price adjustment for Civil Works

The cost of Civil Works as per approved indices of CPWD where completion period is less than eighteen months due to increase/decrease in price of cement and steel reinforcement bars after receipt of tender as given below:

**CLAUSE:**

**PAYMENT DUE TO INCREASE/DECREASE IN PRICES OF CEMENT AND STEEL REINFORCEMENT BARS AFTER RECEIPT OF TENDER.**

If after submission of the tender, the price of cement and/or steel reinforcement bars incorporated in the works (not being a material supplied from the Engineer-in-Charge’s stores in accordance with relevant contract clause thereof) increase(s) beyond the price(s) prevailing at the time of the last stipulated date for receipt of tenders (including extensions, if any) for the work, then the amount of the contract shall accordingly be varied and provided further that any such increase shall not be payable if such increase has become operative after the stipulated date of completion of work in question.

If after submission of the tender, the prices of cement and/or steel reinforcement bars incorporated in the works (not being materials stipulated from the Engineer-in-Charge’s stores in accordance with the relevant contract clause thereof) is decreased. DTL shall in respect of these materials incorporated in the works (not being materials supplied from the Engineer-in-Charge’s stores in accordance with the relevant contract clause thereof) be entitled to deduct from the dues of the contractor such amount as shall be equivalent to the difference between the prices of cement and/or steel reinforcement bars as prevailed at the time of last stipulated date for receipt of tenders including extensions if any for the work and the prices of these materials on the coming into force of such base price of cement and/or steel reinforcement bars issued under authority of Director General (Works) CPWD.

The increase/decrease in prices shall be determined by the All India Wholesale Price Indices for Cement and Steel (bars and rods) as published by Economic Advisor to Government of India, Ministry of Commerce and Industry and base price for cement and/or steel reinforcement bars as issued under authority of Director General (Works), CPWD as valid on the last stipulated date of receipt of tender, including extension if any and for the period under consideration.

The amount of the contract shall accordingly be varied for cement and/or steel reinforcement bars and will be worked out as per the formula given below:

a) **Adjustment for component of ‘Cement’**

\[
V_c = \frac{C_l - C_{lo}}{C_{lo}} \times P_c \times Q_c
\]
Where,

- **Vc** = Variation in cement cost i.e. increase or the amount in rupees to be paid or recovered.
- **Pc** = Base price of cement as issued under authority of DG(W), CPWD valid at the time of the last stipulated date of receipt of tender including extensions, if any.
- **Qc** = Quantity of cement used in the works since previous bill.
- **Clo** = All India Wholesale Price Index for cement as published by the Economic Advisor to Government of India, Ministry of Industry and Commerce & issued by DG (W) CPWD as valid on the last stipulated date of receipt of tenders including extensions, if any.
- **CI** = All India Wholesale Price Index for cement for period under consideration as published by Economic advisor to Government of India, Ministry of Industry and Commerce & issued by DG (W) CPWD.

b) Adjustment for component of ‘Steel’

\[
Vs = \frac{Ps \times Qs \times (Sl - Slo)}{Slo}
\]

Where,

- **Vs** = Variation in cost of steel reinforcement bars i.e. increase or decrease in the amount in rupees to be paid or recovered.
- **Ps** = Base price of steel reinforcement bars as issued under authority of DG(W), CPWD at the time of the last stipulated date of receipt of tender including extensions, if any.
- **Qs** = Quantity of steel paid either by way of secured advance or used in the works since previous bill (whichever is earlier)
- **Slo** = All India Wholesale Price Index for Steel (bars & rods) for the period under consideration as published by Economic Advisor to Government of India, Ministry of Industry and Commerce & issued by DG (W) CPWD as valid on the last stipulated date of receipt of tenders including extensions, if any.
- **Sl** = All India Wholesale Price Index for steel (bars & rods) for the period under consideration as published by Economic advisor to Government of India, Ministry of Industry and Commerce & issued by DG (W) CPWD.
INSURANCE REQUIREMENTS

Insurances to be taken out by the Contractor

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

(a) Cargo Insurance

covering loss or damage occurring, whilst in transit from the Contractor's or manufacturer's works or stores until arrival at the Site, to the Facilities (including spare parts therefore) and to the Construction Equipment to be provided by the Contractor or its Subcontractors.

<table>
<thead>
<tr>
<th>Amount</th>
<th>Deductible limits</th>
<th>Parties Insured</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>165% of the (CIF value)</td>
<td>NIL</td>
<td>Contractor &amp; Employer</td>
<td>Warehouse</td>
<td>Warehouse + 60 days</td>
</tr>
</tbody>
</table>

(b) Installation All Risks Insurance

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

<table>
<thead>
<tr>
<th>Amount</th>
<th>Deductible limits</th>
<th>Parties Insured</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>165% of the (Contract Price)</td>
<td>NIL</td>
<td>Contractor/ Sub-contractor &amp; Employer</td>
<td>Receipt at site</td>
<td>Upto Defect Liability period</td>
</tr>
</tbody>
</table>

(c) Third Party Liability Insurance

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

<table>
<thead>
<tr>
<th>Amount</th>
<th>Deductible limits</th>
<th>Parties Insure</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rs. 0.5 million per person per occasion</td>
<td>NIL</td>
<td>Contractor/ Sub-contractor</td>
<td>Commencement of work</td>
<td>Upto Defect Liability period</td>
</tr>
</tbody>
</table>

(d) Automobile Liability Insurance

covering use of all vehicles used by the Contractor or its Subcontractors (whether or not owned by them) in connection with the supply and installation of the Facilities. Comprehensive insurance in accordance with statutory requirements.
(e) **Worker's Compensation**

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

(f) **Employer's Liability**

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

(g) **Other Insurances**

The Contractor is also required to take out and maintain at its own cost the following insurances:

<table>
<thead>
<tr>
<th>Amount</th>
<th>Deductible limits</th>
<th>Parties Insured</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIL</td>
<td></td>
<td>Contractor/</td>
<td>Receipt</td>
<td>Upto Defect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sub-contractor at site</td>
<td>Liability</td>
<td>period</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&amp; Employer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Employer shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to CC Sub-Clause 34.1 above except for the Third Party Liability, Worker's Compensation and Employer's Liability Insurances, and the Contractor's Subcontractors shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to CC Sub Clause 34.1 above except for the Cargo, Worker's Compensation and Employer's Liability Insurances, and all insurer's rights of subrogation against such co-insured for losses or claims arising out of the performance of the Contract shall be waived under such policies.

**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.

Details:....

<table>
<thead>
<tr>
<th>Amount</th>
<th>Deductible limits</th>
<th>Parties Insured</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

------------- NIL---------------------------
TIME SCHEDULE

1. The Project Completion Schedule shall be as follows:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Activities</th>
<th>Duration in months from the effective date of Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Operational acceptance by the employer upon successful completion of 220/66/33kV GIS Substation at R.K.Puram, New Delhi</td>
<td>12 months</td>
</tr>
</tbody>
</table>

1.1 The bidder shall include in his proposal his programme for furnishing and installation of the equipment including related civil work covered under this package. The programme shall be in the form of a master network plan (MNW) and shall identify the various activities like design, engineering, manufacturing, supply, installation, factory testing, transportation to site, site testing and commissioning guarantee test and operational acceptance etc. of the entire 220/66/33kV GIS Substation at R.K.Puram, New Delhi (India). The network plan shall confirm to the above completion schedule. No credit will be given for earlier completion.

This master network will be discussed and agreed before Award in line with above, engineering drawing and data submission schedule shall also be discussed and finalized before Award. Liquidated damages for delay in successful completion of operational Acceptance at rates specified in Clause 26.2 of CC 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 Contracts to the successful Bidder.

1.3 The successful Bidder shall be required to prepare detailed Network(s) and project implementation plans & programmes and finalize the same with the Employer as per the requirement specified in Technical Specifications, which shall from a part of the Contract.
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 CC Sub-Clause 19.1, the Contractor is free to submit proposals for Subcontractors for additional items from time to time. No Subcontractors 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.

<table>
<thead>
<tr>
<th>Item of Facilities</th>
<th>Approved Subcontractors</th>
<th>Nationality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 CC 10, 20, 21 and 24 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 CC Sub-Clause 18.2.

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

1. Permission will be arranged by the Employer for full site and facilities access as required for site surveys and for the installation, connection and testing of communication equipment and systems. Such permission shall be requested by the Contractor one month prior to the Scheduled need for such access, consistent with the Contractors "Project Implementation Plan", Subsequent to approval of such "Plan" by Employer.

**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.

**Data and Information**  Charge to Contractor - None

Employer will provide all the information and the engineering drawings, schematic diagrams and interface data for all Employer specified equipment to the available with the Employer.

**Works**  Charge to Contractor - None

NIL

**Supplies**  Charge to Contractor - None

NIL
LIST OF DOCUMENTS FOR APPROVAL OR REVIEW

Pursuant to CC Sub-Clause 20.3.1, the Contractor shall prepare, or cause its Subcontractor to prepare, and present to the Project Manager in accordance with the requirements of CC Sub-Clause 18.2 (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 finalized for incorporation into the Contract Agreement.
FUNCTIONAL GUARANTEES

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 power transformers and L.T Transformers furnished by us are guaranteed. 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 relevant clause of Bid Documents.

3. If the guarantees are not established at factory test in case of Power Transformer and L.T Transformer then the Employer at his discretion may reject or accept the equipment after assessing the liquidated damages as per table below against the Contract and such amounts shall be deducted from the Contract Price or otherwise recovered from the Contractor.

4. In case of Power Transformer and L.T Transformer the measured loss for equipment shall be corrected in accordance with IEC-289 & IEC-76 for the purpose of comparison of guaranteed losses with measured losses for levy of liquidated damages. However, the equipment under no circumstances shall be accepted if the measured losses are more than +15 percent of the guaranteed losses at rated voltage quoted by the bidders.

5. The factors and the respective Indian Rupees Value per unit of differential loss over and above the guaranteed for the purpose of calculation of liquated damages for non-performances shall be as stipulated below:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Parameter to be taken for applying differential price Factor (F)</th>
<th>Value of F on Indian Rupees per unit of parameter Differential per KW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Transformer</td>
<td>Differential Copper Loss (KW)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Differential Iron Loss (KW)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Differential Cooler Loss (KW)</td>
<td></td>
</tr>
<tr>
<td>L.T Transformer</td>
<td>Differential Copper Loss (KW)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Differential Iron Loss (KW)</td>
<td></td>
</tr>
</tbody>
</table>
6. PERFORMANCE SECURITY FORM
(For Bidder)
Bank Guarantee – Unconditional

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…………………………………..………………date…………….
between you and ………………………….……………… (“the Contract”) concerning design, execution and
completion of (Brief description of the Facilities).

By this letter we, the undersigned , ……………………………………….a Bank (or Company)
organized under the laws of …………………………..and having its registered/ Principal office at
…………………………..………………………….do hereby jointly and Severally with the Contractor Price
irrevocably guarantee payment to you up to ten percent(10%) of the Contract Price including all taxes and
duties until sixty (60) days beyond the Defect Liability Period.

We undertake to make payment under this Letter of Guarantee upon receipt by us of your first written
demand signed by your duly authorized officer 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 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 you 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 be valid from the date of issue until sixty (60) days beyond the Defect
Liability Period of the Facilities i.e. upto an inclusive of ………………………………………(year, month and
date.)

Except for the documents herein specified, no other documents or other action shall be required,
notwithstanding any applicable law or regulation.

If the Defect Liability Period is extended with respect to any part of the Facilities in accordance with the
Contract, the validity of this letter or Guarantee shall be extended with respect to ten percent (10%) of the
Contract Price including all taxes and duties of that part until expiry of 60 days beyond such extended
Defect Liability Period.

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 you shall equal the sums guaranteed hereunder, whichever is the earlier.

All notice 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 in 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.

Yours truly,
Name of the Bank

Authorized Signature
Signature of Witness
Name
Address

Note:

1. The non-judicial stamp papers of appropriate value shall be purchased in the name of Bank who issues the 'Bank Guarantee'.

2. Performance Security is to be provided by the successful bidder in the form of a bank guarantee which should be issued either:

   (a) by a reputed bank located in the country of Employer and acceptable to the Employer, or

   (b) by a foreign bank confirmed by either its correspondent bank located in the country of Employer which should be reputed and acceptable to the Employer, or

   (c) by a Public Sector Bank in the country of Employer.

All banks shall be nationalized and scheduled banks operating in India.
6A. PERFORMANCE SECURITY FORM
(Form For Collaborator/Parent Company/Principals)

Bank Guarantee – Unconditional

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……………………………………..[date] between you and…………………………………………"(the Contract") concerning design, execution and completion of (Brief description of the Facilities).

By this letter we, the undersigned, …………………………..…………………a Bank (or Company) organized under the laws of …………………………..and having its registered/ Principal office at…………………………………………………do hereby jointly and Severally with the Contractor Price irrevocably guarantee payment to you up to ten percent(10%) of the Contract Price including all taxes and duties until sixty (60) days beyond the Defect Liability Period.

We undertake to make payment under this Letter of Guarantee upon receipt by us of your first written demand signed by your duly authorized officer 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 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 you 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 be valid from the date of issue until sixty (60) days beyond the Defect Liability Period of the Facilities i.e. upto an inclusive of …………………………………… (year, month and date.)

Except for the documents herein specified, no other documents or other action shall be required, notwithstanding any applicable law or regulation.

If the Defect Liability Period is extended with respect to any part of the Facilities in accordance with the Contract, the validity of this letter or Guarantee shall be extended with respect to ten percent (10%) of the Contract Price including all taxes and duties of that part until expiry of 60 days beyond such extended Defect Liability Period.

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 you shall equal the sums guaranteed hereunder, whichever is the earlier.

All notice 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 in increased or deceased.

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.
Yours truly,
Name of the Bank

Authorized Signature
Signature of Witness
Name
Address

Note:

1. The non-judicial stamp papers of appropriate value shall be purchased in the name of Bank who issues the 'Bank Guarantee'.

2. This performance security is to be provided by the Collaborator/Parent Company/Principals of the successful bidder who is the manufacturer of the 220kV GIS equipments, in the form of a bank guarantee which should be issued either:
   
   (d) by a reputed bank located in the country of Employer and acceptable to the Employer, or
   
   (e) by a foreign bank confirmed by either its correspondent bank located in the country of Employer which should be reputed and acceptable to the Employer, or
   
   (f) by a Public Sector Bank in the country of Employer.

All banks shall be nationalized and scheduled banks operating in India.
6B. PERFORMANCE SECURITY
(For GIS Manufacturer proposed by the Erector)

Bank Guarantee – Unconditional

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………………… ……………..……date…………….
between you and …………………… …………………. (“the Contract”) concerning design, execution and
completion of…………………………………..  (Brief description of the Facilities).

By this letter we, the undersigned , …………………………..…………………a Bank (or Company)
organized under the laws of …………………………..and having its registered/ Principal office at
…………………………..…………………………do hereby jointly and Severally with the Contractor Price
irrevocably guarantee payment to you up to ten percent (10%) of the GIS price including taxes and duties
until sixty (60) days beyond the Defect Liability Period.

We undertake to make payment under this Letter of Guarantee upon receipt by us of your first written
demand signed by your duly authorized officer 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 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 you 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 be valid from the date of issue until sixty (60) days beyond the Defect
Liability Period of the Facilities i.e. upto an inclusive of ………………………………………(year, month and
date.)

Except for the documents herein specified, no other documents or other action shall be required,
notwithstanding any applicable law or regulation.

If the Defect Liability Period is extended with respect to any part of the Facilities in accordance with the
Contract, the validity of this letter or Guarantee shall be extended with respect to ten percent (10%) of the
GIS Price of that part until expiry of 60 days beyond such extended Defect Liability Period.

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 you shall equal the sums guaranteed hereunder, whichever is the earlier.

All notice 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 in increased or deceased.

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.

Yours truly,
Name of the Bank

Authorized Signature
Signature of Witness
Name
Address

Note:

1. The non-judicial stamp papers of appropriate value shall be purchased in the name of Bank who issues the 'Bank Guarantee'.

2. Performance Security is to be provided by the Manufacturer of GIS proposed by successful bidder in the form of a bank guarantee which should be issued either:
   
   (g) by a reputed bank located in the country of Employer and acceptable to the Employer, or
   (h) by a foreign bank confirmed by either its correspondent bank located in the country of Employer which should be reputed and acceptable to the Employer, or
   (i) by a Public Sector Bank in the country of Employer.

All banks shall be nationalized and scheduled banks operating in India.
7. BANK GUARANTEE FORM FOR ADVANCE PAYMENT

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................................................................. between you and....................................................... ("the Contractor") concerning design, execution and completion of (Brief description of the Facilities) ..................................................

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 INR in words)

..................................................................................................................(....................)

(Amount in figures)

By this letter we, the undersigned, ........................................, a Bank (or company) organized under the laws of ........................................ ........................... and having its registered/principal office at............................................................... do hereby jointly and severally with the Contractor 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 until the date upon which the Contractor has fully repaid the amount so advanced to the Employer in accordance with the terms of the Contract. At the time at which the outstanding amount is NIL, this Guarantee shall become null and void, whether the original is returned to us or not.

Any claims to be made under this Guarantee must be received by the Bank during its period of validity, i.e. upto 90 (ninety) days after the date of operational acceptance by the Employer i.e. on or before....................................................(year, month, date).

Yours truly,
Name of the Bank

........................................
Authorized Signature
Signature of Witness…………………………
Name……………………
Address…………………………

Note:

1. The non-judicial stamp papers of appropriate value shall be purchased in the name of bank who issues the 'Bank Guarantee'.

2. Advance Bank Guarantee is to be provided by the successful bidder in the form of a bank guarantee which should be issued either:

   (a) by a reputed bank located in the country of Employer and acceptable to the Employer, or

   (b) by a foreign bank confirmed by either its correspondent bank located in the country of Employer which should be reputed and acceptable to the Employer, or

   (c) by a Public Sector Bank in the country of Employer.

All banks shall be nationalized and scheduled banks operating in India.
8. FORM OF COMPLETION CERTIFICATE

Date…………………………

Name of Contract………
Contract No………………

To:

(Name and address of the Contractor)

Dear Ladies and/or Gentlemen,

Pursuant to CC 24 (Completion of the Facilities) of the General Conditions of the Contract entered into between yourselves and the Employer dated ……………………………..…... relating to the …………………………………...
(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 OPERATIONAL ACCEPTANCE CERTIFICATE

Date……………………

Name of Contract………
Contract No……………..

To:

(Name and address of the Contractor)

Dear Ladies and/or Gentlemen,

Pursuant to CC 25.3 (Operational Acceptance) of the General Conditions of the Contract entered into between yourselves and the Employer dated………………….
relating to the ………………………………………………….
(Brief description of the facilities)

we hereby notify you that the Functional Guarantees of the following part(s) of the Facilities were satisfactorily attained 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 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)
10. CHANGE ORDER PROCEDURE

Contract No. .........................

CONTENTS

1. GENERAL

2. CHANGE ORDER LOG

3. REFERENCE FOR CHANGES

4. ANNEXURES

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   ANNEX 2   Estimates for Change Proposal
   ANNEX 3   Acceptance of Estimates
   ANNEX 4   Change Proposal
   ANNEX 5   Change Order
   ANNEX 6   Pending Agreement Change Order
   ANNEX 7   Application for Change Proposal
   ANNEX 8   Change Order Log
CHANGE ORDER PROCEDURE

1. **General**

This section provides samples of procedures and forms for implementing changes in the Facilities during the performance of the Contract in accordance with CC 39 (Change in Facilities) of the Conditions of Contract.

2. **Change Order Log**

The Contractor shall keep an up-to-date change Order Log to show the current status of Requests for Change and Changes authorized or pending as Annex-8 Entries of the Changes in the Change Order Log shall be made to ensure that the log is up-to-date. The Contractor shall attach a copy of the current Change Order Log in the monthly progress report to be submitted to the Employer.

3. **References for Changes**

(i) Request for Changes as referred to in CC Clause 39 shall be serially numbered CR-X-nnn.

(ii) Estimate for Change Proposal as referred to in CC Clause 39 shall be serially numbered CN-X-nnn.

(iii) Acceptance of Estimate as referred to in CC Clause 39 shall be serially Numbered CA-X-nnn.

(iv) Change Proposal as referred to in CC Clause 39 shall be serially numbered CP-X-nnn.

(v) Change Order as referred to in CC Clause 39 shall be serially numbered CO-X-nnn.

**Notes:**

(a) Requests for Change issued from the Employer’s Home Office and the site representatives of the Employer shall have the following respective references:

<table>
<thead>
<tr>
<th>Home Office</th>
<th>CR-H-nnn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>CR-S-nnn</td>
</tr>
</tbody>
</table>

(b) The above number “nnn” is the same for Request for Change, Estimate for Change Proposal Acceptance of Estimate, Change Proposal Change Order.
REQUEST FOR CHANGE PROPOSAL

To: (Contractor’s Name and Address) Date: ………………..

Attention: (Name and Title)

(Contract Name)……………... (Contract No.)……………..

Dear Ladies and/ or Gentlemen:

With reference to the captioned Contract, you are requested to prepare and submit a Change Proposal for the Change noted below in accordance with the following instructions within ……………….days of the date of this letter. (or on before[date])

1. Title of Change: …………………………………………………………………………..

2. Change Request No………………….. (Rev…………………..)

3. Originator of Change:
   Employer (Name)…………………………………………………..
   Contractor (by Application for Change Proposal No……….*)
   * Refer to ANNEX 7.

4. Brief Description of Change:
   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………………………

5. Facilities and/ or Item No. of equipment related to the requested Change:
   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………………………

6. Reference drawings and/or technical documents for the request of Change:
   Drawings No. / Document No. Description
   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………………………

7. Detailed conditions or special requirements on the requested Change:
   ………………………………………………………………………………………
   ………………………………………………………………………………………
8. **General Terms and Conditions**

(1) Please submit your estimate to us showing what effect the requested Change will have on the Contract Price.

(2) Your estimate shall include your claim for the additional time, if any for completion of the requested Change.

(3) If you have any opinion negative to the adoption of the requested Change in connection with the conformability to the other provisions of the Contract on the safety of the Plant or Facilities Please inform us of your opinion in your proposal of revised provisions.

(4) Any increase or decrease in the work of the Contractor relating to the services of its personnel shall be calculated.

(5) You shall not proceed with the execution of the work for the requested Change Until we have accepted and confirmed the amount and nature in writing

...........................................
(Employer's Name)

(Signature)

...........................................
(Name of signatory)

...........................................
(Title of signatory)
ESTIMATE FOR CHANGE PROPOSAL

To: (Employer’s Name and Address)  Date: .........................
Attention: (Name and Title)

Contract Name..........................
Contract Number..........................

Dear Ladies and /or Gentlemen:

With reference to your Request for Change Proposal, we are pleased to notify you of the approximate cost of preparing the below-referenced Change Proposal in accordance with CC Sub-Clause 39.2.1 of the Conditions of Contract. We acknowledge that your agreement to the cost of preparing the Change Proposal, in accordance with CC Sub-Clause 39.2.2, is required before estimating the Cost for Change work.

1. Title of Change ...........................................................

2. Change Request No..................................(Rev....................)

3. Brief Description of Change:

4. Scheduled Impact of Change:

5. Cost for Preparation of Change Proposal (in the currencies of the Contract)

<table>
<thead>
<tr>
<th>(a) Engineering</th>
<th>(Amount)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Engineer _____hrs x _____rate/hr = _______</td>
<td></td>
</tr>
<tr>
<td>(ii) Draftsperson _____hrs x _____rate/hr = _______ sub-total _____hrs</td>
<td></td>
</tr>
<tr>
<td>Total Engineering Cost</td>
<td>_______</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(b) Other Cost</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cost (a) + (b)</td>
<td>_______</td>
</tr>
</tbody>
</table>
(Contractor's Name)

(Signature)

(Name of Signatory)

(Title of signatory)
ACCEPTANCE OF ESTIMATES

To: (Contractor's Name and Address)        Date: …………………

Attention: (Name and Title)…………………………………………………….

Contract Name: …………………
Contract Number: …………………

Dear Ladies and/or Gentlemen:

We hereby accept your Estimate for Change Proposal and agree that you should proceed with the preparation of the Change Proposal.

1. Title of Change: …………………………………………………………….

2. Change Request No. ………………… (Rev …………………)

3. Estimate for Change Proposal No. ………………… (Rev …………………)

4. Acceptance of Estimate No. ………………… (Rev …………………)

5. Brief Description of Change:

……………………………………………………………………………………………………

6. Other Terms and Conditions In the event that we decide not to order the Change accepted, you shall be entitled to compensation for the cost of preparation of Change Proposal described in your estimate for Change Proposal mentioned in para. 3 above in accordance with CC Clause 39.0 of the Conditions of Contract.

-------------------------------

(Employer’s Name)

-------------------------------

(Signature)

-------------------------------

(Name and Title of signatory)
[ANNEXURE 4]

CHANGE PROPOSAL

(Contractor’s Letterhead)

To : (Employer’s Name and Address)   Date :  …………………

Attention :    (Name and Title)

(Contract Name) ……………………….     (Contract No.) …………………

Dear Ladies and / or Gentlemen

In response to your Request for Change Proposal No. ………we hereby submit our proposal as follows :

1. Title of Change : (Name) ………………………..…………………..

2. Change Request No. ……………………(Rev ………………………)

3. Originator of Change :        Employer (Name) ……………………….
                                Contractor (Name) ……………………….

4. Brief Description of Change :

5. Reasons for Change :

6. Facilities and/ or Item No. of equipment related to the requested Change :

7. Reference drawings and/ or technical documents for the requested Change :

Drawing No. / Document No. Description

8. Estimate of increase / decease / (in the currencies of the contract to the Contract Price resulting from Change Proposal

   (Amount)

   (a) Direct Material

   (b) Major construction equipment

   (c) Direct field labour (Total hrs)

   (d) Subcontracts

   (e) Indirect material and labour
(f) Site supervision

(g) Head office technical staff salaries

<table>
<thead>
<tr>
<th>Process engineer</th>
<th>hrs @ rate/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project engineer</td>
<td>hrs @ rate/hr</td>
</tr>
<tr>
<td>Equipment engineer</td>
<td>hrs @ rate/hr</td>
</tr>
<tr>
<td>Procurement</td>
<td>hrs @ rate/hr</td>
</tr>
<tr>
<td>Draftsperson</td>
<td>hrs @ rate/hr</td>
</tr>
</tbody>
</table>

Total hrs @

(h) Extraordinary costs (computer, travel, etc.)

(i) Fee for general administration

| % of Items |

(j) Taxes and customs duties

Total lump sum cost of Change Proposal

Cost to prepare Estimate for Change Proposal

(amount payable if Change is not accepted)

9. Additional time for Completion required due to Change Proposal:

10. Effect on the other Functional Guarantees.

11. Effect on the other terms and Conditions of the Contract.

12. Validity of this Proposal: Within days after receipt of this Proposal by the Employer.

13. Other Terms and Conditions of this Change Proposal:

(a) You are requested to notify us of your acceptance, comments or rejection of this detailed Change Proposal within days from your receipt of this Proposal.

(b) The amount of any increase and/ or decrease shall be taken into account in the adjustment of the Contract Price.

(c) Contractor’s cost for preparation of this Change Proposal:

(Note) This cost shall be reimbursed by the Employer in case of Employer’s withdrawal or rejection of this Change Proposal without default of the Contractor in accordance with CC Clause 39.0 of the Conditions of Contract.

(Contractor’s Name)

(Signature)

(Name of signatory)

(Title of signatory)
CHANGE ORDER

To: (Employer’s Name and Address) Date:  …………………

Attention:    (Name and Title)

(Contract Name) ……………………….     (Contract No.) …………………

Dear Ladies and / or Gentlemen:

We approve the Change Order for the work specified in the Change Proposal No.……….. and agree to adjust the Contract Price, Time for Completion and/ or other conditions of the Contract in accordance with CC Clause 39.0 of General Conditions of Contract.

1. Title of Change : (Name) ………………………..

2. Change Request No. ……………………(Rev ………………………)

3. Change Order No……………………….(Rev…………………… …)

4. Originator of Change :        Employer (Name) ………………………..

Contractor (Name) ……………………….

5. Authorized Price :

Ref. No. ………………… …………(Number)

Date : …………………

Amount (in INR)…………

6. Adjustment of Time for Completion

None   Increase  …………….days  Decrease  …………..days

7. Other effects, if any

Authorized by : ………………………..Date : …………………

(Employer)

Accepted by :  ……………………….. ..Date : …………………

(Contractor)

________________________________________________________________________

(Contractor’s Name)

________________________________________________________________________

(Signature)

________________________________________________________________________

(Name of signatory)

________________________________________________________________________

(Title of signatory)
PENDING AGREEMENT CHANGE ORDER

To: (Employer’s Name and Address) Date: .................

Attention: (Name and Title)

(Contract Name) .................... (Contract No.) .................

Dear Ladies and / or Gentlemen:

We instruct you to carry out the work in the Change Order detailed below in accordance with CC 39.0 of the Conditions of Contract.

1. Title of Change: (Name) ..................................................
2. Employer Request for Change Proposal No.……(Rev ……. ) Dated………..
3. Contractor’s Change Proposal No.………… (Rev………. ) Dated…………
4. Brief Description of Change:

Facilities and/ or Item No. of equipment related to the requested Change:

Reference drawings and/ or technical documents for the requested Change:

Drawing No. / Document No. Description

Adjustment of time for completion:

Other change in the Contract terms:

Other terms and Conditions:

(Contractor’s Name)

(Signature)

(Name of signatory)

(Title of signatory)
APPLICATION FOR CHANGE PROPOSAL

To : (Employer's Name and Address)   Date : .................

Attention :    (Name and Title)

(Contract Name) ………………  (Contract No.) …………………

Dear Ladies and / or Gentlemen :

We hereby propose that the below mentioned work be treated as a Change in the Facilities.

1. Title of Change : 
   (Name) ………………………..……………………..……….

2. Application for Change Proposal No………………(Rev ………………)
   Dated …………….

3. Brief Description of Change :

4. Reasons for Change :

5. Order of Magnitude Estimation (in the currencies of the Contract).

6. Scheduled Impact of Change :

7. Effect on Functional Guarantee. If any :

8. Appendix

   (Contractor’s Name)
   (Signature)

   (Name of signatory)
   (Title of signatory)
CHANGE ORDER LOG

To: (Employer’s Name and Address)  Date: .................

Attention: (Name and Title)

(Contract Name) .........................  (Contract No.) .................

Dear Ladies and / or Gentlemen:

(Contract Name) .........................  (Contract No.) .................

We hereby furnish the up-to date change order log to show the current status of request for changes and authorized or pending.

<table>
<thead>
<tr>
<th>S1. No.</th>
<th>Employer’s Request for change proposal</th>
<th>Contractor application for change proposal including revision</th>
<th>Contractor’s Change proposal including revision</th>
<th>Change order No. proposal No. including revision</th>
<th>Pending</th>
<th>Remarks*</th>
</tr>
</thead>
</table>

(Contractor’s Name)

(Signature)

(Name of signatory)

Title of Signatory

Note:

(i) *In case Employer has authorized to carryout the work pending agreement change order, the details of such authorization shall be furnished.

(ii) The contractor shall attach a copy of the current change order log in the monthly progress report to be submitted to the Employer every month.
11. FORM OF INDEMNITY BOND TO BE EXECUTED BY THE CONTRACTOR FOR THE EQUIPMENT HANDED OVER IN ONE LOT BY DELHI TRANSCO LTD. FOR PERFORMANCE OF ITS CONTRACT

INDEMNITY BOND

THIS INDEMNITY BOND is made this ........ day of............... 200...... by................. a Company registered under the Companies Act, 1956/ 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 DELHI TRANSCO LTD, a Company incorporated under the Companies Act, 1956 having its Registered Office at Shakti Sadan, Kotla Road, New Delhi-110002.

WHEREAS DELHI TRANSCO LTD. 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 DTL 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 DTL for the Equipment handed over to it by DTL 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 DTL indemnified, for the full value of the Equipment. The Contractor hereby acknowledges receipt of the Equipments as per dispatch 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 dispatch title documents in respect of the said equipments duly endorsed by DTL 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 DTL.

2. That the contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the equipment of DTL 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 DTL. The contractor undertakes to keep DTL harmless against any loss or damage that may be caused to the equipments.

3. The contractor undertakes that the equipment shall be used exclusively for the performance/execution of the contract strictly in accordance with its terms and conditions and no part of the equipment shall be utilized for any other work or purpose whatsoever. It is clearly understood by the contractor that non observance of the obligations under this indemnity bond by the contractor shall inter-alia constitute a criminal breach of trust on the part of the contractor for all intents and purpose including legal/penal consequences.

4. That DTL is and shall remain the exclusive owner of the equipment free from all encumbrances, charges or liens of any kind, whatsoever. The equipment shall be all times be open to inspection and checking by the employer or employer’s representative in this regard. Further DTL 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 equipments are likely to be endangered, mis-utilised or intended for use other than those specified in the contract, by any acts of omission or commission on the part of the contractor or any other person or on account of any reason whatsoever and the contractor binds himself and undertakes to comply with the directions of demand of DTL 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 mis-utilised 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 DTL without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to DTL 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 DTL, THEN. The above Bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS, 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**

<table>
<thead>
<tr>
<th>Particulars of the Equipment</th>
<th>Quantity</th>
<th>Particulars of Despatch title Documents</th>
<th>Value of the Equipment</th>
<th>Signature of Attorney in Handed token of receipt</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR/ GR No. Date of lading &amp; Carrier</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For and on behalf of

M/s………………………………..

WITNESS

1. 1. Signature…………………… Signature……………………………
2. Name………………………… Name………………………………
3. Address…………………… Address………………………………

Authorized representative

2. 1. Signature……………………
2. Name………………………… (Common Seal)
3. Address……………………

(In case of Company)

Indemnity Bonds are to be executed by the authorized 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 General Power of Attorney and such documents should be attached to Indemnity Bond.
12. FORM OF INDEMNITY BOND TO BE EXECUTED BY THE CONTRACTOR FOR THE EQUIPMENT HANDED OVER IN INSTALLMENTS BY DELHI TRANSCO LTD FOR PERFORMANCE OF ITS CONTRACT

INDEMNITY BOND

THIS INDEMNITY BOND is made this .............day of ........200..........by.............
.................................................................................................................a Company registered under the Companies Act, 1956/ 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 favor of DELHI TRANSCO LTD a Company incorporated under the Companies Act, 1956 having its Registered Office at Shakti Sadan, Kotla Marg, New Delhi-110002

WHEREAS DTL has awarded to the Contractor a Contractor for ....................vide Its Notification of Award/Contract No. .....................dated ...............and Amendment No. .......................

(APPlicable when amendments have been issued ) (hereinafter called the “Contract”) in terms of which DTL is required to handover various Equipments 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 DTL for the Equipment handed over to it by DTL for the purpose of performance of the Contract/ Erection portion of the Contract (hereinafter called the “Equipment”).

NOW THEREFORE, This Indemnity Bond witnessed 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 for the purpose of performance of the contract, the Contractor hereby undertakes to indemnify and shall keep DTL 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 DTL 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 shall be construed as handing over the Equipment purported to be covered by such title documents and the Contractor shall hold Equipments in trust as a Trustee for and on behalf of DTL

2. That the contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the equipment of DTL 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 DTL. The contractor undertakes to keep DTL harmless against any loss or damage that may be caused to the equipments.

3. The contractor undertakes that the equipment shall be used exclusively for the performance/execution of the contract strictly in accordance with its terms and conditions and no part of the equipment shall be utilized for any other work or purpose whatsoever. It is clearly understood by the contractor that non observance of the obligations under this indemnity bond by the contractor shall inter-alia constitute a criminal breach of trust on the part of the contractor for all intents and purpose including legal/penal consequences.

4. That DTL is and shall remain the exclusive owner of the equipment free from all encumbrances, charges or liens of any kind, whatsoever. The equipment shall be all times be open to inspection and checking by the employer or employer’s representative in this regard. Further DTL 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 equipments are likely to be endangered, mis-utilised or intended for use other than those specified in the contract, by any acts of omission or commission on the part of the contractor or any other person or on account of any reason whatsoever and the contractor binds himself and undertakes to comply with the directions of demand of DTL 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 mis-utilised 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 DTL without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to DTL 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 DTL, then. The above Bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS, the Contractor has hereunto set its hand through its authorized representative under the common seal of the Company, the day, month and year first above mentioned.

**SCHEDULE No. 1**

<table>
<thead>
<tr>
<th>Particulars of the Equipment</th>
<th>Quantity</th>
<th>Particulars of Despatch title Documents</th>
<th>Value of the Equipment</th>
<th>Signature of Attorney in Handed token of receipt</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR/ GR No.</td>
<td></td>
<td>Date of lading &amp; Carrier</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For and on behalf of

M/s…………………………………………

**WITNESS**

1. 1. Signature…………………… Signature……………………

2. Name………………………… Name………………………

3. Address……………………… Address……………………

Authorized representative

2. 1. Signature……………………

2. Name………………………… (Common Seal)

3. Address……………………

(In case of Company)

Indemnity Bonds are to be executed by the authorized 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 General Power of Attorney and such documents should be attached to Indemnity Bond.
13. FORM OF AUTHORIZATION LETTER: DELHI TRANSCO LIMITED.

REF. No.

DATE:

TO,

M/s………………………
…………………………
…………………………

REF: Contract No……………………… dated …………. for……………………… awarded by Delhi Transco limited.

Dear Sir,

Kindly refer to Contract No. …………………………. Dated ……….. for ……….. You are hereby authorized on behalf of Delhi Transco Limited, having its registered office at Delhi Transco Limited, Shakti Sadan, Kotla Road New Delhi-110002 and its project at ………….. to take physical delivery of materials/equipments covered under Dispatch Document/Consignment Note No……………… dated………………………. and 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.
14. FORM OF TRUST RECEIPT FOR PLANT, EQUIPMENT AND MATERIALS RECEIVED

We M/s ________________________________ having our Principal place of business at ________________________________ having been awarded a Contract No. ____________________ dated ______________ for (Contract Name) by (Name of 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 here to, which shall form an integral part of this receipt as “Trustee” of ________________________________ (Name of 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: ________________

Place: ________________

(AUTHORISED SIGNATORY)

SEAL OF COMPANY
15. FORM OF EXTENSION OF BANK GUARANTEE

Ref. No……………………..     Dated………………………..

Delhi Transco Limited,
Shakti Sadan, Kotla Road
New Delhi 110002.
India

Dear Sirs,

Sub: - Extension of Bank Guarantee No. …………………. for……………….. favoring yourself expiring on ……………………………………… On account of M/s.………………….. in respect of Contract No………………….. dated ……………….. (hereinafter called original Bank Guarantee).

At the request of M/s … …………………. We ………………….. Bank branch office at……………. Having its Head Office at …………………… do hereby extend our liability under the above mentioned Guarantee No……………………… dated ………….. for a further period of ………………. Years/Month from to ………………. Expire on ………………. Except as provide 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.

Yours Faithfully,

For…………………………….
Manager. Agent/Accountant

Power of attorney No………….
Dated …………………………..

SEAL OF BANK

Note :  The non. Judicial stamp paper of appropriate value shall be purchased in the name of the bank who has issued the bank Guarantee.
16. FORM OF POWER OF ATTORNEY FOR JOINT VENTURE.

(On Non-judicial Stamp paper of Appropriate Value to be purchased in the name of 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 “Authorized 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 Delhi Transco Limited, Shakti Sadan Building, Kotla Road, New Delhi, India (hereinafter called the “Employer”) to undertaking 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 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 undertaking to ratify and confirm all the whatsoever the said Attorney/ Authorized Representatives/Partner in-charge quotes in the bid, negotiates And signs the Contract with 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 present 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 the unto in the presence of:

WITNESS
1. Signature……………………..
   Name………………………
   Designation …………………
   Occupation………………………….

2. Signature……………………..
   Name………………………
   Designation …………………
   Occupation………………………….
17. FORM OF JOINT VENTURE AGREEMENT

(On non-judicial stamp paper of appropriate value to be purchased in the name of joint venture)

PERFORMA OF JOINT VENTURE AGREEMENT BETWEEN …………………………. AND ……………………………….. FOR BID SPECIFICATION NO…………………………. OF DELHI TRANSCO LIMITED

THIS joint venture agreement executed on this ……………… day of Two thousand……………. between M/s ……………………. a company incorporated under the laws of …………………………….. and having its registered office at……………………………( hereinafter called the “Lead partner” which expression shall include its successors executors and permitted assigns), M/s ……………… ……………….  a company incorporated under  the laws of …………………………………………. and having its registered office at……………………………………………( hereinafter called “the partner” 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 partner” which expression shall include its successors, executors and permitted assigns) for the purpose of making a bid and entering into a contract (in case of award) against the specification No……………………………… for…………………………(Name of the Package) ……………………..under……………… …………………….. (Name of the project) ……… …………………….of Delhi Transco limited,a company incorporated under the Companies Act of 1956 having its registered Shakti Sadan, Kotla Road New Delhi-110002, India (hereinafter caller the; “Employer”)

Whereas the employer invited bids as per the above mentioned Specification for the design, manufacture, supply, installation, testing and commissioning of equipment/materials stipulated in the bidding documents for…………………………….under……………………………. (Name of the Package) ……………………..under……………………………. (Name the project)

AND WHEREAS   Annexure-A, section-ITB (qualification of the bidder) forming part of the bidding documents, stipulates that a joint Venture of two or more qualified firms as partners, meeting the joint Venture fulfills all other requirements under Annexure-A, Section ITB (qualification of the bidder) and in such a case, the BID FROM shall be signed by all the partners so as to legally bind all the partners of the Joint Venture, who as will be jointly  and severally liable to perform the contract and all obligations hereunder.

The above clause further states that the joint venture agreement shall be attached to the bid and the contract performance guarantee will be as per the format enclosed with the bidding document without any restriction or liability for either party.

AND WHEREAS the bid has been submitted to the Employer vide proposal No……………………….. dated…………………..by Lead partner based on the joint venture agreement between all the partners under these present and the bid in accordance with the requirements of Annexure-A, section ITB (Qualification of the Bidders), has been signed by all the partners.

NOW THIS INDENTURE WITNESS AS UNDER:

In consideration of the above premises and agreements all the partners to this joint venture do hereby now agree as follow:

1. In consideration of the award of the contract by the Employer to the joint venture partners, we, the partners to the joint venture agreement do hereby agree that M/s ……………………….. shall act as lead partner and further declare and confirm that we shall joint 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 of the equipments in accordance with the Contract.

2. In case of any breach of the said Contract by the Lead Partner of other partner(s) of the joint Venture agreement, the partner(s) do hereby agree to be fully responsible for the successful performance of the contract and carry out all the obligations and responsible 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 performance guaranteed as per the
specification in terms if the Contract, the partner(s) of these present 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 Partner(s).

4. The financial liability of the partner of this joint venture agreement to the Employer, with respect to any of the claims arising out of the performance or non-performance of the obligations set forth in the said joint venture agreement, 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 of any of the partners of the joint Venture agreement.

5. It is expressly understood and agreed between the partners to the joint venture agreement that the responsibilities and obligations of each of the partners shall be as delineated in Appendix-I (* To be incorporated suitably by the partners) to this agreement. It is further agreed by the partners that the above sharing of responsibilities and obligations shall not in any way be a limitation of joint and servable responsibilities of the partners under this Contract.

6. This joint venture agreement shall be constructed and interpreted in accordance with the laws of India and the courts of Delhi shall have the exclusive jurisdiction in all matters arising there under.

7. In case of an award of a Contract, we the partners to the joint venture agreement do hereby agree that we shall be jointly and severally responsible for furnish a contract performance security from a bank in favour of the Employer in the currency of the Contract.

8. It is further agreed that the venture agreement shall be irrevocable and shall from an integral part of the Contract, and shall continue to be enforceable till the Employer discharges the same. It shall be effective from the date first mentioned above for all purpose and intents.

IN WITNESS WHEREOF, the partners to the joint venture agreement have through their authorized representatives executed these present and affixed Common Seals of their companies, on the day, month and year first mentioned above.

1. Common Seal of ……………
   has been affixed in my/our presence pursuant to the Board of Director's resolution dated...
   Signature............................
   Name............................
   Designation………………..

   For Lead partner
   (Signature of authorized representative)
   Name............................
   Designation………………..
   Common Seal of the company
   …………………………………

2. Common Seal of ……………
   has been affixed in my/our presence pursuant to the Board of Director's resolution dated...
   Signature............................
   Name............................
   Designation………………..

   For partner
   (Signature of authorized representative)
   Name............................
   Designation………………..
   Common Seal of the company
   …………………………………

WITNESSES:
1. …………………………………
   (Signature)
   Name............................
   …………………………………
   (Official address)

2. …………………………………
   (Signature)
   Name............................
   …………………………………
   (Official address)
18. PROFORMA OF JOINT UNDERTAKING BY THE COLLABORATOR ALONGWITH THE BIDDER/MANUFACTURER

(On non-judicial stamp paper of appropriate value)

THIS DEED OF UNDERTAKING executed this ...................... day of Two Thousand and.................... by......................... a company incorporated under the laws of ...................................... and having its registered office at...........................................(hereinafter called the “Collaborator” which expression shall include its successors, executors and permitted assigns) and .................a company incorporated under the laws of ...................................... and having its registered office at.........................(hereinafter called the “Manufacturer” which expression shall include its successors, executors and permitted assigns) and................. a company incorporated under the laws of ...................................... and having its registered office at...........................................(hereinafter called the “Bidder” which expression shall include its successors, executors and permitted assigns) in favour of Delhi Transco Limited, having its Registered office at Shakti Sadan, Kotla Marg, New Delhi.(herein after called the “Employer” which expression shall include its successors executors and permitted assigns)

WHEREAS the “Owner” invited Bid as per Specification No. ........................ for the execution of ....................

AND WHEREAS Clause No. ...................., Section ....................of ...................., Vol. - ........................ forming part of the Bid Documents inter-alia stipulates that the Bidder and/or Manufacturer alongwith its collaborator must fulfill the Qualifying Requirements for the * .................... and be jointly and severally bound and responsible for the successful performance of the * ....................offered in the event the bid submitted by the bidder is accepted by the Owner resulting in Contract.

AND WHEREAS the bidder has submitted its bid to the Owner vide Proposal No. ........................ dated ........................ based on the collaboration/association of the Collaborator with the Bidder/Manufacturer.

NOW THEREFORE THIS UNDERTAKING WITNESSTH as under.

1.0 In consideration of the award of Contract by the Owner to the Bidder (herein after referred to as the “Contract”) we, the collaborator and the Bidder/Contractor and/or manufacturer do hereby declare that we shall be jointly and severally bound unto the DELHI TRANSCO LIMITED , for the successful performance of the * .................... and shall be fully responsible for the design, manufacturer, testing, supply on FOR destination delivery at site basis and supervision of unloading at site, storage, erection, testing & commissioning and successful performance of the collaborator shall advise the manufacturer/ contractor suitable modifications of designs and implement necessary corrective measures to discharge the obligations under the contract.

2.0 Without in any way affecting the generality and total responsibility in terms of deed of Undertaking, the Collaborator in particular hereby agrees to depute their technical experts from time to time to the Bidder/Contractor's/Manufacturers' Works/ Owners' project site as mutually considered necessary by the Owner, bidder/Contractor, Manufacturer and the collaborator to ensure proper design, engineering, manufacturing, testing, supply on for destination delivery at site basis and supervision of unloading at site , storage, erection, testing & commissioning and successful performance of the collaborator shall advise the manufacturer/ contractor suitable modifications of designs and implement necessary corrective measures to discharge the obligations under the contract.

3.0 This deed of undertaking shall be constructed and interpreted in accordance with the laws of India and the Courts in Delhi shall have exclusive jurisdiction in all matters arising under the undertaking.

4.0 As a security, the collaborator/manufacturer shall part from the contractors performance guarantee furnish a contract performance guarantee from its Bank in favour of the Owner on a form acceptable to the Owner. The value of such guarantee shall be equivalent to 10% of price of the equipment as identified in the contract awarded by the Owner to the bidder/contractor and it shall be part of guarantee towards the faithful performance/compliance of this deed of undertaking in terms of the contract. The guarantee shall be unconditional, irrevocable and valid for the entire period of the contract, namely till the end of the warranty period *........................under the contract. The bank guarantee amount shall be payable to the owner on demand without any reservation or demur.

5.0 We the collaborator/bidder/contractor and/or manufacturer agree this undertaking shall be irrevocable and shall from integral part of a contract and further agree that this undertaking shall continue to be enforceable till the owner discharges it. It shall become operative from the effective date of contract.
IN WITNESS WHEREOF the collaborator, the manufacturer and/or the bidder/contractor have through their Authorized Representatives executed these present a fixed common seals of their respective Companies, on the day, month and year first above mentioned.

WITNESSES:

<table>
<thead>
<tr>
<th>1.</th>
<th>Signature of Authorized (Representative)</th>
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</thead>
<tbody>
<tr>
<td>(Signature)</td>
<td>(Name in Block Letter)</td>
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<tr>
<td>(Office Address)</td>
<td>Common seal of Company</td>
</tr>
</tbody>
</table>

For Collaborator

<table>
<thead>
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<th>2.</th>
<th>Signature of Authorized (Representative)</th>
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<tbody>
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</tbody>
</table>

For Manufacturer

<table>
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<tr>
<th>3.</th>
<th>Signature of Authorized (Representative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Signature)</td>
<td>(Name in Block Letter)</td>
</tr>
<tr>
<td>(Office Address)</td>
<td>Common seal of Company</td>
</tr>
</tbody>
</table>

Note:

(i) This deed of Joint undertaking duly certified by the Company Secretary shall be submitted along with the bid. Further, the deed of Joint Undertaking attested by Notary Public of the place(s) of the respective executants (s) or registered with the Indian Embassy/High Commission in the country shall be submitted by the bidder within ten (10) days from the date of intimation of post bid discussion. In case the bidder fails to submit the deed of Joint Undertaking as mentioned above, the bidders bid guarantee may be forfeited.

(ii) In the event the bidder is a Manufacturer and the collaboration is between collaborator and the Bidder, then the Joint deed of Undertaking shall be accordingly.

(iii) *The name(s) of equipment for which Joint deed of undertaking is to be submitted is to be inserted.

(iv) The manufacturer may be having ongoing collaboration agreement or had collaboration agreement in the past with the collaborator.
# TECHNICAL SPECIFICATIONS

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<td>16</td>
<td>SEC-16; POWER &amp; CONTROL CABLE</td>
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</tbody>
</table>
SECTION : 1

PROJECT

1.0 GENERAL

Preamble:

1.1 Delhi Transco Ltd. hereinafter termed as DTL or Owner/Purchaser is a company incorporated under Company Act 1956, fully owned by govt. of NCT of Delhi.

1.2 Delhi Transco Ltd. (DTL) is State Transmission Utility and responsible for Bulk Power Transmission of Electrical Energy in National Capital Delhi.

1.3 Delhi Transco Ltd. (DTL) is now establishing one new 220/66/33kV Gas Insulated Substation at R.K.Puram, Delhi (India).

2.0 INTENT OF SPECIFICATION:

2.1 The specification covers the design, engineering, manufacture, fabrication, testing at manufacturers works, delivery, unloading at site, storage, erection, testing and commissioning at site of the complete 220/66/33 KV switchyard including indoor SF6 gas insulated metal enclosed switchgear (GIS), Two nos. 100 MVA and Two nos. 160 MVA Transformers with fire protection system (NIFPES), associated civil works, internal roads, drains, necessary buildings etc, gas insulated terminal connection (XLPE cable/SF6) for making connection between transformer and 66kV GIS, gas insulated terminal connection for connecting transformer through suitable size and number of XLPE Copper cable considering 110% continuous loading with cable termination enclosure/bus duct and accessories with 33kV GIS, GIS bus ducts for making connections with 100 MVA and 160 MVA outdoor transformer and 220kV GIS, Indoor & outdoor End Termination Boxes, Substation Automation with Relay & Protection, optical fiber equipments & Communication (Converter) Equipments and other electrical and mechanical auxiliary systems on turnkey basis. The Bus Duct/cable connection should be such that it is possible to remove transformer for repair/maintenance conveniently. Bidder shall also ensure GIS compatibility for line feeder/cable termination and provide the ancillary equipment required for the same. For connecting 220kV GIS with primary of transformer, bidder will use SF6/Oil interface. 11kV Cable (from Metering Cubicle onward) and room for Discom (if required) shall be in the scope of Bidder.

2.2 The supply will include all supporting structures, auxiliary equipments, mechanical linkages, hydraulic piping for control devices with pumps, SF6 gas piping, auxiliary circuits wiring, interlocking devices, current and voltage transformers, cable end boxes and SF6 bus ducts.

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

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

3.0 SCOPE OF WORK

I. 220kV SYSTEM

The 245kV SF₆ gas insulated switch gear shall have double bus bar arrangement with 16 bays- 4 nos. 100MVA transformer bays, 2 no. bus-coupler, 2 no. bus-section and 8 nos. feeder bays. There shall be provision for 2 no. future bays in the GIS building. The SF₆ gas insulated switch gear rated for 220kV, 3-phase, 50 Hz shall be of the indoor metal-enclosed type, comprising of following items:

(A) Sectionalized Double bus bar arrangement with provision of Bus-section, 3-phase/three 1-phase (isolated) units, 2500A, SF₆ gas insulated, metal enclosed bus bars, each section comprising of:
a. Bus bars enclosures running the length of the switch gear to interconnect each of the circuit breaker bay modules in double main bus system.
b. Three inductive or capacitive type voltage transformers, complete with isolator switch and safety grounding switches.
c. One 3-phase, single pole, group operated safety grounding switch, complete with manual and motor driven operating mechanisms.
d. GIS duct with gas monitoring devices, barriers, pressure switches, etc. as required.
e. Local control cubicle (if required).

(B) **Two nos. bus coupler bay module comprising of:**

a. One 2500 A, 3-phase, SF6 gas insulated circuit breaker, complete with operating mechanism.
b. Three 5-core, multi ratio, single phase current transformers.
c. Two 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.
d. Two 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.
e. GIS duct with gas monitoring devices, barriers, pressure switches, etc. as required.
f. Local Control Cubicle (if required).

(C) **Two nos. bus sectionaliser bay module comprising of:**

a. One 2500 A, 3-phase, SF6 gas insulated circuit breaker, complete with operating mechanism.
b. Three 5-core, multi ratio, single phase current transformers.
c. Two 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.
d. Two 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.
e. GIS duct with gas monitoring devices, barriers, pressure switches, etc. as required.
f. Local Control Cubicle (if required).

(D) **Four transformers feeder circuit breaker bay modules with one spare bay, each comprising of:**

a. One 1600 A, 3-phase, SF6 gas insulated circuit breaker, complete with operating mechanism.
b. Three 5-core, multi ratio, single phase current transformers.
c. Three 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.
d. Three 3-phases, single pole group operated safety grounding switches, complete with group operated manual and motor driven operating mechanisms.
e. Three single phase SF6 ducts and SF6/oil interface to 220kV, 100 MVA transformer.
f. Three single phase, SF6 gas insulated surge arresters.
g. GIS Bus duct with gas monitoring device, pressure switch etc as required.
h. Local control cubicle (if required).

(E) **Eight transmission line feeder circuit breaker bay modules, each comprising of:**

a. One 1600 A, 3-phase, SF6 insulated circuit breaker, complete with operating mechanism.
b. Three 5-core, multi ratio, single phase current transformers.
c. Three 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.
d. Two 3-phases, single pole group operated safety grounding switches, complete with manual and motor driven operating mechanisms.
e. One 3-phase, single pole, high speed fault make grounding switch, complete with group
operated manual and motor driven operating mechanisms.
f. Three, single phase SF6/XLPE cable terminations.
g. Three, 3-core, single phase voltage transformers/ PTs.
h. Three single phase, SF6 gas insulated surge arresters.
i. Suitable provision for testing of cable.
j. GIS Cable termination enclosure suitable for connecting single phase 1200/1000 sq. mm XLPE cable.
k. GIS duct with gas monitoring devices, barriers, pressure switches, etc. as required.

The Switchgear shall be complete with all necessary terminal boxes, SF6 gas filling, interconnecting power and control wiring, grounding connections, gas monitoring equipment and piping, support structures.

II. 66kV System
72.5kV SF6 gas insulated switch gear shall have double bus bar arrangement with 11 bays- 2 nos. I/C bays, 1 no. bus-coupler and 8 nos. feeder bays. There shall be provision for 4 no. future bays in the GIS building. The SF6 gas insulated switch gear rated for 66kV, 3-phase, 50 HZ shall be of the indoor metal-enclosed type, comprising of following items:

(A) Double bus bar arrangement (3000A), Three-phase or single phase encapsulated SF6 gas insulated, metal enclosed bus bars, each Bus Bar comprising of :
   a. Bus bar enclosures running through the length of the switchgear to interconnect each of the circuit breaker bay modules in double main bus system.
   b. Three, 3-core, single phase voltage transformers/ PTs.
   c. One 3-phase, single pole, group operated isolator/disconnector with one 3-phase, single pole, group operated earthing switch with manual and motor driven operating mechanisms.
   d. Gas monitoring equipment.
   e. Terminal boxes.
   f. Interconnecting wiring/piping
   g. Grounding, support structures and platforms
   h. Local control cubicle.

(B) One bus coupler bay module comprising of :
   a. One 2500 A, 3-phase, SF6 Circuit Breaker, complete with operating mechanism
   b. Three 3-core, single phase current transformers.
   c. Two 3-phase, single pole, group operated isolator switches each with three phase single pole group operated Earthing switch and complete with manual and motor driven operating mechanisms.
   d. Local control cubicle.

(C) Two no. bays for Incomer from 220/66kV transformer, each comprising of :
   a. One 2000A, 3-phase, SF6 circuit breaker, complete with operating mechanism for incomer bay from 220/66 kV transformer.
   b. Three 4-core, single phase current transformers.
   c. One 2000A, 3-phase, single pole, group operated isolator without earthing switch, complete with manual and motor driven operating mechanisms.
   d. One 2000A, 3-phase, single pole, group operated isolator with one 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
   e. One 2000A, 3-phase, single pole, group operated isolator with one normal and one high speed fault make 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
   f. Three single phase SF6 / XLPE cable terminations.
g. Three SF6 type Surge Arrester (single phase).

h. Suitable provision for testing of cable.

i. GIS Cable(s) termination enclosure suitable for connecting 66kV XLPE cable (The cable shall be designed by the bidder considering 110% continuously loading of 66kV side of the 160MVA Transformer).

j. Local control cubicle.

(D) Eight outgoing line feeder circuit breaker bay modules, each comprising of:

a. One 2000A, 3-phase, SF6 circuit breaker, complete with operating mechanism for outgoing feeder.

b. Three 3-core, single phase current transformers.

c. One 2000 A, 3-phase, single pole, group operated isolator without earthing switch, complete with manual and motor driven operating mechanisms.

d. One 2000A, 3-phase, single pole, group operated isolator with one 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.

e. One 2000 A, 3-phase, single pole, group operated isolator with one normal and one high speed fault make 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.

f. Three, 3-core, single phase voltage transformers/PTs.

g. Three SF6 type Surge Arrester (single phase).

h. Suitable provision for testing of cable.

i. GIS Cable termination enclosure suitable for connecting 3 cables of 1x1000 sq.mm XLPE cable. However actual size shall be finalised during detailed engineering.

j. Local control cubicle.

III. 33kV System

The 36kV SF$_6$ Gas Insulated Switchgear shall have sectionalized double bus bar arrangement with 12 bays (2 nos. I/C bays from 100MVA Transformer, 1 no. bus-coupler and 9 nos. feeder bays). There shall be provision for 4 no. future bays in the building for future 33kV outlets. The SF6 Gas Insulated Switchgear rated for 33kV, 3-phase, 50Hz, 31.5kA fault level shall be of the indoor metal-enclosed type, comprising of following items:

(A) Double bus bar arrangement, 2500A, Three -phase or single phase encapsulated SF$_6$ gas insulated, metal enclosed bus bars, each Bus Bar comprising of:

a. Bus bar enclosures running through the length of the switchgear to interconnect each of the circuit breaker bay modules in double main bus system.

b. Three, 3-core, single phase voltage transformers/PTs.

c. One, 3-phase, single pole, group operated isolator/disconnector with one 3-phase, single pole, group operated earthing switch with manual and motor driven operating mechanisms.

d. Gas monitoring equipment.

e. Terminal boxes.

f. Interconnecting wiring/piping

g. Grounding, support structures and platforms

h. Local control cubicle.

(B) One no. bus coupler bay module comprising of:

a. One 2500 A, 3-phase, Vacuum/SF6 Circuit Breaker, complete with operating mechanism

b. Three 3-core, single phase current transformers.

c. Two 3-phase, single pole, group operated isolator switches each with three phase single pole group operated Earthing switch and complete with manual and motor driven operating mechanisms.
d. Local control cubicle.

(C) **Two Bay for Incomer from 220/33 kV transformer each comprising of:**
   a. One 2500A, 3-phase, Vacuum/SF6 circuit breaker, complete with operating mechanism for incomer bay from 220/33 kV transformer.
   b. Three 3-core, single phase current transformers.
   c. One 2500A, 3-phase, single pole, group operated isolator without earthing switch, complete with manual and motor driven operating mechanisms.
   d. One 2500A, 3-phase, single pole, group operated isolator with one 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
   e. Three single phase Oil/XLPE cable terminations.
   f. Three SF6 type Surge Arrester (single phase).
   g. Suitable provision for testing of cable.
   h. GIS termination enclosure suitable for connecting transformer through 33kV XLPE cable with cable termination enclosure/Bus Duct & accessories with GIS to complete transformer bay module (It shall be designed by the bidder considering 110% continuous loading of 33kV side of the 100MVA Transformer).
   i. Local control cubicle.

(D) **Nine outgoing line feeder circuit breaker bay modules, each comprising of:**
   a. One 1250A, 3-phase, Vacuum/SF6 circuit breaker, complete with operating mechanism for outgoing feeder.
   b. Three 3-core, single phase current transformers.
   c. One 1250A, 3-phase, single pole, group operated isolator without earthing switch, complete with manual and motor driven operating mechanisms.
   d. One 1250A, 3-phase, single pole, group operated isolator with one 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
   e. Three, 3-core, single phase voltage transformers/ PTs.
   f. Three SF6 type Surge Arrester (single phase).
   g. Three single phase SF6/XLPE cable terminations.
   h. Suitable provision for testing of cable.
   i. GIS Cable termination enclosure suitable for connecting 2 x 3C x 400 sq.mm 33kV XLPE cable. However actual size shall be finalized during detailed engineering.
   j. Local control cubicle.

IV. Complete sub-station automation system based on IEC 61850 including hardware and software for remote control station, relay and protection system along with associated equipments and kiosk for following bays (bay as defined in technical specification, section _ sub-station automation):
   - 220kV: 16 bays + 2 future bays
   - 66 kV: 11 bays + 4 future bays
   - 33kV: 12 bays + 4 future bays

The sub-station is proposed to control from a remote location and mode of communication shall be optical fiber for all voltage levels.

V. Complete relay and protection system.

VI. Bus post Insulators, insulator strings and hardwares, clamps & connectors, terminal connector, Conductor, earth wire and earthing materials, spacers, cable supporting angles/channels, Cable trays & covers, Junction box, buried cable trenches etc.
VII. One no. 400kVA, 11kV/433V LT Transformer having 170kVp BIL at 11kV side & One no. 400KVA, 11kV/433V LT Transformer having 75kVp BIL at 11kV side.

VIII. Nitrogen Injection Fire Prevention and Extinguishing System (NIFPES) for all transformers and Fire Protection for GIS room and control room building, DG Set etc.

IX. Air Conditioning System as per specification in section substation automation system.

X. Ventilation system for 220kV, 66kV and 33kV GIS hall. The requirement of ventilation system shall be as per Annexure-V.

XI. LT Switchgear

XII. 250KVA Outdoor Silent type DG Set.

XIII. 220V Batteries & Battery Chargers.

XIV. 1.1kV grade Power & Control cables along with complete accessories.

XV. Earth mat (Measurement of resistivity is in the scope of contractor)

XVI. Complete lighting and illumination of the installation. This shall include the illumination for GIS Building, control room building including street lights (if any). The specification for control room GIS building illumination shall be as per Annexure-IV.

XVII. Provision of CCTV camera for 220kV GIS, 66kV GIS and 33kV GIS & main gate of substation.

XVIII. Special Equipments for testing and maintenance.

XIX. Bidder shall arrange suitable provision for testing of 220kV, 66kV & 33kV cables after isolation from the main GIS. In addition, one set of each size of test bushing/plug shall also be provided for testing purpose.

XX. Purchaser’s site office and stores are in the scope of the bidder.

XXI. Bidder has to submit a ‘Model’ of the substation before starting actual work at site.

XXII. Mandatory Spares.

XXIII. The work to be done under this specification comprises the provision of all labour, plant, equipment and material and the performance of all work necessary for the complete installation and commissioning of switchyard. It is hereby required that the contractor should provide all apparatus, appliances, material and labour etc. not specifically mentioned or included, but are necessary to complete the entire work or any portion of the work in compliance with the requirements implied in this specification is deemed to be included in the scope of contractor.

XXIV. The scope of work shall cover in complete conformity with the specifications, the followings:-
A single line schematic of the 220kV, 66kV & 33kV SF6 gas insulated switchgear with double bus bar arrangement is enclosed with the specification. In case any additional
equipment is required, the same should be included in the scope of the supply and the offer should be complete and comprehensive. In addition all necessary platforms, supports, ladders and catwalks etc. for operation & maintenance work shall also be supplied. A tentative layout of the switchyard is enclosed with this specification. Bidder may adopt similar arrangement or optimize the same further without affecting any of the functional requirements specified.

XXV. Any other equipment/material required for completing the specified scope.

3.2 Civil works at 220/66/33kV R.K.Puram GIS Sub-station - The work shall include but not limited to the following:-

i. Soil Investigation.

ii. Design, Engineering and civil work for :
   a. Buildings for control room and GIS hall (including furniture) as per details in Section civil works. Each GIS hall shall be provided with EOT crane and the requirement of crane shall be as per clause no. 24.0 of section GIS.
   b. DTL site office (Pota cabin with furniture and AC) and store.
   c. RCC frame boundary wall with brick paneling including gates.
   d. Foundation of 100MVA and 160 MVA Trfs. including soak pit, sump pit, fire protection wall etc.
   e. Foundation of 400 KVA LT transformers.
   f. Foundation of 250KVA DG set.
   g. All civil works associated with erection of SF6 gas insulated metal enclosed switchgear including their foundation.
   h. Foundation for lighting poles, panels & control cubicles of equipments wherever required.
   i. Foundation for Lattice and pipe structures.
   j. RCC in foundation including earth work in excavating disposal of surplus earth PCC, RCC, reinforcement steel for structures and equipments.
   k. All roads including all crossings.
   l. Site surfacing (gravelling) and anti weed treatment of complete switchyard area with provision of anti-termite treatment in control room building.
   m. Cable trenches including all types of crossings (including power cable trench).
   n. Substation fencing along with gates.
   o. Rain Water harvesting.
   p. Drainage system in the substation including storm water drainage.
   q. Pump house building.
   r. Any other work required for functional requirement of establishment of the substation.

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

The complete design (unless specified otherwise in specification elsewhere) and detailed engineering shall be done by the Contractor based on conceptual tender drawings.
3.4 The Contractor shall also be responsible for the overall co-ordination with internal/external agencies, project management, training of Purchaser's manpower, loading, unloading, handling, moving to final destination for successful erection, testing and commissioning of the substation/switchyard.

3.5 Design of substation and its associated electrical & mechanical auxiliaries systems includes preparation of single line diagrams and electrical layouts for extension area, erection key diagrams, electrical and physical clearance diagrams, design calculations for Earth mat, control and protection schematics, wiring and termination schedules, civil designs (as applicable) and drawings, design of fire fighting system and air conditioning system, indoor/outdoor lighting/illumination and other relevant drawings & documents required for engineering of all facilities under the scope of this contract.

3.6 The Bidder shall keep the provision of service bays for increasing the length of GIS room to meet the future requirement, keeping the width of the building same. GIS building size shall be frozen after considering the requirement of two nos. 220kV GIS, four nos. 66kV GIS and four nos. 33kV GIS future bays which have been planned for cable bays.

3.7 **Specific Exclusions**

   The following items of work are specifically excluded from the scope of the specifications for substation:

   1. Transmission line side insulator string for line termination and tension clamp for earth wire termination.
   2. Road outside Boundary Wall.

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

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

4.0 **PHYSICAL AND OTHER PARAMETERS**

4.1 **Location of the Substation** - The location of substation is indicated below:

<table>
<thead>
<tr>
<th>Name of Substation</th>
<th>Name of State</th>
<th>Nearest Railway station</th>
<th>Railway Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.K.Puram</td>
<td>Delhi Region</td>
<td>Delhi</td>
<td>Northern Railways</td>
</tr>
</tbody>
</table>

4.2 **Meteorological data**

   The meteorological data of the substation shall be handed over to successful bidder. However for design purposes, ambient temperature shall be considered as 50 degree centigrade.

4.3 **Soil Data**

   The bidder shall be responsible for carrying out the required tests and should fully satisfy himself about the nature of soil expected to be encountered prior to the submission of bid. Any variation of soil data during detailed engineering or construction stage shall not constitute a valid reason in affecting the terms and conditions of the bid.

5.0 **SCHEDULE OF QUANTITIES**

   The requirement of various items/equipments and civil works are indicated in Bid price Schedules.
All equipments/items and civil works for which quantities has been given in the price schedule shall be payable on unit rate basis. During actual execution, any variation in such quantities shall be paid based on the unit rate under each item incorporated in the letter of award.

Wherever the quantities of items/works are not indicated, the bidder is required to estimate the quantity required for entire execution and completion of works and incorporate their price in respective Bid price schedules.

The detailed bill of quantities of the mandatory spares with break up is given in the bid price Schedules (Volume-III).

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

6.0 BASIC REFERENCE DRAWINGS

6.1 220/66/33kV R.K.Puram GIS Sub-station (DTL) is a new Gas Insulated Substation. For 220, 66kV and 33kV voltage level, Double bus switching scheme layout arrangement shall be used. Single line diagram and layout arrangements are enclosed with the bid documents, which shall be further engineered by the bidder.

The drawings enclosed in Annexure-II shall give the basic scheme, layout of substation, substation buildings, associated services etc. In case of any discrepancy between the drawings and text of specification, the requirements of text shall prevail in general. However, the Bidder is advised to get these clarified from Purchaser.

6.2 The auxiliary transformers of rating 400KVA shall be used to feed the substation auxiliaries at R.K.Puram GIS substation.

The 400 KVA, 11/0.433 kV (170kVp - BIL) auxiliary transformer shall be connected through overhead conductor to the tertiary of any one of the 160 MVA or 100 MVA power transformers and shall be located near the power transformer while another 400KVA (75kVp - BIL) auxiliary transformer shall be located in LT station area and HT side shall be connected with Discom supply through 11kV HT Cable. These auxiliary transformers should not be used for construction purpose. The detailed scheme is shown in the single line diagram.

7.0 ORDER OF PRECEDENCE OF DIFFERENT SECTIONS OF TECHNICAL SPECIFICATION

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

1) Section-1 : Project
2) Section-2 : GIS
3) Section-3 : General Technical Requirement (GTR)
4) Section-4 : Transformers
5) Section-5 : Fire Protection System
6) Section-6 : Power and Control Cables
7) Section-7 : LT Switchgear
8) Section-8 : Battery and Battery Charger
9) Section-9 : Lighting System
10) Section-10 : LT transformer  
11) Section-11 : DG Set  
12) Section-12 : Switchyard Erection  
13) Section-13 : Civil Works  
14) Section-14 : Substation Automation System  
15) Section-15 : Control and Relay Panels  
16) Section-16 : Special Equipments

In case of any discrepancy between Section-PROJECT, Section- GTR and other technical specifications on scope of works, Section-PROJECT shall prevail over all other sections.

In case of any discrepancy between Section-GTR and individual sections for various equipments, requirement of individual equipment section shall prevail.

8.0 MANDATORY SPARES
The Mandatory Spares shall be included in the bid proposal by the bidder. The prices of these spares shall be given by the Bidder in the relevant price schedule and shall be considered for evaluation of bid. It shall not be binding on the Purchaser to procure all of these mandatory spares.

The bidder is clarified that no mandatory spares shall be used during the commissioning of the equipment. Any spares required for commissioning purpose shall be arranged by the Contractor. The unutilized spares if any brought for commissioning purpose shall be taken back by the contractor.

9.0 SPECIAL TOOLS AND TACKLES
The bidder shall include in his proposal the deployment of all special tools and tackles required for erection, testing, commissioning and maintenance of equipment. However a list of all such devices should be indicated in the relevant schedule provided in the price schedule. In addition to this the Contractor shall also furnish a list of special tools and tackles for the various equipment in a manner to be referred by the Purchaser during the operation of these equipment.

10.0 FACILITIES TO BE ARRANGED BY THE CONTRACTOR
10.1 For construction purpose, the Contractor shall arrange suitable electricity supply from the Distribution Utility at his own cost and in case of failure of power due to any unavoidable circumstances, the contractor shall make his own necessary arrangements like diesel generator sets etc., at his own cost so that progress of work is not affected and Employer shall in no case be responsible for any delay in works because of non-availability of power.

10.2 The contractor shall make his own arrangement for water supply at his own cost and the Employer shall in no case be responsible for any delay in works because of non-availability or inadequate availability of water.

11.0 TERTIARY WINDING (TRANSFORMER)
The tertiary winding shall be suitable for connection to LT transformer for auxiliary supply. The details of equipment associated with loading tertiary winding are enclosed as Annexure-III.

12.0 SPECIFIC REQUIREMENT
12.1 Training of Owner’s Personnel

Contractor shall organize and conduct complete & thorough Training programme (to be conducted in English language) providing necessary training material at no extra cost to
the employer. However, the travelling and living expenses of owner’s engineers, if any, shall be borne by the owner. The training shall be carried out at site for 120 mandays to cover testing, operation & maintenance aspects so as to ensure the complete adequacy of the programme.

12.2 In addition to the requirement stipulated in clause no. 9.3, section - GTR for repetition of type tests, the type tests for 220kV, 66kV and 33kV GIS are intended to be repeated for which charges shall be payable as per provision of contract.

12.3 The equipment to be supplied for 220kV system including 100MVA and 160 MVA power transformers shall be suitable for system fault current of 40 KA for 1 second as specified elsewhere in the specification.

12.4 The contractor shall place their panels i.e. Bay level units, bay mimic, relay and protection panels etc in an enclosure for 220kV, 66kV as well as 33 kV in respective GIS hall. The enclosure shall be air-conditioned and requirement of air-conditioning shall be as detailed in section Sub-station Automation System clause no. 4.3.

12.5 Control, monitoring and protections (over current and open delta protections) for 400 KVA Auxiliary transformer and associated equipments shall be from auxiliary BCU to be provided as per section sub-station automation.

12.6 The specification of 66kV XLPE cable required for interconnection between 66kV side of power transformer to 66kV GIS hall and 33kV XLPE cable required for interconnection between 33kV side of transformer to 33kV GIS hall are enclosed as Annexure-VI.

12.7 As 220kV,66kV and 33kV GIS are proposed to be extended in near future, the contractor shall made available all details such as cross section, gas pressure etc required to design adopter in future for extension of both GIS during detailed engineering.

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

12.9 In Section-GTR and other technical specifications, the word ‘Employer’ and/or ‘Owner’ may be read as ‘Purchaser’.
The mandatory spares for the equipments with break up are mentioned in relevant bid price schedules (Vol.-III).
Annexure-II

List of Drawings for 220/66/33kV Gas Insulated sub-station at R.K.Puram

2. Tentative Layout Plan of 220/66/33kV GIS Sub-station (Land Area and Location).
TECHNICAL PARAMETERS FOR TERTIARY LOADING EQUIPMENTS FOR 160 MVA or 100 MVA TRANSFORMER

A. 36kV, outdoor type, SF6 Circuit Breaker
   Technical Parameters
   a) Rated Current (A) – 630
   b) Insulation level - BIL- 170kVpeak
   c) Short time rating - 25KA for 1 sec.
   d) The circuit breaker shall be provided with the provision of local and remote operation.

B) 33kV, outdoor type, Current Transformer
   Technical Parameters
   a) Ratio (A) - 25/1-1
   b) Insulation level - BIL- 170kVpeak
   c) Short time rating - 25KA for 1 sec.
   d) Class - 0.2 – metering
      5P20 - overcurrent & earth fault protection
   e) VA burden - 20 each

C) 11kV, outdoor type, Potential Transformer
   Technical Parameters
   a) Ratio - 11kV/\sqrt{3}/110V/\sqrt{3}/110V/\sqrt{3}.
   b) Insulation level - BIL- 170kVpeak
   c) Class - 0.2 – metering
      3P - open delta protection
   d) VA burden - 20 each

D) 33kV, outdoor type, isolator with earth switch
   Technical Parameters
   a) Isolator shall be horizontally mounted MOM type with local and remote operation.
   b) Insulation level - BIL- 170kVpeak
   c) Short time rating - 25KA for 1 sec.

E) 11 kV Surge Arrester
   The rating of surge arrester shall be finalized during detailed engineering.

F) Control & Relay protection scheme
   The control & relay panel for tertiary shall be mounted either in 33kV incomer panel or in separate panel. Tertiary control shall also be monitored through sub-station automation system, however, various items are required for control & relay panel is as follows:-
   i) One Multifunction Meter.
   ii) One Static Tri- vector meter 0.2 Class, ABT compliant.
   iii) One Control switch for circuit breaker operation.
   iv) LED for C.B/ Isolator closed/ open position in red and green colour.
   v) Alarm and LED for DC failure.
   vi) One painted mimic bus equipped with symbols and semaphore indicators to represent breaker position.
   vii) LED for auto trip in amber colour.
   viii) LED blue coloured for C.B. spring charged condition (if required).
   ix) DC supervision scheme.
   x) Push button and bulb for on demand checking of trip circuit healthy for ON/OFF position with relay.
   xi) Static O/C and E/F relay.
   xii) Inverse characteristic Neutral unbalance voltage relay.
   xiii) Bell operation on DC.
   xiv) Buzzer operating on 230V A.C.
xv) Push button for alarm cancellation.
xvi) Test terminal block for testing of meters.
xvii) Set of auxiliary relays and tripping relays required to complete the scheme.
xviii) A.C failure relay.

G) The sub-station auxiliary supply is normally met through a system having the following parameters. The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation system shall also conform the parameters as indicated in the following.

<table>
<thead>
<tr>
<th>Normal Voltage</th>
<th>Variation in Voltage</th>
<th>Frequency in Hz</th>
<th>Phase/Wire</th>
<th>Neutral connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>415V</td>
<td>+/- 10%</td>
<td>50 +/- 5%</td>
<td>3/4 Wire</td>
<td>Solidly Earthed.</td>
</tr>
<tr>
<td>240V</td>
<td>+/- 10%</td>
<td>50 +/- 5%</td>
<td>1/2 Wire</td>
<td>Solidly Earthed.</td>
</tr>
<tr>
<td>220V</td>
<td>190V to 240V DC</td>
<td></td>
<td>2 wire</td>
<td>Isolated System</td>
</tr>
</tbody>
</table>

Combined variation of voltage and frequency shall be limited to +/- 10%.
LIGHTING SPECIFICATION FOR GIS at R.K.Puram

1. **GIS BUILDING**
   The GIS Building main halls will be illuminated using enclosed type high bay, luminaries having 250 watt metal halide fixtures along with surface mounted 1x60W GLS down lighters for emergency areas.

2. **CONTROL ROOM LIGHTING**
   1. Control room area will be illuminated using mirror optics luminaries, which have superb glare control, the luminaries will have Cat II mirrors. Philips TBS 088 / 236 C5 HF or equivalent.
   2. In addition to mirror optics luminaries CFL down lighter with turbo louvers will be used. The luminaries would be suitable for 2XPL 16 Watt Lamp.
   3. For non false ceiling areas, the illumination will be carried out using 2x28 Watt lamps with industrial reflector Philips TMS 122 / 228 HF or equivalent.
   4. DC Emergency Lighting in non false ceiling areas to be carried out with surface mounted down lighters.
   5. For all areas necessary exit sign lights and minimum 4 nos portable emergency lights will be provided.

3. **Following Average Lux Levels will be maintained :**

<table>
<thead>
<tr>
<th>Area</th>
<th>Lux</th>
<th>Uniformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Control Room</td>
<td>350 Lux</td>
<td>0.8</td>
</tr>
<tr>
<td>2. GIS Building</td>
<td>200 Lux</td>
<td>0.7</td>
</tr>
<tr>
<td>3. Offices</td>
<td>300 Lux</td>
<td>0.8</td>
</tr>
<tr>
<td>4. Indoor areas other</td>
<td>150 Lux</td>
<td>0.7</td>
</tr>
</tbody>
</table>

4. **Control :**
   Sufficient number of occupancy and light level sensors shall be provided subject to following minimum requirement:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Area</th>
<th>No. of Occupancy Sensor</th>
<th>No. of Light Level Sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control Room</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Conference Room</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Room For Engineers</td>
<td>4</td>
<td>---</td>
</tr>
<tr>
<td>4</td>
<td>Room for Non-executive</td>
<td>1</td>
<td>---</td>
</tr>
<tr>
<td>5</td>
<td>S/Stn. In-charge Room</td>
<td>1</td>
<td>---</td>
</tr>
<tr>
<td>6</td>
<td>Electronic Lab</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>220kV GIS Hall</td>
<td>---</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>66kV GIS Hall</td>
<td>---</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>33kV GIS Hall</td>
<td>---</td>
<td>4</td>
</tr>
</tbody>
</table>

No occupancy sensor and light level sensors are envisaged for ACDB room, DCDB room, Lobby, Corridor and DG set.

Each light level sensor shall be provided to measure and regulate lighting. The light level sensor shall be used to achieve bank switching.

Each occupancy sensor shall be used for indoor use with time delay programmable in the minimum range of 1 sec. to 2 Hour to control the illumination in the area.
ANNEXURE-V

VENTILATION SYSTEM FOR GIS HALL

Ventilation system

Each GIS hall shall have an independent ventilation system. Each ventilation system shall consist of two 100% capacity systems, one operating and one stand-by.

To ensure that the air being supplied to the GIS hall is free from dust particles, a minimum two-stage dust filtration process shall be supplied. This shall consist of at least the following:

1. Pre Filters: To remove dust particles down to 10 micron in size with at least 95% efficiency.
2. Fine Filters: To remove dust particles down to 5 microns in size with at least 99% efficiency.

All the filters shall be panel type. Easy access should be available to the filters for replacement/cleaning.

The ventilation of the GIS hall shall be of a positive pressure type with minimum 4 air changes per hour. The pressure inside the GIS hall shall be maintained 5 mm of Water above the atmospheric pressure. Fresh outdoor air shall be filtered before being blown into the GIS hall by the air fans to avoid dust accumulation on components present in the GIS hall. Each GIS hall shall be provided with motorized exhaust dampers with local control.
TECHNICAL SPECIFICATION FOR 66kV XLPE CABLE

1.0 TECHNICAL REQUIREMENTS

1.0.1 The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 1 (one) km of single core, 66kV or higher grade XLPE insulated cable which must be in satisfactory operation for at least 2 (two) years on the date of bid opening.

1.0.2 The XLPE insulated, HT cable shall be manufactured & tested in accordance with the IS 7098 Part-III and shall also conform to the requirements of internationally accepted standards IEC 60502-2 (applicable clauses only) for construction and IEC 62067 for testing. The terminating accessories shall conform to IEC 62067 (latest).

1.0.3 The cable shall be 66 kV grade, single core, un-armoured, stranded compacted Copper conductor, core screening by a layer of semiconducting tape followed by a layer of semiconducting compound, cross linked polyethylene (XLPE) dry cured insulation, insulation screening with semiconducting compound extruded directly over the insulation, longitudinal sealing by a layer of non woven tape with water swellable absorbent over insulation screen, metallic sheath of such metal/material (except lead/ lead alloy) designed to meet the requirement of the system short circuit rating of 31.5 KA for 1 sec and provide radial moisture barrier & outer jacket of extruded black colored PVC alternatively, PE with anti-termite protection and conforming to the technical particulars of specification.

1.0.4 The construction of cable shall generally conform to the description mentioned at sl no.1.0.2 of the specification. Bidder may offer necessary layers such as separation tape, binder tapes etc additionally as per their manufacturing practices for meeting required performance of the offered cable. The bidder shall enclose with the bid, drawing showing cross section of the cable. The conductors screen (non-metallic semi-conductive) shall be extruded in a single one-time process to ensure homogeneity and absence of voids.

2.0 Type Tests:

2.0.1 The cable shall conform to all type, routine and acceptance tests listed in the relevant IS/IEC.

2.0.2 The cable should have been type tested for all type tests as per IEC 62067/IS: 7098 (Part-3) – 1993 including its amendments for XLPE insulated HT cable and its report shall be submitted to employer for its acceptance.

2.0.3 The bidder shall submit type test reports for all type test as per clause no. 11.3.2, IEC
62067 including amendments for employer’s acceptance for accessories for 66kV XLPE cable.

3.0 **Cable Laying and Termination:**

66 kV, XLPE insulated cable shall be laid from 160 MVA transformer to GIS in buried cable trench. Single point bonding system shall be employed along with sheath voltage limiters (SVL) if required, to limit the standing voltage to 65V. Laying route along with cable length shall be planned to keep provision of a future cable joint in all cables by providing S bend.
TECHNICAL SPECIFICATION FOR 33kV XLPE CABLE

1.0 SCOPE
1.1 Scope of this section covers the general technical data of the system and also the technical requirement of the 33 kV Cable.

1.2 SYSTEM PARAMETERS:

The brief particulars of the 33 kV system parameters are given hereafter:

(i) Nominal system voltage 33 KV rms.
(ii) Highest system voltage 36 KV rms.
(iii) Impulse withstand voltage 1.2/50 micro 170 KV peak
     Seconds wave of positive/negative polarity
(iv) System Frequency 50 Hz.
(v) No. of phase per circuit Three
(vi) System Earthing solidly grounded.
(vii) Ratted short time current 31.5 KA
(viii) One minute Power Frequency withstand voltage 70kVrms
(ix) Duration of fault current one second

1.3 CABLE
1.3.1 The cross linked polyethylene insulated (XLPE) cable (Dry cured) shall be manufactured in accordance with the internationally accepted standard and also confirm to the requirements of IEC Publication No.502 “Extruded solid dielectric insulated power cable for rated voltage from 1 KV to 30 KV”.

1.3.2 The cable shall be suitable for laying in an area likely to be flooded by water and shall be designed to be protected against rodent and termite attack.

1.3.3 The construction of cable shall generally confirm to the description in this specification. Tender shall enclose with Bid offer required drawing showing cross-section of the cable.

1.3.4 The supplier shall quote for 33 KV XLPE insulated single core cable, of solid extruded dielectric with metallic sheath with an outer PVC jacket. The supplier shall furnish technical justification for choice of the metal sheath.

1.3.5 The conductor screen, (non-metallic semi conductive) insulation and insulation screen (non-metallic semi conductive) shall all be extruded in a single one time process to ensure homogeneity and absence of voids.

1.4 CONDUCTOR

The tendered shall quote for XLPE cable with aluminium conductor of 1000 Sq mm cross section. The shape of the conductor shall be compact circular standard.

1.5 CONDUCTOR SHIELD:

The conductor shield shall consist of extruded semi conductive XLPE. Semi-conducting separator tapes shall be supplied between conductor and the extruded semi conductor XLPE.

1.6 INSULATION:
The extruded XLPE insulation shall be of very high degree of purity and dry cured. The average thickness shall not be less than the nominal value given in IEC-811. The minimum thickness at any point shall not fall below the nominal value by more than 10%.

1.7 **INSULATIONS SHIELD**
The insulation shield shall consist of extruded semi conducting XLPE. Suitable bedding tapes shall be supplied over the extruded semi conducting XLPE.

1.8 **ARMOUR:**
There shall be Armouring of Round/Flat type

1.9 **OUTER JACKET:**
The outer jacket shall consist of extruded black colored PVC. The minimum thickness at any point shall not fall below 90% of the nominal.

1.10 **RATING:**
1.10.1 The cable size shall be suitable to carry the load current on 3 kV continuously followed by a 10% overloading capacity for two hours without exceeding the maximum conductor temperature of 90°C (The manufacturer shall specify such final temperature which shall ensure that there is no loss of life of the cable insulation.) The cable rating size shall be based on loading of 2 Nos. three phase circuit at an ambient temperature of 50°C and soil temperature of 35°C. A complete set of experimentally verified data and calculation made in arriving at the conductor rating shall be enclosed with the offer.

2.0 **TYPE TESTS:**
2.1 The cable shall confirm to all Type, Routine and Acceptance tests listed in the relevant IS/IEC.

2.2 The cable should have been type tested for all type tests as per IS: 10810 “Methods of test for cables” including its amendments for XLPE insulated LT Cable and its report shall be submitted to Employer for its acceptance.

2.3 The bidder shall submit type test reports for all type test as per IS: 10810 including amendments for employer’s acceptance for accessories for 33kV XLPE cable.

3.0 **CABLE LAYING & TERMINATION:**
33kV XLPE cable shall be laid from ICT to GIS in buried cable trench. Single point bonding system shall be employed along with sheath voltage limiters (SVL), if required, to limit the standing voltage to 65V. Laying route along with cable length shall be planned to keep provision of a future cable joints in all cables by providing S bend.
SECTION : 2

SF6 GAS INSULATED METAL ENCLOSED SWITCHGEAR

1.0 GENERAL CHARACTERISTICS
The SF6 gas insulated metal enclosed switchgear shall be totally safe against inadvertent touch of any of it's live constituent parts. It should be designed for indoor/outdoor (as specified) application with meteorological conditions at site as per Section Project. All parts of the switchgear should be single phase/ three phase enclosed.

The arrangement of gas sections or compartments shall be such as to facilitate future extension of any make on either end without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays.

The design should be such that all parts subjected to wear and tear are easily accessible for maintenance purposes. The equipment offered shall be protected against all types of voltage surges and any equipment necessary to satisfy this requirement shall be deemed to be included. The required overall parameters of GIS are as follows:-

<table>
<thead>
<tr>
<th>S. No</th>
<th>Technical particulars</th>
<th>220kV System</th>
<th>66kV system</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Rated Voltage</td>
<td>245 kV (rms)</td>
<td>72.5 kV (rms)</td>
</tr>
<tr>
<td>b)</td>
<td>Rated frequency</td>
<td>50 HZ</td>
<td>50 HZ</td>
</tr>
<tr>
<td>c)</td>
<td>Grounding</td>
<td>Effectively earthed</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td>d)</td>
<td>Rated power frequency withstand Voltage (1 min ) line to earth</td>
<td>460 kV (rms)</td>
<td>140 kV (rms)</td>
</tr>
<tr>
<td>e)</td>
<td>Impulse withstand BIL (1.2/50 µsec) Line to earth</td>
<td>±1050 kVp</td>
<td>±325 kVp</td>
</tr>
<tr>
<td>f)</td>
<td>Rated short time withstand current (1 sec)</td>
<td>40 kA (rms)</td>
<td>31.5 kA (rms)</td>
</tr>
<tr>
<td>g)</td>
<td>Rated peak withstand Current</td>
<td>100 kA (peak)</td>
<td>80 kA (peak)</td>
</tr>
<tr>
<td>h)</td>
<td>Guaranteed maximum gas losses for complete installation as well as for all individual sections in %.</td>
<td>As per IEC-62271-203</td>
<td>As per IEC-62271-203</td>
</tr>
<tr>
<td>i)</td>
<td>Rated current normal/ at site (at 50°C design ambient temperature)</td>
<td>As per BID Price Schedule</td>
<td>As per BID Price Schedule</td>
</tr>
<tr>
<td>j)</td>
<td>Seismic Level</td>
<td>Zone-IV, as per IS-1893,Year-2002</td>
<td>Zone-IV, as per IS-1893,Year-2002</td>
</tr>
</tbody>
</table>

The metal-enclosed gas insulated switchgear, including the operating devices, accessories and auxiliary equipment forming integral part thereof, shall be designed, manufactured, assembled and tested in accordance with the IEC-62271-203 & IEC-62271-200 publications including their parts and supplements as amended or revised to date.

2.0 REFERENCE STANDARDS
The metal-enclosed gas-insulated switchgear, including the operating devices, accessories and auxiliary equipment forming integral part thereof, shall be designed, manufactured, assembled and tested in accordance with the following International Electro-technical Commission (IEC) Publications including their parts and supplements as amended or revised
<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 62271-203</td>
<td>Gas Insulated metal-enclosed switchgear for rated voltages above 52KV</td>
</tr>
<tr>
<td>IEC 62271-100</td>
<td>High voltage alternating current Circuit breakers</td>
</tr>
<tr>
<td>IEC 60694</td>
<td>Common clauses for high voltage Switchgear and control-gear standards</td>
</tr>
<tr>
<td>IEC 62271-200</td>
<td>Gas Insulated metal-enclosed switchgear for rated voltages above 11kV &amp; upto and including 52kV</td>
</tr>
<tr>
<td>IEC 62271-102</td>
<td>Alternating current disconnectors (isolators) and earthing switches</td>
</tr>
<tr>
<td>IEC 61128</td>
<td>Alternating current disconnectors. Bus-transfer current switching by disconnectors</td>
</tr>
<tr>
<td>IEC 61129</td>
<td>Alternating current earthing switches. Induced current switching</td>
</tr>
<tr>
<td>IEC 66044-1</td>
<td>Current transformers</td>
</tr>
<tr>
<td>IEC 66044-2</td>
<td>Voltage transformers</td>
</tr>
<tr>
<td>IEC 60137</td>
<td>Bushings for alternating voltages above 1000 V</td>
</tr>
<tr>
<td>IEC 60859</td>
<td>Cable connections for gas-insulated switchgear</td>
</tr>
<tr>
<td>IEC 60480</td>
<td>Guide to checking of sulphur hexafluoride taken from electrical equipment</td>
</tr>
<tr>
<td>IEC 60099-1/4</td>
<td>Non-linear resistor type arresters for AC systems</td>
</tr>
<tr>
<td>IEC 60427</td>
<td>Report on synthetic testing of high-voltage alternating-current breaker</td>
</tr>
</tbody>
</table>

The components and devices which are not covered by the above standards shall conform to, and comply with, the latest applicable standards, rules, codes and regulations of the internationally recognized standardizing bodies and professional societies as may be approved by the Employer. The manufacturer shall list all applicable standards; codes etc. and provide copies thereof for necessary approval.

In case the requirements laid down herein differ from those given in above standard in any aspect the switchgear shall comply with the requirements indicated herein in regard thereto.

### 3.0 DEFINITIONS

#### 3.1 Assembly

Assembly refers to the entire completed GIS equipment furnished under contract.

#### 3.2 Bay

Bay refers to the area occupied by one Circuit Breaker and associated equipments used to protect one feeders/line/bus coupler in double bus scheme.

#### 3.3 Compartment

When used in conjunction with GIS equipment, compartment refers to a gas tight volume bounded by enclosure walls and gas tight isolating barriers.

#### 3.4 Enclosure

When used in conjunction with GIS equipment, enclosure refers to the grounded metal housing or shell which contains and protects internal Power system equipment (breaker, disconnecting switch, grounding switch, voltage transformer, current transformer, surge arresters, interconnecting bus etc.)

#### 3.5 Manual Operations

Manual operation means operation by hand without using any other source of Power.
3.6 Module
When used in conjunction with GIS equipment, module refers to a portion of that equipment. Each module includes its own enclosure. A module can contain more than one piece of equipment, for example, a module can contain a disconnecting switch and a grounding switch.

3.7 Reservoir
When used in conjunction with GIS equipment, reservoir refers to a larger gastight volume.

4.0 GENERAL DESIGN AND SAFETY REQUIREMENT
4.1. The GIS assembly shall consist of separate modular compartments, e.g., Circuit Breaker compartment, Bus bar compartment filled with SF6 Gas and separated by gas tight partitions so as to minimize risk to human life, allow ease of maintenance and limit the effects of gas leaks failures & internal arcs etc. These compartments shall be such that maintenance on one feeder may be performed without de-energizing the adjacent feeders. These compartments shall be designed to minimize the risk of damage to adjacent sections and protection of personnel in the event of a failure occurring within the compartments. Rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting of pressures developing within the enclosures under worst operating conditions.

4.2. The workmanship shall be of the highest quality and shall conform to the latest modern practices for the manufacture of high technology machinery and electrical switchgear.

4.3. The switchgear, which shall be of modular design, shall have complete phase isolation. The conductors and the live parts shall be mounted on high graded epoxy resin insulators. These insulators shall be designed to have high structural strength and electrical dielectric properties and shall be shaped so as to provide uniform field distribution and to minimize the effects of particle deposition either from migration of foreign particles within the enclosure or from the by-products of SF6 breakdown under arcing conditions.

4.4. Gas barrier insulators and support insulators shall have the same basis of design. The support insulators shall have holes on both sides for proper flow of gas.

4.5. Gas barrier insulators shall be provided so as to divide the GIS into separate compartments. They shall be suitably located in order to minimize disturbance in case of leakage or dismantling. They shall be designed to withstand any internal fault thereby keeping an internal arc inside the faulty compartment. Due to safety requirement for working on this pressurized equipment, whenever the pressure of the adjacent gas compartment is reduced, it should be ensured by the bidder that adjacent compartment would remain in service with reduced pressure. The gas tight barriers shall be clearly marked on the outside of the enclosures.

4.6. The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through as per IEC. The material shall be such that it has no effect of environment as well as from the by-products of SF6 breakdown under arcing condition.

4.7. Each section shall have plug- in or easily removable connection pieces to allow for easy replacement of any component with the minimum of disturbance to the remainder of the equipment. Inspection windows shall be provided for disconnector and earth switches.

4.8 The material used for manufacturing the switchgear equipment shall be of the type, composition and have physical properties best suited to their particular purposes and in accordance with the latest engineering practices. All the conductors shall be fabricated of
aluminum/ copper tubes of cross sectional area suitable to meet the normal and short circuit current rating requirements. The finish of the conductors shall be smooth so as to prevent any electrical discharge. The conductor ends shall be silver plated and fitted into finger contacts or tulip contacts. The contacts shall be of sliding type to allow the conductors to expand or contract axially due to temperature variation without imposing any mechanical stress on supporting insulators.

4.9 Each pressure filled enclosure shall be designed and fabricated to comply with the requirements of the applicable pressure vessel codes and based on the design temperature and design pressures as defined in IEC-62271-203/ IEC-62271-200.

4.10 The manufacturer shall guarantee that the pressure loss within each individual gas-filled compartment shall not be more than half percent (0.5%) per year.

4.11 Each gas-filled compartment shall be equipped with static filters, density switches, filling valve and safety diaphragm. The filters shall be capable of absorbing any water vapor which may penetrate into the enclosures as well as the by-products of SF6 during interruption. Each gas compartment shall be fitted with separate non-return valve connectors for evacuating & filling the gas and checking the gas pressure etc.

4.12 The switchgear line-up when installed and operating under the ambient conditions shall perform satisfactorily and safely under all normal and fault conditions. Even repeated operations up to the permissible servicing intervals under 100% rated and fault conditions shall not diminish the performance or significantly shorten the useful life of the switchgear. Any fault caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear. The internal components shall be maintenance free for at least 10 years. Routine replacements of insulating gas shall not be required in intervals of less than ten years.

4.13 The thermal rating of all current carrying parts shall be minimum for one sec. for the rated symmetrical short-circuit current.

4.14 The switchgear shall be of the free standing, self-supporting with easy accessibility to all the parts during installation & maintenance with all high-voltage equipment installed inside gas- insulated metallic and earthed enclosures, suitably sub-divided into individual arc and gas-proof compartments preferably for:
   a) Bus bars
   b) Intermediate compartment
   c) Circuit breakers
   d) Line disconnectors
   e) Voltage Transformers
   f) Gas Insulated bus duct section between GIS and XLPE cable
   g) Gas Insulated bus section between GIS & Transformer/ Reactor (if applicable)
The bus enclosure should be sectionalized in a manner that maintenance work on any bus disconnector (when bus and bus disconnector are enclosed in a single enclosure) can be carried out by isolating and evacuating the small effected section and not the entire bus.

4.15 The arrangement of the individual switchgear bays shall be such so as to achieve optimum space-saving, neat and logical arrangement and adequate accessibility to all external components.

4.16 It is required that the three phases of each switchgear bay be arranged side by side. The arrangement of the equipment offered must provide adequate access for operation, testing
4.17. Local Control & Substation Automation System:-
Separate control cubicle including gas monitoring kiosk shall be provided for each bay which shall be installed near the switchgear for local control & monitoring of respective switchgear bay.

Local control cubicle for GIS shall be equipped with suitable hardware & software for remote control operation and conform to the bay level controller as detailed in Section: Substation Automation System.

BCU/BPU can also be used as Local Control Cubicle (LCC) depending upon the design of the offered equipment, as such separate LCC need not be provided.

Relay & Protection panels room shall house these equipments and shall be located adjacent to GIS room. It shall be air- conditioned through split air conditioners. The capacity and quantity of air conditioners shall be finalized during detailed engineering.

4.18. All the elements shall be accessible without removing support structures for routine inspections and possible repairs. The removal of individual enclosure parts, or entire breaker bays shall be possible without disturbing the enclosures of neighboring bays.

4.19. It should be impossible to unwillingly touch live parts of the switchgear or to perform operations that lead to arcing faults without the use of tools or brute force.

4.20. In case of any repair or maintenance on one bus bar disconnectors, the other bus bar should be live and in service.

4.21. All interlocks that prevent potentially dangerous mal-operations shall be constructed such that they can not be operated easily, i.e. the operator must use tools or brute force to over- ride them.

4.22. In general the contours of energized metal parts of the GIS and any other accessory necessary shall be such, so as to eliminate areas or points of high electrostatic flux concentrations. The surfaces shall be smooth with no projection or irregularities which may cause visible corona. No corona shall be visible in complete darkness which the equipment is subjected to specified test voltage. There shall be no radio interference from the energized switchgear at rated voltage.

4.23. The enclosure shall be of continuous design and shall meet the requirement as specified in clause no. 10 (special considerations for GIS) of IEEE- 80, Year- 2000. The enclosure shall be sized for carrying induced current equal to the rated current of the Bus. The conductor and the enclosure shall form the concentric pair with effective shielding of the field internal to the enclosure.

4.24. The fabricated metal enclosures shall be of Aluminum alloy having high resistance to corrosion, low electrical loses and negligible magnetic losses. All joint surfaces shall be machined and all castings shall be spot faced for all bolt heads or nuts and washers. All screws, bolts, studs and nuts shall conform to metric system. The other type of non- magnetic enclosures may be considered.

4.25. The breaker enclosure shall have provision for easy withdrawal of the interrupter assemblies. The removed interrupter assembly must be easily and safely accessible for and maintenance.
4.26. The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electrodynamics stresses even under short circuit conditions.

4.27. The elbows, bends, cross and T-sections of interconnections shall include the insulators bearing the conductor when the direction changes take place in order to ensure that live parts remain perfectly centered and the electrical field is not increased at such points.

4.28. The Average Intensity of electromagnetic field shall not be more than 50 micro-Tesla. The contractor shall furnish all calculations and documents in support of the above during detailed engineering.

4.29. The Bidder shall furnish the following information regarding the loosely distributed metallic particles within the GIS encapsulation.
   a) Calculations of critical field strength for specific particles of defined mass & geometry
   b) The methodology and all the equipment for electrical partial discharge (PD) detection and/or acoustic detection methods, including that mentioned in the specification elsewhere.

4.30. The switchgear shall have provision for connection with ground mat risers. This provision shall consist of grounding pads to be connected to the ground mat riser in the vicinity of the equipment.

4.31. The ladders and walkways shall be provided wherever necessary for access to the equipment. A portable ladder with adjustable height may also be supplied to access to the equipment.

4.32. Wherever required, the heaters shall be provided for the equipment in order to ensure the proper functioning of the switchgear at specified ambient temperatures. The heaters shall be rated for 240V AC supply and shall be complete with thermostat, control switches and fuses, connected as a balanced 3-phase, 4-wire load. The possibility of using heaters without thermostats in order to achieve the higher reliability may be examined by the bidder and accordingly included in the offer but it shall be ensured by the bidder that the temperature rise of different enclosures where heating is provided should be within safe limits as per relevant standards. One copy of the relevant extract of standard to which the above arrangement conforms along with cost reduction in offer, if any, shall also be furnished along with the offer. The heaters shall be so arranged and protected as to create no hazard to adjacent equipment from the heat produced.

4.33. The enclosure & support structure shall be designed that a mechanic 1780 mm in height and 80 Kg in weight is able to climb on the equipment for maintenance.

4.34. The sealing provided between flanges of two modules / enclosures shall be such that long term tightness is achieved.

4.35. Alarm circuit shall not respond to faults for momentary conditions. The following indications including those required elsewhere in the specifications shall be generally provided in the alarm and indication circuits.

4.35.1. **Gas Insulating System**
   a) Loss of Gas Density.
   b) Loss of Heater power (if required)
c) Any other alarm necessary to indicate deterioration of the gas insulating system.

4.35.2. **Operating System:**
   a) Low operating pressure
   b) Loss of Heater power
   c) Loss of operating power
   d) Loss of control
   e) Pole Disordance

4.36. The equipment will be operated under the following ambient conditions:
   a) The ambient temperature varies between 0 degree-C and 50 degree-C.
   b) The humidity will be about 95% (indoors)
   c) The elevation is less than 1000 meters

4.37. Temperature rise of current carrying parts shall be limited to the values stipulated in IEC-694, under rated current and the climatic conditions at site. The temperature rise for accessible enclosure shall not exceed 20 degree C above the ambient temperature of 50 degree C. In the case of enclosures, which are accessible but need not be touched during normal operation, the temperature rise limit may be permitted upto 30 degree C above the ambient of 50 degree C.

4.38 In case of any internal arc fault regardless whether it occurs in a bus bar section, a bus bar isolator or the circuit breaker, repair works should be possible without shutting down the substation; at least one busbar and the undisturbed feeder should remain in operation. It should be possible to remove and replace a fully assembled circuit breaker without interfering the operation of the adjacent feeder. All circuit breakers of same rating should be interchangeable.

4.39 The GIS equipments shall be arranged in such a manner that in case of maintenance work on any of the equipment, at least one bus bar should be available for operation.

4.40 The inter bay width shall be sufficient to allow access to all drive mechanisms and other termination boxes without the need of dismantling other apparatuses.

These conditions shall be taken into account by the supplier in the design of the equipment.

5.0 **Bellows or Compensating Units:**
   Adequate provision shall be made to allow for the thermal expansion of the conductors and of differential thermal expansion between the conductors and the enclosures. The bellows shall be metallic (preferably of stainless steel) of following types or other suitable equivalent arrangement shall be provided wherever necessary.

   1. Lateral / Vertical mounting units: These shall be inserted, as required, between sections of busbars, on transformer, shunt reactor and XLPE cable etc. Lateral mounting shall be made possible by a sliding section of enclosure and tubular conductors.
   2. Axial compensators: These shall be provided to accommodate changes in length of bus bars due to temperature variations.
   3. Parallel compensators: These shall be provided to accommodate large linear expansions and angle tolerances.
   4. Tolerance compensators: These shall be provided for taking up manufacturing, site assembly and foundation tolerances.
   5. Vibration compensators: These bellow compensators shall be provided for absorbing
6. **INDICATION AND VERIFICATION OF SWITCH POSITIONS**

Indicators shall be provided on all circuit breakers, isolators and earth-switches, which shall clearly show whether the switches are open or closed. The indicators shall be mechanically coupled directly to the main contact operating drive rod or linkages and shall be mounted in a position where they are clearly visible through glass windows.

7. **PRESSURE RELIEF**:

Pressure relief devices shall be provided in the gas sections to protect the main gas enclosures from damage or distortion during the occurrence of abnormal pressure increase or shock waves generated by internal electrical fault arcs (preferably in downward direction).

Pressure relief shall be achieved either by means of diaphragms or plugs venting directly into the atmosphere in a controlled direction.

If the pressure relief devices vent directly into the atmosphere, suitable guards and deflectors shall be provided. Contractor shall submit to the owner the detailed criteria design regarding location of pressure relief devices/rupture diaphragms.

8. **PRESSURE VESSEL REQUIREMENTS**

The enclosure shall be designed for the mechanical and thermal loads to which it is subjected in service. The enclosure shall be manufactured and tested according to the pressure vessel code (ASME/CENELEC code for pressure Vessel.)

Each enclosure has to be tested as a routine test at 1.5 time the design pressure for one minute. The bursting strength of Aluminum castings has to be at least 5 times the design pressure. A bursting pressure test shall be carried out at 5 times the design pressure as a test on each type of enclosure.

9. **GROUNDING**

The grounding system shall be designed and provided as per IEEE-80-2000 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences.

As the area involved is small, contractor has to take special measures for the same.

The GIS supplier shall define clearly what constitutes the main grounding bus of the GIS. The GIS supplier must supply the entire material for grounding bus of GIS viz conductor, clamps, joints, operating and safety platforms etc. The GIS supplier is also required to supply all the earthing conductors and associated hardware material for the following:

1. Connecting all GIS equipment, bus ducts, enclosures, control cabinets, supporting structure etc. to the ground bus of GIS.
2. Grounding of transformer, CVT, SA and other outdoor switchyard equipments/structures etc.

Enclosure of the GIS may be grounded at several points so that there shall be grounded cage around all the live parts. A minimum of two nos. of grounding connections should be provided for each of circuit breaker, transformer terminals, cable terminals, surge arrestors, earth switches and at each end of the bus bars. The grounding continuity between each enclosure shall be effectively interconnected with Cu/ Al bonds of suitable size to bridge the flanges. In case the bidder does not offer external bonding, the bidder shall demonstrate that the connectivity offered by them between each enclosure is effective and does not require external bonding. Further similar design should have been
in service for offered voltage. Subassembly to subassembly bonding shall be provided to provide gap & safe voltage gradients between all intentionally grounded parts of the GIS assembly & between those parts and the main grounding bus of the GIS.

Each marshalling box, local control panel, power and control cable sheaths and other non current carrying metallic structures shall be connected to the grounding system of GIS via connections that are separated from GIS enclosures.

The grounding connector shall be of sufficient mechanical strength to withstand Electromagnetic forces as well as capable of carrying the anticipated maximum fault current without overheating. At least two grounding paths shall be provided to connect each point to the main grounding bus. Necessary precautions should be under taken to prevent excessive currents from being induced into adjacent frames, structures of reinforcing steel and to avoid establishment of current loops via other station equipment.

All flexible bonding leads shall be tinned copper. All connectors, for attaching flexible bonding leads to grounding conductors and grounding conductors to support structures shall tinned bronze with stainless steel or tinned bronze hardware.

The contractor shall provide suitable measure to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrestor, ph./ earth fault and discharges between contacts during switching operation. The grounding system shall ensure safe touch & step voltages in all the enclosures. The contractor shall provide suitable barrier of non-linear resistor/ counter discontinued SF6/ Air termination, SF6/ Transformer or Reactor termination, SF6/ HV cable bushing etc. to mitigate transient enclosure voltage.

The bidders shall provide lightening mast/GS shield wire at suitable place for protection of whole sub-station including transformers, GIS cum control room building etc. The bidder shall submit detailed proposal for grounding system of whole substation including indoor and outdoor equipments with Earthmat using 40mm. dia MS rod for approval of purchaser. The riser shall be GS flat of size 75X12mm for outdoor equipments and 50X6mm for indoor.

The bidder shall submit detailed proposal for grounding system for approval of purchaser. Any provision to be made in the building design to take care of earthing requirement shall also be clearly spelt-out.

10. CIRCUIT BREAKERS

General
SF6 gas insulated metal enclosed circuit breakers shall comply with the latest revisions of IEC- 62271-100 & relevant IEC except to the extent explicitly modified in the specification and shall meet with requirements specified.

Circuit breakers shall be equipped with the operating mechanism. Circuit breakers shall be of single pressure (puffer) type. Complete circuit breaker with all necessary items for successful operation shall be supplied. The circuit breakers shall be designed for high speed single and three phase reclosing with an operating sequence and timing as specified.

10.1 Duty Requirements
Circuit breaker shall be C2 – M2 class as per IEC 62271-100.
Circuit breaker shall meet the duty requirements for any type of fault or fault location also for line charging and dropping when used on 220/66/33kV effectively grounded system,
with transmission lines of lengths and characteristics as indicated in Section Project and perform make and break operations as per the stipulated duty cycles satisfactorily.

10.2. The circuit breaker shall be capable of:
   i) Interrupting the steady and transient magnetizing current corresponding to 220/33/11kV and 220/66/11kV class transformers on 220/66/33 kV side.
   ii) Interrupting line/cable charging current as per IEC without re-strikes and without use of opening resistors.
   iii) Clearing short line fault (Kilometric faults) with source impedance behind equivalent to symmetrical fault current specified.
   iv) Breaking 25% the rated fault current at twice the rated voltage under phase opposition Condition.
   v) Interrupting capacitor bank if applicable.

The breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energisation of capacitor bank & lines with trapped charges.

10.3. Total Break Time
   The total break time shall not be exceeded under any of the following duties
   i) Test duties T10,T30,T60,T100 (with TRV as per IEC-62271-100)
   ii) Short line fault L90, L75 (with TRV as per IEC-62271-100)
   iii) The Bidder may please note that total break time of the breaker shall not be exceeded any duty conditions specified such as with the combined variation of the trip coil voltage (70-110%), pneumatic/hydraulic pressure and SF6 gas pressure etc. While furnishing the proof for the total break time of complete circuit breaker, the bidder may bring out the effect of non simultaneity between poles and show how it is covered in the total break time.

The values guaranteed shall be supported with the type test reports.

10.4 CONSTRUCTIONAL FEATURES
   The features and constructional details of breakers shall be in accordance with requirements stated hereunder.

10.4.1. Contacts
   All making and breaking contacts' shall be sealed and free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have a life expectancy so that frequent replacement due to excessive burning will not be necessary. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

10.4.2 Any device provided for voltage grading to damp oscillations or, to prevent re-strike prior to the complete interruption of the circuit or to limit over voltage on closing, shall have a life expectancy comparable of that of the breaker as a whole.

10.4.3 Breakers shall be so designed that when operated within their specified rating, the temperature of each part will be limited to values consistent with a long life for the material used. The temperature rise shall not exceed that indicated in IEC-62271-100 under specified ambient conditions.

10.4.4 The gap between the open contacts shall be such that it can withstand at least the rated phase to ground voltage for eight hours at zero pressure above atmospheric level of SF6 gas due to its leakage. The breaker should be able to withstand all dielectric stresses
imposed on it in open condition at lockout pressure continuously (i.e. 2 pu. power frequency voltage across the breaker continuously).

10.4.5 In the interrupter assembly, there shall be an adsorbing product box to minimize the effect of SF6 decomposition products and moisture. The material used in the construction of the circuit breakers shall be such as to be fully compatible with SF6 gas decomposition products.

10.4.6 Provisions shall be made for attaching an operational analyzer to record travel, speed and making measurement of operating timings etc. after installation at site.

10.5 OPERATING MECHANISM

10.5.1 General Requirements

a) Circuit breaker shall be operated by spring charged mechanism or elector hydraulic mechanism or a combination of these. The mechanism shall be housed in a dust proof cabinet and shall have IP: 42 degree of protection.

b) The operating mechanism shall be strong, rigid, not subject to rebound or to critical adjustments at site and shall be readily accessible for maintenance.

c) The operating mechanism shall be suitable for high speed reclosing and other duties specified. During reclosing the breaker contacts shall close fully and then open. The mechanism shall be antidumping and trip free (as per IEC definition) under every method of closing.

d) The 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 operating devices.

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

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

g) The bidder shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for break the circuit.

10.5.2 Control

a) The close and trip circuits shall be designed to permit use of momentary- contact switches and push buttons.

b) Each Circuit breaker pole shall be provided with two (2) independent tripping circuits’ valves, pressure switches, and coils each connected to a different set of protective relays.

c) The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However, provisions shall be made for local electrical control. For this purpose a local/remote selector switch and close
and trip control switch/push buttons shall be provided in the breaker central control cabinet.

d) The trip coil shall be suitable for trip circuit supervision during both open and close position of breaker.

e) Closing coil and associated circuits shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip and associated circuits shall operate correctly under all operating conditions of the circuit breaker up to 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 and reliability for similar applications on circuit breakers shall be clearly brought out in the additional information schedules. In the absence of adequate details the offer is likely to be rejected.

f) Dosimeter contacts and pressure switch contacts shall be suitable for direct use as permissive in closing and tripping circuits. Separate contacts have to be used for each of tripping and closing circuits. If contacts are not suitably rated and multiplying relays are used then fail safe logic/schemes are are to be employed. DC supplies for all auxiliary circuit shall be monitored and for remote annunciations and operation lockout in case of dc failures.

g) The auxiliary switch of the breaker shall be positively driven by the breaker operating rod.

10.5.3 Spring operated Mechanism

a) Spring operated mechanism shall be complete with motor in accordance with Section GTR. Opening spring and closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided.

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

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

d) Breaker operation shall be independent of the motor which shall be used for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided. The motor rating shall be such that it required preferably not more than 60 seconds for full charging of the closing spring.

e) Closing action of circuit breaker shall compress the opening spring ready for tripping.

f) 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.

g) Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition.
h) Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in the closed position.

i) 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.

10.5.4 Hydraulically Operated Mechanism:

a) Hydraulically operated mechanism shall comprise of operating unit with power cylinder, control valves, high and low pressure reservoir, motor etc.

b) The hydraulic oil used shall be fully compatible for the temperature range to be encountered during operation.

c) The oil pressure switch controlling the oil pump and pressure in the high pressure reservoir shall have adequate no. of spare contacts, for continuous monitoring of low pressure, high pressure etc. at switchyard control room.

d) The mechanism shall be suitable for at-least two close open operations after failure of AC supply to the motor starting at pressure equal to the lowest pressure of auto reclose duty plus pressure drop for one close open operation.

e) The mechanism shall be capable of operating the circuit breaker correctly and performing the duty cycle specified under all conditions with the pressure of hydraulic operated fluid in the operating mechanism at the lowest permissible pressure before make up.

f) Trip lockout shall be provided to prevent operations of the circuit breaker below the minimum specified hydraulic pressure. Alarm contacts for lost of Nitrogen shall also be provided.

g) All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage.

10.6 ADDITIONAL DATA TO BE FURNISHED ALONGWITH THE OFFER:

a) Drawing showing contacts in close, arc initiation, full arcing, arc extinction and open position.

b) Data on capabilities of circuit breakers in terms of time and number of operations at duties ranging from 100% fault currents to load currents of the lowest possible value without requiring any maintenance or checks.

c) Curves supported by test data indicating the opening time under close open operation with combined variation of trip coil voltage and hydraulic pressure.

10.7 TESTS

10.7.1 In accordance with the requirements stipulated under Section GTR the circuit breaker alongwith its operating mechanism shall conform to the type tests as per IEC-62271-100.

10.7.2 Routine Tests

Routine tests as per IEC: 62271-100 shall be performed on all circuit breakers. In addition to the mechanical and electrical tests specified by IEC, the following shall also be performed.
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-reclosing (if applicable) and trip free operation under normal as well as limiting operating conditions (control voltage, pneumatic pressure etc.). 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 break make operation etc. This test shall also be performed at site for which the necessary operation analyzer along with necessary transducers, cables, console etc. shall be furnished as mandatory maintenance equipment.

The test for getting signature of the dynamic contact resistance measurement shall also be carried out at factory. The test result shall be treated as reference signature for condition monitoring in future.

### 10.7.3 TECHNICAL PARAMETERS

#### 245 kV CIRCUIT BREAKER

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Rated voltage kV (rms)</td>
<td>245</td>
</tr>
<tr>
<td>b) Rated frequency (Hz)</td>
<td>50</td>
</tr>
<tr>
<td>c) No. of poles</td>
<td>3</td>
</tr>
<tr>
<td>d) Type of circuit breaker</td>
<td>SF6 insulated</td>
</tr>
<tr>
<td>e) Rated continuous current (A) at an ambient temperature of 40°C</td>
<td>1600/2500 (2500 for bus-coupler breaker)</td>
</tr>
<tr>
<td>f) Rated short circuit capacity</td>
<td>40 kA with percentage of DC component as per IEC-62271-100 corresponding to minimum opening conditions as specified.</td>
</tr>
<tr>
<td>g) Symmetrical interrupting capability kA (rms)</td>
<td>40</td>
</tr>
<tr>
<td>h) Rated short circuit making current kAp</td>
<td>100</td>
</tr>
<tr>
<td>i) Short time Current carrying capability for one second kA (rms)</td>
<td>40</td>
</tr>
<tr>
<td>j) Rated line charging interrupting As per IEC current at 90 deg. Leading power factor angle (A rms)</td>
<td>As per IEC (The breaker shall be able to interrupt the rated line charging current with test voltage immediately before opening equal to the product of U/√3 and 1.4 as per IEC-62271-100)</td>
</tr>
<tr>
<td>k) First pole to clear factor</td>
<td>1.3</td>
</tr>
<tr>
<td>l) Rated break time as IEC (ms)</td>
<td>60</td>
</tr>
<tr>
<td>m) Total break time (ms)</td>
<td>65</td>
</tr>
<tr>
<td>n) Total closing time (ms)</td>
<td>Not more than 200</td>
</tr>
<tr>
<td>o) Rated operating duty cycle</td>
<td>O-0.3s-CO-3 min-CO</td>
</tr>
<tr>
<td>p) Reclosing auto-reclosing</td>
<td>Single phase/Three phase</td>
</tr>
<tr>
<td>q) Rated insulation levels</td>
<td>Full wave impulse with stand voltage (1.2x50 μsec.)</td>
</tr>
<tr>
<td>r) - between line terminals and ground</td>
<td>±1050 kVp</td>
</tr>
<tr>
<td>s) - between terminals with circuit breaker open</td>
<td>±1200 kVp</td>
</tr>
<tr>
<td>t) One minute power frequency withstand Voltage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>r)</td>
<td>Max. radio interference voltage for frequency b/w 0.5 MHz and 2 MHz at 156 kV (Micro volts)</td>
</tr>
<tr>
<td>s)</td>
<td>Max. difference in the instants of closing/opening (ms) between poles</td>
</tr>
<tr>
<td>t)</td>
<td>Trip coil and closing coil voltage this Section</td>
</tr>
<tr>
<td>u)</td>
<td>Auxiliary Contacts Auxiliary switch shall also comply with requirements as given. Independent single pole reversible contacts (from NO to NC &amp; vice versa)</td>
</tr>
<tr>
<td>v)</td>
<td>Rating of Auxiliary contacts</td>
</tr>
<tr>
<td>w)</td>
<td>Breaking capacity of Aux. Contacts less than 20 ms.</td>
</tr>
<tr>
<td>x)</td>
<td>System neutral earthing</td>
</tr>
</tbody>
</table>

**72.5 kV CIRCUIT BREAKER**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Technical particulars</th>
<th>66kV System</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Rated voltage kV (rms)</td>
<td>72.5</td>
</tr>
<tr>
<td>b)</td>
<td>Rated frequency (Hz)</td>
<td>50</td>
</tr>
<tr>
<td>c)</td>
<td>No. of poles</td>
<td>3</td>
</tr>
<tr>
<td>d)</td>
<td>Type of circuit breaker</td>
<td>SF6 insulated</td>
</tr>
<tr>
<td>e)</td>
<td>Rated continuous current (A) at an ambient temperature of 40°C</td>
<td>2000/2500 (2500 for bus-coupler breaker)</td>
</tr>
<tr>
<td>f)</td>
<td>Rated short circuit capacity</td>
<td>31.5 kA with percentage of DC component as per IEC- 62271-100 corresponding to minimum opening conditions as specified.</td>
</tr>
<tr>
<td>g)</td>
<td>Symmetrical interrupting capability kA (rms)</td>
<td>31.5</td>
</tr>
<tr>
<td>h)</td>
<td>Rated short circuit making current kAp</td>
<td>80</td>
</tr>
<tr>
<td>i)</td>
<td>Short time current carrying capability for one second kA (rms)</td>
<td>31.5</td>
</tr>
<tr>
<td>j)</td>
<td>Rated line charging interrupting current at 90 deg. Leading power factor angle (A rms) (The breaker shall be able to interrupt the rated line charging current with test voltage immediately before opening equal to the product of ( \frac{U}{\sqrt{3}} ) and 1.4 as per IEC-62271-100)</td>
<td>As per IEC</td>
</tr>
<tr>
<td>k)</td>
<td>First pole to clear factor</td>
<td>1.5</td>
</tr>
<tr>
<td>l)</td>
<td>Rated break time as IEC (ms)</td>
<td>60</td>
</tr>
</tbody>
</table>
m) Total break time (ms) | 65
n) Total closing time (ms) | Not more than 200
o) Rated operating duty cycle | O-0.3s-CO-3 min-CO
p) Reclosing auto reclosing | Three phase
q) Rated insulation levels
   i) Full wave impulse with stand voltage (1.2x50 micro sec.)
      - between line terminals and ground | ±325 kVp
      - between terminals with circuit breaker open | ±375 kVp
ii) One minute power frequency withstand voltage
      - between line terminals and ground | As per IEC
      - between terminals with circuit breaker open | As per IEC
r) Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 1.1 Un/√3 (Micro volts) | -
s) Max. difference in the instants of closing/opening of contacts (ms) between poles | As per IEC
t) Trip coil and closing coil voltage | 220V DC with variation as specified in Sec. GTR
i) Auxiliary Contacts Auxiliary switch shall also comply with requirements as given. Independent single pole reversible contacts (from NO to NC & vice versa) | Each circuit breaker pole shall be provided with an auxiliary switch with 20% of spare - NO and 20% spare NC contact for use in future.
ii) Rating of Auxiliary contacts | 10A at 220V DC
u) Breaking capacity of Aux. Contacts. | 2A DC with the circuit time constant of not less than 20 ms.
v) System neutral earthing | Effectively earthed.

11. DISCONNECTORS (ISOLATORS).
11.1. General
Disconnectors shall be of the single-pole/three pole, group operated type, installed in the switchgear to provide electrical isolation of the circuit breakers, the transformers, shunt reactor, double bus and transmission lines/cables. The disconnectors shall conform to IEC-62271-102 and shall have the following ratings as specified.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Particulars</th>
<th>220 kV</th>
<th>66kV</th>
</tr>
</thead>
</table>
a) | Rated voltage (rms) Un | 245 kV | 72.5 kV |
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>b)</td>
<td>Rated frequency</td>
<td>50 HZ</td>
<td>50 HZ</td>
</tr>
<tr>
<td>c)</td>
<td>System earthing</td>
<td>Effectively earthed</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td>d)</td>
<td>Type</td>
<td>SF6 insulated</td>
<td>SF6 insulated</td>
</tr>
<tr>
<td>e)</td>
<td>Rated continuous current (A) at 40°C ambient temp.</td>
<td>1600/2500 (2500 for bus-coupler)</td>
<td>2000/2500 (2500 for bus-coupler)</td>
</tr>
<tr>
<td>f)</td>
<td>Rated short time withstand current of isolator and earth switch</td>
<td>40 kA for 1 Sec</td>
<td>31.5 kA for 1 Sec</td>
</tr>
<tr>
<td>g)</td>
<td>Rated dynamic short circuit withstand current of isolator and earth switch</td>
<td>100 kAp</td>
<td>80 kAp</td>
</tr>
<tr>
<td>h)</td>
<td>Rated insulation level: One minute power freq. Withstand voltage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To earth :</td>
<td>As per IEC</td>
<td>As per IEC</td>
</tr>
<tr>
<td></td>
<td>Across isolating distance</td>
<td>As per IEC</td>
<td>As per IEC</td>
</tr>
<tr>
<td>h)</td>
<td>Rated insulation levels; 1.2/50 micro sec. Lighting impulse withstand voltage (+ve or –ve polarity)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To earth:</td>
<td>±1050 kVp</td>
<td>±325 kVp</td>
</tr>
<tr>
<td></td>
<td>Across Isolating distance</td>
<td>±1200 kVp</td>
<td>±375 kVp</td>
</tr>
<tr>
<td>i)</td>
<td>Rated mechanical terminal load</td>
<td>As per IEC</td>
<td>As per IEC</td>
</tr>
<tr>
<td>j)</td>
<td>No. of spare auxiliary contacts on each isolator</td>
<td>6 NO and 6 NC</td>
<td>6 NO and 6 NC</td>
</tr>
<tr>
<td>k)</td>
<td>No. of spare auxiliary contacts on each earthing switch</td>
<td>6 NO and 6 NC</td>
<td>6 NO and 6 NC</td>
</tr>
</tbody>
</table>

### 11.2 Construction & Design

11.2.1 The three pole group operated disconnectors shall be operated by electric motor suitable for use on 220 V DC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.

11.2.2 Disconnectors shall be designed as per relevant IEC. These shall be suitable to make and break the charging currents during their opening and closing. They shall also be able to make and break loop current which appears during transfer between bus bars. The contact shielding shall also be designed to prevent restrikes and high local stresses caused by transient recovery voltages when these currents are interrupted.

11.2.3 The disconnecting switches shall be arranged in such a way that all the three phases operate simultaneously. All the parts of the operating mechanism shall be able to withstand starting torque of the motor mechanism without damage until the motor overload protection operates.
11.2.4 It shall be possible to operate the disconnecting switches manually by cranks or hand wheels. The contacts shall be both mechanically and electrically disconnected during the manual operation.

11.2.5 The operating mechanisms shall be complete with all necessary linkages, clamps, couplings, operating rods, support brackets and grounding devices. All the bearings shall be permanently lubricated or shall be of such a type that no lubrication or maintenance is required.

11.2.6 The opening and closing of the disconnectors shall be achieved by either local or remote control. The local operation shall be by means of a two-position control switch located in the bay module control cabinet.

11.2.7 Remote control of the disconnectors from the control room shall be made by means of remote/local transfer switch.

11.2.8 The disconnector operations shall be inter-locked electrically with the associated circuit breakers in such a way that the disconnector control is inoperative if the circuit breaker is closed.

11.2.9 Each disconnector shall be supplied with auxiliary switch having six normally open and six normally closed contacts for future use over and above those required for switchgear interlocking and automation purposes. The auxiliary switch contacts are to be continuously adjustable such that, when required, they can be adjusted to make contact before the main switch contacts.

11.2.10 The signaling of the closed position of the disconnector shall not take place unless it is certain that the movable contacts will reach a position in which the rated normal current, peak withstand current and short-time withstand current can be carried safely.

11.2.11 The signaling of the open position of the disconnector shall not take place unless the movable contacts have reached such a position that the clearance between the contacts is at least 80 percent of the rated isolating distance.

11.2.12 All auxiliary switches and auxiliary circuits shall be capable of carrying a current of at least 10 A DC continuously.

11.2.13 The auxiliary switches shall be capable of breaking at least 2 A in a 220 V DC circuit with a time constant of not less than 20 milliseconds.

11.2.14 The disconnectors and safety grounding switches shall have a mechanical key (pad locking key) and electrical inter-locks to prevent closing of the grounding switches when isolator switches are in the closed position and to prevent closing of the disconnectors when the grounding switch is in the closed position.

11.2.15 The local control of the Isolator and high-speed grounding switches from the bay module control panel should be achieved from the individual control switches with the remote/local transfer switch set to local.

11.2.16 All electrical sequence interlocks will apply in both remote and local control modes.

11.2.17 Each disconnector shall have a clearly identifiable local, positively driven mechanical position indicator, together with position indicator on the bay module control
cabinet and provisions for taking the signals to the control room. The details of the inscriptions and colouring for the indicator are given as under:

<table>
<thead>
<tr>
<th>SIGN</th>
<th>COLOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open position</td>
<td>Open</td>
</tr>
<tr>
<td>Closed position</td>
<td>Closed</td>
</tr>
</tbody>
</table>

11.2.18 All the disconnecting switches shall have arrangement allowing easy visual inspection of the travel of the switch contacts in both open and close positions, from the outside of the enclosure.

11.2.19 The disconnecting switches shall be provided with rating plates and shall be accessible for inspection.

11.2.20 The disconnecting switches shall be capable of being padlocked in both the open and closed positions with the operating motor automatically disengaged. The padlocking device shall be suitable for a standard size lock with a 10 mm shank. The padlock must be visible and directly lock the final output shaft of the operating mechanism. Integrally mounted lock when provided shall be equipped with a unique key for such three phase group. Master key is not permitted.

12. SAFETY GROUNDING SWITCHES

12.1 Three-pole, group operated, safety grounding switches shall be operated by electric motor for use on 220 V DC ungrounded system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over-current and short circuit.

12.2 Each safety grounding switch shall be electrically interlocked with its associated disconnector and circuit breaker such that it can only be closed if both the current break and disconnector are in open position. Safety grounding switch shall also be mechanical key interlocked with its associated disconnector.

12.3 Each safety grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay module control cabinet and provision for taking the signal to Control room.

12.4 The details of the inscription and coloring for the indicator are given as under:

<table>
<thead>
<tr>
<th>SIGN</th>
<th>COLOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open position</td>
<td>Open</td>
</tr>
<tr>
<td>Closed position</td>
<td>Closed</td>
</tr>
</tbody>
</table>

12.5 Interlocks shall be provided so that manual operation of the switches or insertion of the manual operating device will disable the electrical control circuits.

12.6 Each ground switch shall be fitted with auxiliary switches having six normally open and six normally closed contacts for use by others over and above those required for local interlocking and position indication purposes.

12.7 Provision shall be made for padlocking the ground switches in either the open or closed position.

12.8 All portions of the grounding switch and operating mechanism required for grounding shall be connected together utilizing flexible copper conductors having a minimum cross-sectional area of 50 sq. mm.

12.9 The main grounding connections on each grounding switch shall be rated to carry the full short circuit rating of the switch for 1 sec. and shall be equipped with a silver-plated terminal connector suitable for steel strap of adequate rating for connection to the grounding grid.

12.10 The safety grounding switches shall conform to the requirements of IEC- 62271-102.
12.11 Mechanical position indication shall be provided locally at each switch and remotely at each bay module control cabinet/ substation automation system.

12.12 The rated Induced Current and Voltage for earth switches for both electrostatic and electromagnetic coupling shall be as per IEC 62271-102.

13. High Speed Make Proof Grounding Switches

13.1 Grounding switches located at the beginning of the feeder bay modules shall be of the high speed, make proof type and will be used to discharge the respective charging currents, in addition to their safety grounding function. These grounding switches shall be capable of interrupting the inductive currents and to withstand the associated TRV.

13.2 Single phase switches shall be provided with operating mechanism suitable for operation from a 220V DC.

13.3 The switches shall be fitted with a stored energy closing system to provide fault making capacity.

13.4 The short circuit making current rating of each ground switch shall be at least equal to its peak withstand current rating of 100 kA. The switches shall have inductive/ capacitive current switching capacity as per IEC-62271-102.

13.5 Each high speed make proof grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay module control cabinet and provision for taking the signal Control Room.

13.6 The details of the inscription and coloring for the indicator shall be as under:-

<table>
<thead>
<tr>
<th>SIGN</th>
<th>COLOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open position</td>
<td>Green</td>
</tr>
<tr>
<td>Closed position</td>
<td>Red</td>
</tr>
</tbody>
</table>

13.7 High speed ground switch operation should be possible locally from the bay module control cabinet, or remotely from the control room in conjunction with opening of the associated disconnector.

13.8 These high speed grounding switches shall be electrically interlocked with their associated circuit breakers and disconnectors so that the grounding switches can not be closed if the circuit breakers and disconnectors are closed.

13.9 Interlocks shall be provided so that the insertion of the manual operating devices will disable the electrical control circuits.

13.10 Each high speed ground switch shall be fitted with auxiliary switches having six NO & six NC auxiliary contacts for use by others, over and above these required for local interlocking and position indication. All contacts shall be wired to terminal blocks in the local bay control cabinet. Provision shall be made for padlocking the ground switches in their open or closed position.

13.11 All portion of the grounding switches and operating mechanism required for connection to ground shall be connected together utilizing copper conductor having minimum cross-sectional area of 50 sq. mm.

13.12 The main grounding connection on each grounding switch shall be rated to carry the peak withstand current rating of the switch for 1 sec. and shall be equipped with a silver plated
terminal connector suitable for steel strap of adequate design for connection to the grounding grid.

13.13 The high speed make proof grounding switches shall confirm to the requirements of IEC-62271-102.

13.14 The rated Induced Current and Voltage for earth switches for both electrostatic and electromagnetic coupling shall be as per IEC 62271-102.

14. INSTRUMENT TRANSFORMERS
14.1 Instrument Transformers
14.1.1 Current Transformers.

A) General:
i) The current transformers and accessories shall conform to IEC : 60044-1 and other relevant standards except to the extent explicitly modified in the specification.

ii) The particulars of the various cores may change within reasonable limits as per the requirements of protection relay supplier. The manufacturer is required to have these values confirmed from the purchaser before proceeding with design of the cores. The other characteristics of CTs shall be as given in TECHNICAL PARAMETER of Current Transformer.

B) Ratios and Characteristics
The number, rating, ratios, accuracy class, etc. for the individual current transformers secondary cores shall be in accordance with Table-IA & IB. Where multi-ratio current transformers are required the various ratios shall be obtained by changing the effective number of turns on the secondary winding.

C) Rating and Diagram Plates.
Rating and diagram plates shall be as specified in the IEC specification incorporating the year of manufacture. The rated extended current rating voltage and rated thermal current shall also be marked on the name plate.

The diagram plates shall show the terminal markings and the relative physical arrangement of the current transformer cores with respect to the primary terminals (P1 & P2).

The position of each primary terminal in current transformer SF6 gas section shall be clearly marked by two plates fixed to the enclosure at each end of current transformer.

D) Constructional Details:
a) The current transformers incorporated into the GIS will be used for protective relaying and metering and shall be of metal- enclosed type. The secondary windings shall be air insulated and mounted inside the metal enclosure. All the current transformers shall have effective electromagnetic shields to protect against high frequency transients.

b) Each current transformer shall be equipped with a marshalling box with terminals for the secondary circuits, which are connected to the local control cubicle. The star/ delta configuration and the inter connection to the line protection panels will be done at the CT terminal block located in the local control cubicle.

c) Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.
d) The rated extended primary current shall be 150% at all ratios and 200% at ratios other than highest ratios.

e) The instrument security factor at all ratios shall be less than five (5) for metering core. ISF shall be verified without use of any auxiliary reactor.

f) The wiring diagram, for the interconnections of the three single phase CTs shall be provided inside the marshalling box.

g) The current transformers shall be suitable for high speed auto-reclosing.

h) Provisions shall be made for primary injection testing either within CT or outside.

i) Electromagnetic shields to be provided against high frequency transients typically 1-30 MHz.

j) The bidder will take care for the compatibility of the CT vis-à-vis burden of relay and connecting leads, however for calculation purpose fault current may be taken as 40kA for 220kV & 31.5 kA for 66kV as well as 33kV and secondary current may be calculated accordingly.

k) The output burden of cores shall be as table IA & IB. However, burden of each core shall be finalized during detailed engineering.

14.1.2 VOLTAGE TRANSFORMERS

A) General
The voltage transformers shall conform to IEC- 60044-2 and other relevant standards except to the extent explicitly modified in the specification. Voltage transformers shall be of the electromagnetic type with SF6 gas insulation. The earth end of the high voltage winding and the ends of the secondary winding shall be brought out in the terminal box.

B) Ratios and Characteristics
The rating, ratio, accuracy class, connection etc. for the voltage transformers shall be in accordance with Table II-A and Table II-B.

C) Rating and diagram plates
Rating and diagram plate shall be provided complying with the requirements of the IEC specification incorporating the year of manufacture and including turns ratio, voltage ratio, burden, connection diagram etc.

D) Secondary Terminals, Earthing and Fuses
The beginning and end of each secondary winding shall be wired to suitable terminals accommodated in a terminal box mounted directly on the voltage transformer section of the SF6 switchgear. All terminals shall be stamped or otherwise marked to correspond with the marking on the diagram plate. Provision shall be made for earthing of the secondary windings inside the terminal box.

E) The transformer shall be able to sustain full line to line voltage without saturation of transformer. The accuracy class will be at maximum tap.

F) Constructional Details of Voltage Transformers.

a) The voltage transformers shall be located in a separate bay module on the bus and will be connected phase- to ground and shall be used for protection, metering and synchronization. The voltage transformers shall be located in a separate module.

b) The voltage transformers shall be of inductive type, nonresistant and shall be
contained in their own-SF6 compartment, separated from other parts of installation. The voltage transformers shall be effectively shielded against high frequency electromagnetic transients. The voltage transformers shall have three secondary windings

c) Voltage transformers secondary’s shall be protected by MCB for all the windings. In addition Contacts shall be provided for MCB monitoring scheme. The secondary terminals of the VT’s shall be terminated to the stud type non-disconnecting terminal blocks in the secondary boxes via the fuse.

d) The voltage transformer should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens.

e) The accuracy of 0.2 on secondary III should be maintained through out the entire burden range as per Table IIA and IIB, without any adjustments during operation. However, the burden of each core shall be finalized during detailed engineering.

f) The diagram for the interconnection of the VTs shall be provided inside the marshalling box.

14.1.3 TESTS:
Current and voltage transformers shall conform to type tests and shall be subjected to routine test in accordance with IEC.

14.1.4 TECHNICAL PARAMETERS

14.1.4.1 Current Transformers

<table>
<thead>
<tr>
<th>S. No</th>
<th>Particular</th>
<th>220 kV</th>
<th>66kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Rated voltage Un</td>
<td>245 kV (rms)</td>
<td>72.5 kV (rms)</td>
</tr>
<tr>
<td>b)</td>
<td>Rated frequency</td>
<td>50 Hz</td>
<td>50 Hz</td>
</tr>
<tr>
<td>c)</td>
<td>System neutral earthing</td>
<td>Effectively earthed</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td>d)</td>
<td>Rated short time thermal current</td>
<td>40 kA for 1 Second</td>
<td>31.5 kA for 1 second</td>
</tr>
<tr>
<td>e)</td>
<td>Rated dynamic current</td>
<td>100 kA</td>
<td>80 kA</td>
</tr>
<tr>
<td>f)</td>
<td>Rated insulation levels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>1.2/50 μsecond impulse voltage</td>
<td>±1050 kVp</td>
<td>±325 kVp</td>
</tr>
<tr>
<td>ii)</td>
<td>1 Minute power frequency withstand voltage</td>
<td>460 kV (rms)</td>
<td>140 kV (rms)</td>
</tr>
<tr>
<td>iii)</td>
<td>250/2500 μsecond switching impulse voltage (dry &amp; wet)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>g)</td>
<td>Maximum temperature rise over an ambient temp of 40°C</td>
<td>As per IEC 60044-1</td>
<td>As per IEC 60044-1</td>
</tr>
<tr>
<td>h)</td>
<td>Radio interference voltage at 1.1 Un/√3 and frequency range 0.5 to 2 MHz</td>
<td>&lt; 1000 microvolts</td>
<td>-</td>
</tr>
<tr>
<td>i)</td>
<td>One minute power frequency withstand voltage between sec. Terminal &amp; earth</td>
<td>5 kV (rms)</td>
<td>5 kV (rms)</td>
</tr>
<tr>
<td>j)</td>
<td>Partial discharge level</td>
<td>&lt; 10 pico coulombs</td>
<td>-</td>
</tr>
</tbody>
</table>
14.1.4.2 Voltage Transformers

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particular</th>
<th>220 kV</th>
<th>66kV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>245 kV (rms)</td>
<td>72.5 kV (rms)</td>
</tr>
<tr>
<td></td>
<td><strong>a)</strong> Rated voltage Un</td>
<td>245 kV (rms)</td>
<td>72.5 kV (rms)</td>
</tr>
<tr>
<td></td>
<td><strong>b)</strong> Rated frequency</td>
<td>50 Hz</td>
<td>50 Hz</td>
</tr>
<tr>
<td></td>
<td><strong>c)</strong> System neutral earthing</td>
<td>Effectively earthed</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td></td>
<td><strong>d)</strong> System fault level</td>
<td>40 kA for 1 second</td>
<td>31.5 kA for 1 second</td>
</tr>
<tr>
<td></td>
<td><strong>e)</strong> Rated insulation levels</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>i) 1.2/50 micro second impulse</td>
<td>±1050 kVp</td>
<td>±325 kVp</td>
</tr>
<tr>
<td></td>
<td>voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ii) 1 Minute power frequency</td>
<td>460 kV (rms)</td>
<td>140 kV (rms)</td>
</tr>
<tr>
<td></td>
<td>withstand voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>iii) 250/2500 μsecond switching</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>impulse voltage (dry &amp; wet)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>f)</strong> One minute power frequency</td>
<td>3 kV (rms)</td>
<td>3 kV (rms)</td>
</tr>
<tr>
<td></td>
<td>withstand voltage for secondary</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>winding</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>g)</strong> Radio interference voltage</td>
<td>&lt; 1000 microvolts</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>at 1.1 Un/√3 and frequency range</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5 to 2 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>h)</strong> Rated total thermal burden</td>
<td>400 VA</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td><strong>j)</strong> Partial discharge level</td>
<td>&lt; 10 pico coulombs</td>
<td>-</td>
</tr>
</tbody>
</table>

15.1 OUTDOOR BUSHINGS:

A. General

Outdoor bushings, for the connection of conventional external conductors to the SF6 metal enclosed switchgear, shall be provided where specified and shall conform to the requirements given in GTR. The dimensional and clearance requirements for the metal enclosure will be the responsibility of the manufacturer and their dimensions must be coordinated with the switchgear.

Bushings shall generally be in accordance with the requirements of IEC publication 137 as applicable.

B. Insulation levels and creepage distances

All bushings shall have an impulse and power frequency withstand level that is greater than or equal to the levels specified for GIS.

The creepage distance over the external surface of outdoor bushings shall not be less than 25 mm/kV.

C) Bushing types and fitting

Condenser type bushings will be preferred but alternative types can also be considered. Liquid filled bushings shall be provided with liquid level gauges clearly visible from ground level, preferably of the direct reading prismatic type or the magnetic type. Other types of liquid level gauges will only be accepted if specifically approved.

D) Mechanical forces on bushing terminals

Outdoor bushings must be capable of withstanding cantilever forces due to weight of bus duct and short circuit forces. Design calculations in support of the cantilever strength
chosen shall be submitted for owners review and approval.

15.2 Incomer and Outgoing Connections
There shall be provision to connect XLPE cables at incomer and outgoing feeders. The sizes of cable have been defined in the specifications. However, final size will be decided during detailed engineering. In addition, one set of each size of test bushing/plug shall also be provided for testing purpose.

16. Surge Arrestors
The surge arrestors shall confirm in general to latest IEC –60099-4.

16.1 Insulation Co-Ordination and Selection of Surge Arrestor
The contractor shall be fully responsible for complete insulation co-ordination of switchyard including GIS. Contractor shall carry out detailed studies and design calculations to evolve the required parameters locations, energy capability etc. of surge arrestors such that adequate protective margin is available between peak Impulse, surge and power frequency discharge voltages and BIL of the protected requirement. The locations of surge arrestors shown in single line diagram are indicative only. If the bidder feels that at some more locations the surge arrestors are required to be provided the same should also be included in the offer.

If distance between Surge Arrestor and transformer bushing terminal inclusive of head length is more than 60 m or 170 ft then one surge arrester shall be with GIS System and another shall be with transformer.

The contractor shall perform all necessary studies. The report shall detail the limits of all equipment parameters which could affect the insulation co-ordination the report shall also detail the characteristics of the surge arrester and shall demonstrate that the selected insulators protective and withstand levels, discharge and coordinating currents, and arrester ratings and comply with the requirement of this specification.

The contractor shall also consider in the studies the open circuit breaker condition, fast transients generated by slow operation of disconnecting switches. The study report and design calculations shall be submitted for Owner’s approval.

16.2 Duty requirements
a) The surge arrester shall be of SF6 filled, heavy duty station class and gapless (Metal oxide) type without any series or shunt gaps.

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

c) 245 kV class arrester shall be capable of discharging energy equivalent to class 3 of IEC for 245 kV system on two successive operations.

d) The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

e) The surge arresters are being provided to protect the following whose insulation levels are indicated in the table given below:-
### 16.3 Constructional Features

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

The arrestor enclosure shall be vertically or horizontally mounted to suit the layout of the switchgear as suggested by the manufacturer and shall be fitted with a discharge counter located in an easily accessible position.

The main grounding connection from the surge arrestor to the earth shall be provided by the bidder. The size of the connecting conductor shall be such that all the energy is dissipated to the ground without getting overheated.

### 16.4 Tests

In accordance with the requirements stipulated the surge arrestors shall conform to type tests and shall be subjected to routine and acceptance tests in accordance with IEC document.

Each metal oxide block shall be tested for the guaranteed specific energy capability in addition to the routine/acceptance test as per IEC-60099.

**Test on Surge Monitors:**

The Surge monitors shall also be connected in series with the test specimens during residual voltage and current impulse withstand tests to verify efficacy of the same. Additional routine/functional tests with one 100A and 10 kA current impulse, (8/20 micro sec.) shall also be performed on the surge monitor.

### 16.5 Parameters

Following are the parameters for 220kV and 66kV system generally adopted by Owner for their installations. These parameters are indicative and not binding. The actual parameters required for the installation shall be evolved by contractor.

#### 245 kV & 72.5kV CLASS SURGE ARRESTOR

<table>
<thead>
<tr>
<th>Particulars</th>
<th>220 kV</th>
<th>66kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Rated system voltage</td>
<td>245 kV</td>
<td>72.5kV</td>
</tr>
<tr>
<td>b) System neutral earthing</td>
<td>Effectively earthed</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td>c) Rated arrester voltage</td>
<td>198kV</td>
<td>60kV</td>
</tr>
<tr>
<td>d) Nominal discharge current</td>
<td>10 kA of 8/20 micro second wave</td>
<td>10 kA of 8/20 micro second wave</td>
</tr>
<tr>
<td>e) Rated frequency</td>
<td>50 Hz</td>
<td>50 Hz</td>
</tr>
<tr>
<td>f) Maximum continuous operating</td>
<td>168 kVrms</td>
<td>50kVrms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td><strong>Max. residual voltage at</strong></td>
<td><strong>Long duration discharge class</strong></td>
<td></td>
</tr>
<tr>
<td>i) 10kA nominal discharge current</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ii) 20kA nominal discharge current</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>High current short duration test</strong></td>
<td><strong>System fault level and its duration</strong></td>
<td></td>
</tr>
<tr>
<td>value (4/10 micro second wave)</td>
<td>40kA for 1 sec</td>
<td></td>
</tr>
<tr>
<td><strong>Pressure relief device class</strong></td>
<td><strong>Basic insulation level of equipment</strong></td>
<td></td>
</tr>
<tr>
<td>a) Impulse withstand voltage for</td>
<td>1050kVp</td>
<td></td>
</tr>
<tr>
<td>1.25/50 micro sec</td>
<td>325 KVp</td>
<td></td>
</tr>
<tr>
<td>b) One minute power frequency</td>
<td>460kVrms</td>
<td></td>
</tr>
<tr>
<td>withstand voltage</td>
<td>140 KVrms</td>
<td></td>
</tr>
<tr>
<td><strong>Current through arrestors at</strong></td>
<td><strong>Step current impulse residual</strong></td>
<td></td>
</tr>
<tr>
<td>operating voltage</td>
<td>730kVp</td>
<td></td>
</tr>
<tr>
<td><strong>Step current impulse residual</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>voltage</td>
<td>220kVp</td>
<td></td>
</tr>
</tbody>
</table>

### 17. **220kV & 66kVGIS BUILDING:**

a) The buildings shall house 220kV and 66kV Gas Insulated Switchgear (GIS) separately and other associated equipments inside in each of the GIS building.

b) The bidder shall submit the design & construction proposal of the building along with necessary information, data, and drawings in the techno-commercial bid according to the complete requirements.

c) Bidder shall finalize the dimensions for 220kV and 66kV GIS building according to the equipment offered by them providing enough space & access for erection, operation and maintenance.

### 18.0 **Seismic Design Criteria:**

The equipment shall be designed for operation in seismic zone for earthquake resistance. The seismic loads are due to the horizontal and vertical acceleration which may be assumed to act non concurrently. Seismic level Zone- IV, as per new IS- 1893, Year-2002 has to be considered for the design of equipment. The seismic loads shall be equal to static loads corresponding to the weight of the parts multiplied by the acceleration. The equipments along with its parts shall be strong enough and sufficiently well connected to resist total operating stresses resulting from the forces in normal operation but in case of abnormal condition shall also resist with forces superimposed due to earthquakes. The copies of type test reports for similar rated equipment, if tested earlier, should be furnished along with the tender. If the equipment has not been type tested earlier, design calculations of simulated parameters should be furnished along with the offer.

To prevent the movement of GIS sub assemblies i.e. various bay modules during the earthquake, suitable devices shall be provided for fixing the sub assemblies to the foundation. The contractor shall supply necessary bolts for embedding in the concrete foundation. The fixing of GIS sub assemblies to the foundation shall be designed to
withstand the seismic events. It will also be ensured that the special devices as well as bolts shall not be over stressed. The details of the devices used and the calculations for establishing the adequacy shall be furnished by the supplier and shall be subject to the approval.

19.0 **Partial Dishacrghe Monitoring System & Dew Point Meter:-**
Static Contact Resistance Meter and Dynamic Contact Resistance Meter, CB operational Analyzer, SF6 Gas Leak Detector Meter, Portable P.D meter & Dew point meter shall be offered as per relevant price schedule and shall be considered for evaluation of bid. The specifications are enclosed in section special equipments.

20.0 **Quality of Sf6 Gas**

a) The SF6 gas insulated metal-clad switchgear shall be designed for use with SF6 gas complying with the recommendations of IEC 376, 376A & 376B, at the time of the first charging with gas. All SF6 gas supplied as part of the contract shall comply with the requirements of IEC as above as a minimum & should be suitable in all respects for use in the switchgear under all operating conditions.

b) The high pressure cylinders in which SF6 gas is supplied & stored at site shall comply with the requirements of following standards & regulations.

<table>
<thead>
<tr>
<th>IS</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4379</td>
<td>Identification of the contents of industrial gas cylinders.</td>
</tr>
<tr>
<td>7311</td>
<td>Seamless high carbon steel cylinders for permanent &amp; high pressure liquefiable gases. The cylinders shall meet Indian Boilers Regulations. (Mandatory)</td>
</tr>
</tbody>
</table>

c) **Test**
SF6 gas shall be tested for purity, dew point, air, hydrolysable fluorides and water contents as per IEC: 376, 376A & 376B and test certificates shall be furnished to the owner indicating all test results as per IEC standards for each lot of SF6 gas. Further site tests for moisture, air content, flash point and dielectric strength to be done during commissioning of GIS. Gas bottles should be tested for leakage during receipt at site.

d) The bidder shall indicate diagnostic test methods for checking the quality of gas in the various sections during service. The method proposed shall, as a minimum check the moisture content & the percentage of purity of the gas on annual basis.

e) The bidder shall also indicate clearly the precise procedure to be adopted by maintenance personnel for handling equipment that are exposed to the products of arcing in SF6 Gas so as to ensure that they are not affected by possible irritants of the skin and respiratory system. Recommendations shall be submitted for suitable protective clothing, method of disposal of cleaning utensils and other relevant matters.

f) The bidder shall also indicate the details and type of filters used in various gas sections, and should also submit the operating experience with such filters.

21. **SF6 GAS MONITORING DEVICES AND ALARM CIRCUITS:-**

21.1 Dial type temperature compensated gas density or density monitoring devices with associated pressure gauge will be provided. The devices shall provide continuous & automatic monitoring of the state of the gas & a separate device shall be provided for each gas compartment so that each compartment can be monitored simultaneously as follows:-

1. **Compartments except circuit breaker**
   a) **Gas Refill level**
   This will be used to annunciate the need for the gas refilling. The contractor shall provide a contact for remote indication.

   b) 'Zone Trip' level
This is the minimum level at which the manufacturer will guarantee the insulation rating of the assembly. Contacts shall be in accordance with requirement.

2. Circuit Breaker.
   a) 'Gas Refill' level
      This will be used to annunciate the need for gas refilling. The contractor shall provide a contact for remote indication.
   b) '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 breaker block contact shall operate & the tripping & closing circuit shall be blocked.
   c) 'Zone Trip' level
      This is the minimum level at which the manufacturer will guarantee the insulation rating of the assembly. Contacts shall be in accordance with requirement.

The bidder should furnish temperature v/s pressure curves for each setting of density monitor along with details of the monitoring device.

It shall be possible to test all gas monitoring relays/devices without de-energizing the primary equipment & without reducing pressure in the main section. Plugs & sockets shall be used for test purposes. It shall also damp the pressure pulsation while filling the gas in service, so that flickering of the pressure switch contacts does not take place.

21.2 a) Gas Leakage.
   The maximum gas leakage shall not exceed 0.5% (half percent) per year for the whole equipment and for any individual gas compartment separately.

b) Gas Supply
   The contractor shall include the supply of all SF6 gas necessary for filing & putting into operation the complete switchgear installation being supplied. In addition 20% of total gas requirement shall be supplied in separate cylinders as spare requirement, over & above the requirement of gas for successful commissioning. Pl. refer list of mandatory spares in this connection.

22. GAS FILLING AND EVACUATING PLANT:-
   All the plant necessary for filling and evacuating the SF6 gas in the switchgear shall be supplied with the contract to enable any maintenance work to be carried out. This shall include all the necessary gas cylinders for temporarily storing the evacuated SF6 gas. The capacity of the temporary storage facilities shall at least be sufficient for storing the maximum quantity of gas that could be removed when carrying out maintenance or repair work on the switchgear and associate equipment of at least one complete bay. Where any item of the filling and evacuating plant is of such a weight that it cannot easily be carried by maintenance personnel, it shall be provided with lifting hooks for lifting and moving with the overhead cranes.

   The capacity of the plant should be such that it is capable of excavation/ filling of maximum quantity of gas contained in a compartment could be removed/ filled within 30 minutes while carrying out maintenance/ repair work.

   The evacuation equipment shall be provided with all the necessary pipes couplings, flexible tubes and valves for coupling up to the switchgear for filling or evacuating all the gases.
   The gas compartments shall preferably be fitted with permanent non-return valves through
which the gas is pumped into or evacuated from the compartments. Details of the filling and evacuating plant that will be supplied, as well as the description of the filling and evacuating procedures shall be provided along with the bid.

23. **SF6 GIS to XLPE Cable Termination (If Applicable):**
   The 220 kV underground cables are to be connected to 220 kV GIS by the interfacing of XLPE cable sealing end to GIS Cable termination enclosure for making connection 1C x 1000/1200 mm sq. XLPE cable. The 66kV underground cables are to be connected to 66kV GIS by the interfacing of XLPE cable sealing end to GIS Cable termination enclosure for making connection three cables of size 1C X 1000 sq. mm XLPE cable. However exact size shall be intimated at the time of detailed engineering. This interface section shall be designed in a manner which will allow ease of operation and maintenance.

   The SF6 GIS to XLPE cable termination shall conform to IEC-859 (latest edition). The provision shall be made for a removable link. The gap created when the link is removed should have sufficient electric strength to withstand the switchgear high voltage site tests. The bidder may suggest alternative arrangements to meet these requirements. The corona rings/stress shields for the control of electrical field in the vicinity of the isolation gap shall be provided by the GIS manufacturer.

   All supporting structures for the SF6 bus duct connections between the XLPE cable sealing ends and the GIS shall be supplied by the supplier. The supplier may specify alternative connecting & supporting arrangements for approval of the purchaser.

   The opening for access shall be provided in each phase terminal enclosures as necessary to permit removal of connectors to isolate the XLPE cables to allow carrying out the insulation tests. The typical arrangement drawing of interconnecting bus-duct/cables from GIS bay module to XLPE cable termination end shall be submitted along with offer.

24. **Electric Overhead Crane:**
   EOT Crane of suitable capacity shall be provided for erection & maintenance of largest GIS component/assembly. The crane shall consist of all special requirements for erection & maintenance of GIS equipments.

   The crane shall be possible to be operated through the cable & through the pendant control, which shall be easily accessible from the floor of GIS building.

   EOT crane shall be supplied for 220kV & 66kV GIS separately.

25. **TRANSFORMER TERMINATION MODULE:**
   The transformer termination module enables a direct transition from the SF6 gas insulation to the bushing of an oil-insulated transformer coil. For this purpose, the transformer bushing must be oil-tight, gas-tight and pressure resistant. Any temperature related movement and irregular setting of the switchgear’s or transformer’s foundations are absorbed by the expansion fittings. However, in case of 66kVkV system, the bidder could go bus duct/ cable connection between the transformer and GIS to meet the system requirement.

26. **PAINTING OF ENCLOSURE**
   All enclosures shall be painted externally as per manufacturer’s painting procedure. The painting procedures as followed shall be enclosed with the bid.
27. **HEATERS**

Wherever required, heaters shall be provided to prevent moisture condensation. Heaters are not allowed inside the main circuit.

28. **IDENTIFICATION & RATING PLATE**

i) Each bay shall have a nameplate showing
a) A listing of the basic equipment from air entrance bushing to air entrance bushing (such as a breaker, disconnectors, grounding switches, current transformers, voltage transformers, and bushings).

b) A schematic diagram indicating their relative locations.

c) DTL Contract Number.

ii) Each module will have its own Identification & rating plate.

The rating plate marking for each individual equipments like circuit breaker, disconnectors, grounding switches, current transformer, voltage transformers, surge arrester etc shall be as per their relevant IEC.
### TABLE-IA
**REQUIREMENTS FOR 245 kV CURRENT TRANSFORMER**

<table>
<thead>
<tr>
<th>No. of cores</th>
<th>Core No.</th>
<th>Application</th>
<th>Current ratio</th>
<th>Output Burden (VA)</th>
<th>Accuracy Class as Per IEC: 44-1</th>
<th>Min. Knee pt Voltage V&lt;sub&gt;k&lt;/sub&gt;</th>
<th>Max CT Sec. Wdg. Resistance (ohm)</th>
<th>Max Excitation current at V&lt;sub&gt;k&lt;/sub&gt; in mA</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1</td>
<td>BUS DIFF CHECK</td>
<td>1600-800/1</td>
<td>-</td>
<td>-</td>
<td>1600/800</td>
<td>8/4</td>
<td>25 on1600/1tap. 50 on800/1tap.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>BUS DIFF MAIN</td>
<td>1600-800/1</td>
<td>-</td>
<td>-</td>
<td>1600-800/1</td>
<td>8/4</td>
<td>25 on1600/1tap. 50 on800/1tap.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>METEERING</td>
<td>1600-800/1</td>
<td>20</td>
<td>0.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>TRANS. BACK UP/ LINE PRTN.</td>
<td>1600-800/1</td>
<td>-</td>
<td>-</td>
<td>1600-800/1</td>
<td>8/4</td>
<td>25 on1600/1tap. 50 on800/1tap.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>TRANS. DIFF/ LINE PRTN.</td>
<td>1600-800/1</td>
<td>-</td>
<td>-</td>
<td>1600-800/1</td>
<td>8/4</td>
<td>25 on1600/1tap. 50 on800/1tap.</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:-**

- *220kV C.T. ratio of 800-400/1-1-1-1-1 A for feeder & Transformer bay & ratio of 1600-800/1-1-1-1-1A for bus coupler bay.*
- *The Bidder will ensure compatibility of CT and numerical relay in respect of knee-point voltage as well as operating time of relay to avoid mal-functioning or damage to the numerical relay.*
- *All relaying CTs shall be of accuracy class PS as per IS: 2705*
### TABLE-IB

**REQUIREMENTS FOR 72.5 kV CURRENT TRANSFORMER**

<table>
<thead>
<tr>
<th>No. of Cores</th>
<th>Core no.</th>
<th>Application</th>
<th>Current ratio</th>
<th>Output Burden (VA)</th>
<th>Accuracy Class as Per IEC: 44-1</th>
<th>Min.Knee pt. Voltage V&lt;sub&gt;k&lt;/sub&gt;</th>
<th>Instrument security factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1</td>
<td>METERING</td>
<td>*</td>
<td>20</td>
<td>0.2</td>
<td>-</td>
<td>Less than 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Differential Protection</td>
<td>*</td>
<td>-</td>
<td>*</td>
<td>V&lt;sub&gt;k&lt;/sub&gt;&gt;K.I.(Rc +R)V</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Back-up Protection(O/C and E/F)</td>
<td>*</td>
<td>-</td>
<td>*</td>
<td>V&lt;sub&gt;k&lt;/sub&gt;&gt;K.I.(Rc +R)V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>REF Protection</td>
<td>*</td>
<td>-</td>
<td>*</td>
<td>V&lt;sub&gt;k&lt;/sub&gt;&gt;K.I.(Rc +R)V</td>
<td></td>
</tr>
</tbody>
</table>

* **NOTE:-**

i) All relaying CTs shall be of accuracy class PS as per IS: 2705

ii) 66kV C.T. of ratio 2000/1-1-1-1 A for incoming from 160 MVA Trf and 2000/1-1-1 for bus coupler (with core one for metering and core 2 for back-up protection)

iii) 66kV C.T. ratio 1000 /1-1-1-1 A for Feeder Protection with core 1 for metering, core 2 for Line protection and core 3 for back-up protection with above accuracy class.
### TABLE-IIA

**REQUIREMENT OF 220kV VOLTAGE TRANSFORMERS**

<table>
<thead>
<tr>
<th>S. N</th>
<th>PARTICULARS</th>
<th>220kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rated primary voltage</td>
<td>245/√3 kV</td>
</tr>
<tr>
<td>2</td>
<td>Type</td>
<td>Electromagnetic</td>
</tr>
<tr>
<td>3</td>
<td>No. of secondaries</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Rated voltage factor</td>
<td>1.2 continuous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.5-30 seconds</td>
</tr>
<tr>
<td>5</td>
<td>Phase angle error</td>
<td>±20 minutes</td>
</tr>
<tr>
<td>6</td>
<td>Rated voltage (V)</td>
<td>110/√3, 110/√3, 110/√3</td>
</tr>
<tr>
<td>7</td>
<td>Application</td>
<td>Protection, Protection, Metering</td>
</tr>
<tr>
<td>8</td>
<td>Accuracy</td>
<td>3P, 3P, 0.2</td>
</tr>
<tr>
<td>9</td>
<td>Output burden (VA) (minimum)</td>
<td>50, 50, 50</td>
</tr>
</tbody>
</table>

### TABLE-IIB

**REQUIREMENT OF 72.5kV VOLTAGE TRANSFORMERS**

<table>
<thead>
<tr>
<th>S. N</th>
<th>PARTICULARS</th>
<th>66 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rated primary voltage</td>
<td>72.5/√3 kV</td>
</tr>
<tr>
<td>2</td>
<td>Type</td>
<td>Electromagnetic</td>
</tr>
<tr>
<td>3</td>
<td>No. of secondaries</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Rated voltage factor</td>
<td>1.2 continuous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.5-30 seconds</td>
</tr>
<tr>
<td>5</td>
<td>Phase angle error</td>
<td>±20 minutes</td>
</tr>
<tr>
<td>6</td>
<td>Rated voltage (V)</td>
<td>110/√3, 110/√3, 110/√3</td>
</tr>
<tr>
<td>7</td>
<td>Application</td>
<td>Metering, Protection, Protection</td>
</tr>
<tr>
<td>8</td>
<td>Accuracy</td>
<td>0.2, 3P, 3P</td>
</tr>
<tr>
<td>9</td>
<td>Output burden (VA) (minimum)</td>
<td>50, 50, 50</td>
</tr>
</tbody>
</table>
1.0 General Characteristics

The SF6 gas insulated metal enclosed switchgear shall be totally safe against inadvertent touch of any of its live constituent parts. It should be designed for indoor/outdoor (as specified) application with meteorological conditions at site as per Section Project. All parts of the switchgear should be three phase enclosed for 33kV GIS.

The arrangement of gas sections or compartments shall be such as to facilitate future extension of any make on either end without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays.

The design should be such that all parts subjected to wear and tear are easily accessible for maintenance purposes. The equipment offered shall be protected against all types of voltage surges and any equipment necessary to satisfy this requirement shall be deemed to be included. The required overall parameters of GIS are as follows:-

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Technical Particulars</th>
<th>33 kV System</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Rated Voltage</td>
<td>36 kV (rms)</td>
</tr>
<tr>
<td>b)</td>
<td>Rated frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>c)</td>
<td>Grounding</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td>d)</td>
<td>Rated power frequency withstand Voltage (1 min) line to earth</td>
<td>70 kV (rms)</td>
</tr>
<tr>
<td>e)</td>
<td>Impulse withstand BIL (1.2/50/mic. Sec) Line to earth</td>
<td>±170 kVp</td>
</tr>
<tr>
<td>f)</td>
<td>Rated short time withstand current</td>
<td>31.5 kA (rms) for 1 sec</td>
</tr>
<tr>
<td>g)</td>
<td>Rated peak withstand current</td>
<td>80 kA (peak)</td>
</tr>
<tr>
<td>h)</td>
<td>Guaranteed maximum gas losses for complete installation as well as for all individual sections in %</td>
<td>As per IEC- 62271-200</td>
</tr>
<tr>
<td>i)</td>
<td>Seismic level</td>
<td>Zone- IV, as per IS-1893, Year- 2002</td>
</tr>
</tbody>
</table>

The metal-enclosed gas insulated switchgear, including the operating devices, accessories and auxiliary equipment forming integral part thereof, shall be designed, manufactured, assembled and tested in accordance with the IEC-62271-200 publications including their parts and supplements as amended or revised to date.

2.0 Reference Standards

The metal-enclosed gas-insulated switchgear, including the operating devices, accessories and auxiliary equipment forming integral part thereof, shall be designed, manufactured, assembled and tested in accordance with the following International Electro-technical Commission (IEC) Publications including their parts and supplements as amended or revised to date:

- IEC 62271-200 Gas Insulated metal-enclosed switchgear for rated voltages above 1 kV and upto and including 52 kV
- IEC 60376 New sulphur hexafluoride
- IEC 62271- 100 High voltage alternating current Circuit breakers
- IEC 60694 Common clauses for high voltage Switchgear and control-gear standards
- IEC 62271-102 Alternating current disconnectors (isolators) and earthing switches.
- IEC 60128 Alternating current disconnectors. Bus-transfer current switching by disconnectors.
- IEC 66044-1 Current transformers
IEC 66044-2 Voltage transformers
IEC 60137 Bushings for alternating voltages above 1000 V
IEC 60859 Cable connections for gas-insulated switchgear
IEC 60480 Guide to checking of sulphur hexafluoride taken from electrical equipment
IEC 60099-1/4 Non-linear resistor type arresters for AC systems
IEC 60439 Factory-built assemblies of low-voltage switchgear and control gear.
IEC 60427 Report on synthetic testing of high-voltage alternating-current circuit breaker.
CIGRE-44 Earthing of GIS- an application guide. (Electra no.151, Dec’93)

The components and devices which are not covered by the above standards shall conform to, and comply with, the latest applicable standards, rules, codes and regulations of the internationally recognized standardizing bodies and professional societies as may be approved by the Employer. The manufacturer shall list all applicable standards, codes etc. and provide copies thereof for necessary approval.

In case the requirements laid down herein differ from those given in above standard in any aspect the switchgear shall comply with the requirements indicated herein in regard thereto.

3.0 Definitions
3.1 Assembly
Assembly refers to the entire completed GIS equipment furnished under contract.

3.2 Bay
Bay refers to the area occupied by one Circuit Breaker and associated equipments used to protect one feeder/line/transformer/bus coupler, capacitor, bus bar section in double sectionalize bus scheme.

3.3 Compartment
When used in conjunction with GIS equipment, compartment refers to a gas tight volume bounded by enclosure walls and gas tight isolating barriers.

3.4 Enclosure
When used in conjunction with GIS equipment, enclosure refers to the grounded metal housing or shell which contains and protects internal Power system equipment (breaker, disconnecting switch, grounding switch, voltage transformer, current transformer, surge arresters, interconnecting bus etc.)

3.5 Manual Operations
Manual operation means operation by hand without using any other source of Power.

3.6 Module
When used in conjunction with GIS equipment, module refers to a portion of that equipment. Each module includes its own enclosure. A module can contain more than one piece of equipment, for example, a module can contain a disconnecting switch and a grounding switch.

3.7 Reservoir
When used in conjunction with GIS equipment reservoir refers to a larger gastight volume.

4.0 General Design & Safety Requirement
4.01 The GIS assembly shall consist of separate modular compartments e.g. Circuit Breaker compartment, Bus bar compartment filled with SF6 Gas and separated by gas tight partitions so as to minimize risk to human life, allow ease of maintenance and limit the effects of gas leaks failures & internal arcs etc. These compartments shall be such that maintenance on one bus-bar/compartment may be performed without de-energising the adjacent bus-bar/feeder. These
compartments shall be designed to minimize the risk of damage to adjacent sections and protection of personnel in the event of a failure occurring within the compartments. Rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting of pressures developing within the enclosures under worst operating conditions.

4.02 The workmanship shall be of the highest quality and shall conform to the latest modern practices for the manufacture of high technology machinery and electrical switchgear.

4.03 The switchgear shall be of modular design. The conductors and the live parts shall be mounted on high graded epoxy resin insulators. These insulators shall be designed to have high structural strength and electrical dielectric properties and shall be shaped so as to provide uniform field distribution and to minimize the effects of particle deposition either from migration of foreign particles within the enclosures or from the by-products of SF6 breakdown under arcing conditions.

4.04 Gas barrier insulators and support insulators shall have the same basis of design. The support insulators shall have holes on both sides for proper flow of gas.

4.05 Gas barrier insulators shall be provided so as to divide the GIS into separate compartments. They shall be suitably located in order to minimize disturbance in case of leakage or dismantling. They shall be designed to withstand any internal fault thereby keeping an internal arc inside the faulty compartment. Due to safety requirement for working on this pressurized equipment, whenever the pressure of the adjacent gas compartment is reduced, it should be ensured by the bidder that adjacent compartment would remain in service with reduced pressure. The gas tight barriers shall be clearly marked on the outside of the enclosures.

4.06 The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through as per IEC. The material shall be such that it has no effect of environment as well as from the by-products of SF6 breakdown under arcing condition.

4.07 Each section shall have plug- in or easily removable connection pieces to allow for easy replacement of any component with the minimum of disturbance to the remainder of the equipment.

4.08 The material used for manufacturing the switchgear equipment shall be of the type, composition and have physical properties best suited to their particular purposes and in accordance with the latest engineering practices. All the conductors shall be fabricated of aluminum/ copper tubes of cross sectional area suitable to meet the normal and short circuit current rating requirements. The finish of the conductors shall be smooth so as to prevent any electrical discharge. The conductor ends shall be silver plated and fitted into finger contacts or tulip contacts. The contacts shall be of sliding type to allow the conductors to expand or contract axially due to temperature variation without imposing any mechanical stress on supporting insulators.

4.09 Each pressure filled enclosure shall be designed and fabricated to comply with the requirements of the applicable pressure vessel codes and based on the design temperature and design pressures as defined in IEC-62271-200.

4.10 The manufacturer shall guarantee that the pressure loss within each individual gas-filled compartment shall not be more than half percent (0.5%) per year.

4.11 Each gas-filled compartment shall be equipped with desicents/ absorber, density switches, filling valve and safety diaphragm. The desicents/ absorber shall be capable of absorbing any water vapour which may penetrate into the enclosures. Each gas compartment shall be fitted with separate non-return valve connectors for evacuating & filling the gas and checking the gas pressure etc.

4.12 The switchgear line-up when installed and operating under the ambient conditions shall perform satisfactorily and safely under all normal and fault conditions. Even repeated operations up to the permissible servicing intervals under 100% rated and fault conditions shall not diminish the performance or significantly shorten the useful life of the switchgear. Any fault caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear. The internal components shall be maintenance free for at least 10 years. Routine replacements of insulating gas shall not be required in intervals of less than ten years.
4.13 The thermal rating of all current carrying parts shall be minimum for one sec. for the rated symmetrical short-circuit current.

4.14 The arrangement of the individual switchgear bays shall be such so as to achieve optimum space-saving, neat and logical arrangement and adequate accessibility to all external components.

4.15 Local Control & Substation Automation System:-

Separate control cubicle including gas monitoring kiosk shall be provided for each bay which shall be installed near the switchgear for local control & monitoring of respective switchgear bay.

Local control cubicle for GIS shall be equipped with suitable hardware & software for remote control operation and confirm to the bay level controller as detailed in Section: Substation Automation System.

BCU/BPU can also be used as Local Control Cubicle (LCC) depending upon the design of the offered equipment, as such separate LCC need not be provided.

Relay & Protection panels room shall house these equipments and shall be located adjacent to GIS room. It shall be air- conditioned through split air conditioners. The capacity and quantity of air conditioners shall be finalized during detailed engineering.

4.16 All the elements shall be accessible without removing support structures for routine inspections and possible repairs. The removal of individual enclosure parts, or entire breaker bays shall be possible without disturbing the enclosures of neighboring bays.

4.17 It should be impossible to unwillingly touch live parts of the switchgear or to perform operations that lead to arcing faults without the use of tools or brute force.

4.18 In case of any repair or maintenance on one busbar disconnectors, the other busbar/ other equipments should be live and in service.

4.19 All interlocks that prevent potentially dangerous mal-operations shall be constructed such that they can not be operated easily, i.e. the operator must use tools or brute force to over-ride them.

4.20 In general the contours of energized metal parts of the GIS and any other accessory shall be such, so as to eliminate areas or points of high electrostatic flux concentrations.

4.21 The enclosure shall be of continuous design and shall meet the requirement as specified in clause no. 10 (special considerations for GIS) of IEEE- 80, Year- 2000. The enclosure shall be sized for carrying induced current equal to the rated current of the Bus. The conductor and the enclosure shall form the concentric pair with effective shielding of the field internal to the enclosure.

4.22 The fabricated metal enclosures shall be of Aluminium alloy having high resistance to corrosion, low electrical loses and negligible magnetic losses. All joint surfaces shall be machined and all castings shall be spot faced for all bolt heads or nuts and washers. All screws, bolts, studs and nuts shall conform to metric system. The other type of non-magnetic enclosures may be considered.

4.23 The breaker enclosure shall have provision for easy withdrawal of the interrupter assemblies. The removed interrupter assembly must be easily and safely accessible for inspection and possible repairs.

4.24 The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electrodynamic stresses even under short circuit conditions.

4.25 The elbows, bends, cross and T-sections of interconnections shall include the insulators bearing the conductor when the direction changes take place in order to ensure that live parts remain perfectly centered and the electrical field is not increased at such points.
4.26 The Average Intensity of electromagnetic field shall not be more than 500 micro Tesla. The contractor shall furnish all calculations and documents in support of the above during detailed engineering.

4.27 The Bidder shall furnish the following information regarding the loosely distributed metallic particles within the GIS encapsulation.

   a) Calculations of critical field strength for specific particles of defined mass and geometry.
   b) The methodology and all the equipment for electrical partial discharge (PD) detection and/or acoustic detection methods, including that mentioned in the specification elsewhere.

4.28 The switchgear shall have provision for connection with ground mat risers. This provision shall consist of grounding pads to be connected to the ground mat riser in the vicinity of the equipment.

4.29 The ladders and walkways shall be provided wherever necessary for access to the equipment. A portable ladder with adjustable height may also be supplied to access to the equipment.

4.30 Wherever required, the heaters shall be provided for the equipment in order to ensure the proper functioning of the switchgear at specified ambient temperatures. The heaters shall be rated for 230V AC supply and shall be complete with thermostat, control switches and fuses, connected as a balanced 3-phase 4-wire load. The possibility of using heaters without thermostats in order to achieve the higher reliability may be examined by the bidder and accordingly included in the offer but it shall be ensured by the bidder that the temperature rise of different enclosures where heating is provided should be within safe limits as per relevant standards. One copy of the relevant extract of standard to which the above arrangement conforms along with cost reduction in offer, if any, shall also be furnished along with the offer. The heaters shall be so arranged and protected as to create no hazard to adjacent equipment from the heat produced.

4.31 The enclosure & support structure shall be designed that a mechanic 1780 mm in height and 80Kg in weight is able to climb on the equipment for maintenance.

4.32 The sealing provided between flanges of two modules / enclosures shall be such that long term tightness is achieved.

4.33 Alarm circuit shall not respond to faults for momentary conditions. The following indications including those required elsewhere in the specifications shall be generally provided in the alarm and indication circuits.

   4.33.1 Gas Insulating System:

      a) Loss of Gas Density.
      b) Loss of Heater power(if required)
      c) Any other alarm necessary to indicate deterioration of the gas insulating system.

   4.33.2 Operating System:

      a) Low operating pressure
      b) Loss of Heater power
      c) Loss of operating power
      d) Loss of control
      e) Pole Disordance

4.34 The equipment will be operated under the following ambient conditions:

   a) The ambient temperature varies between 0 degree-C and 50 degree-C. The humidity will be about 95% (indoors)
   b) The elevation is less than 1000 meters.
4.35 Temperature rise of current carrying parts shall be limited to the values stipulated in IEC-694, under rated current and the climatic conditions at site. The temperature rise for accessible enclosure shall not exceed 20 degree C above the ambient temperature of 50 degree C. In the case of enclosures, which are accessible but need not be touched during normal operation, the temperature rise limit may be permitted up to 30 degree C above the ambient of 50 degree C.

4.36 In case of any internal arc fault regardless whether it occurs in a bus bar section, a bus bar isolator or the circuit breaker, repair works should be possible without shutting down the substation; at least one busbar and the undisturbed feeder should remain in operation. It should be possible to remove and replace a fully assembled circuit breaker without interfering the operation of the adjacent feeder. All circuit breakers of same rating should be interchangeable.

4.37 The GIS equipments shall be arranged in such a manner that in case of maintenance work on any of the equipment, at least one bus bar should be available for operation.

4.38 The inter bay width shall be sufficient to allow access to all drive mechanisms and other termination boxes without the need of dismantling other apparatuses.

These conditions shall be taken into account by the supplier in the design of the equipment.

4.0 A Special Design Requirements for 33kV GIS:

The 33kV GIS should consist of the following constructional feature as brought out (i), (ii) besides other features mentioned above.

i) The 33kV GIS shall be SF6 metal enclosed with compartments suitable for indoor/outdoor installation. The switchboard structure must be made of standardized cubicles placed side by side, each consisting of modular buildup and standardized elements. Cubicles must be completely segregated one from other, containing the power parts of the cubicles.

ii) Bus bar system must be three phase, sized to support short circuit current of 31.5 kA for 1 second.

5.0 Bellows or Compensating Units:

Adequate provision shall be made to allow for the thermal expansion of the conductors and of differential thermal expansion between the conductors and the enclosures. The bellows shall be metallic (preferably of stainless steel) of following types or other suitable equivalent arrangement shall be provided wherever necessary.

1) Lateral / Vertical mounting units: These shall be inserted, as required, between sections of busbars, on transformer and XLPE cable etc. Lateral mounting shall be made possible by a sliding section of enclosure and tubular conductors.

2) Axial compensators: These shall be provided to accommodate changes in length of busbars due to temperature variations.

3) Parallel compensators: These shall be provided to accommodate large linear expansions and angle tolerances.

4) Tolerance compensators: These shall be provided for taking up manufacturing, site assembly and foundation tolerances.

5) Vibration compensators: These bellow compensators shall be provided for absorbing vibrations caused by the transformers when connected to SF6 switchgear by oil- SF6 bushings.

6.0 Indication and Verification of Switch Positions

Indicators shall be provided on all circuit breakers, isolators and earth-switches, which shall clearly show whether the switches are open or closed. The indicators shall be mechanically
coupled directly to the main contact operating drive rod or linkages and shall be mounted in a position where they are clearly visible through glass windows.

7.0 Pressure Relief Devices

Pressure relief devices shall be provided in the gas sections to protect the main gas enclosures from damage or distortion during the occurrence of abnormal pressure increase or shock waves generated by internal electrical fault arcs (preferably in downward direction).

Pressure relief shall be achieved either by means of diaphragms or plugs venting directly into the atmosphere in a controlled direction.

If the pressure relief devices vent directly into the atmosphere, suitable guards and deflectors shall be provided. Contractor shall submit to the Employer the detailed criteria design regarding location of pressure relief devices/rupture diaphragms.

8.0 Pressure Vessel Requirements

The enclosure shall be designed for the mechanical and thermal loads to which it is subjected in service. The enclosure shall be manufactured and tested according to the pressure vessel code (ASME/CENELEC code for pressure Vessel.)

Each enclosure has to be tested as a routine test at 1.5 time the design pressure for one minute. The bursting strength of Aluminium castings has to be at least 5 times the design pressure. A bursting pressure test shall be carried out at 5 times the design pressure as a type test on each type of enclosure.

9.0 Grounding

The grounding system shall be designed and provided as per IEEE-80-2000 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences.

As the area involved is small, contractor has to take special measures for the same.

The GIS supplier shall define clearly what constitutes the main grounding bus of the GIS. The GIS supplier must supply the entire material for grounding bus of GIS viz. conductor, clamps, joints, operating and safety platforms etc. The GIS supplier is also required to supply all the earthing conductors and associated hardware material for the following:

1) Connecting all GIS equipment, enclosures, control cabinets, supporting structure etc. to the ground bus of GIS.

2) Grounding of other outdoor switchyard equipments/ structures etc.

The enclosure of the GIS may be grounded at several points so that there shall be grounded cage around all the live parts. A minimum of two nos. of grounding connections should be provided for each of circuit breaker, transformer terminals, cable terminals, surge arrestors, earth switches and at each end of the bus bars. Subassembly to subassembly bonding shall be provided to provide gap & safe voltage gradients between all intentionally grounded parts of the GIS assembly & between those parts and the main grounding bus of the GIS.

Each marshalling box, local control panel, power and control cable sheaths and other non current carrying metallic structures shall be connected to the grounding system of GIS via connections that are separated from GIS enclosures.

The grounding connector shall be of sufficient mechanical strength to withstand electromagnetic forces as well as capable of carrying the anticipated maximum fault current without overheating. At least two grounding paths shall be provided to connect each point to the main grounding bus. Necessary precautions should be under taken to prevent excessive currents from being induced into adjacent frames, structures of reinforcing steel and to avoid establishment of current loops via other station equipment.

All flexible bonding leads shall be tinned copper. All connectors, for attaching flexible bonding leads to grounding conductors and grounding conductors to support structures shall be tinned bronze with stainless steel or tinned bronze hardware.
The contractor shall provide suitable measure to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrester, ph./ earth fault and discharges between contacts during switching operation. The grounding system shall ensure safe touch & step voltages in all the enclosures. The contractor shall provide suitable barrier of non-linear resistor/ counter discontinued SF6/ Air termination, SF6/ Transformer termination, SF6/ HV cable bushing etc. to mitigate transient enclosure voltage.

The bidders shall provide lightening mast/GS shield wire at suitable place for protection of 33KV GIS, GIS cum control room building etc. The bidder shall submit detailed proposal for grounding system of whole 33 kVGIS including indoor and outdoor equipments with Earth mat using 40mm. dia MS rod for approval of purchaser. The riser shall be GS flat of size 75X12mm for outdoor equipments and 50X6mm for indoor.

The bidder shall submit detailed proposal for grounding system for approval of purchaser. Any provision to be made in the building design to take care of earthing requirement shall also be clearly spelt-out.

10 Circuit Breakers

General

Vacuum circuit breakers or SF6 circuit breakers shall comply with the latest revisions of IEC-62271-100 & relevant IEC except to the extent explicitly modified in the specification and shall meet with requirements specified.

Circuit breakers shall be equipped with the operating mechanism. Complete circuit breaker with all necessary items for successful operation shall be supplied. The circuit breakers shall be designed for high speed three phase reclosing with an operating sequence and timing as specified.

10.1 Duty Requirements

Circuit breaker shall be C2 - M2-E2 class as per IEC-62271-100.

Circuit breaker shall meet the duty requirements for any type of fault or fault location and perform make and break operations as per the stipulated duty cycles satisfactorily.

10.2 The circuit breaker shall be capable of:

   i) Interrupting the steady and transient magnetizing current corresponding to 220/33 kV class transformers of 100 MVA & 50MVA ratings on 33 kV side.
   ii) Interrupting line/cable charging current as per IEC without re-strikes and without use of opening resistors.
   iii) Clearing short line fault (Kilometric faults) with source impedance behind the bus equivalent to symmetrical fault current specified.
   iv) Breaking 25% the rated fault current at twice the rated voltage under phase opposition condition.
   v) Interrupting capacitor bank if applicable.

   The breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energisation of capacitor bank & lines with trapped charges.

10.3 Total Break Time

The total break time shall not be exceeded under any of the following duties:

   i) Test duties T10, T30, T60, T100 (with TRV as per IEC- 62271-100)
   ii) Short line fault L90, L75 (with TRV as per IEC-62271-100)

   The Bidder may please 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 (70-110%) and SF6 gas pressure etc. While furnishing the proof for the total break time of complete circuit
breaker, the bidder may specifically bring out the effect of non simultaneity between poles and show how it is covered in the total break time.

The values guaranteed shall be supported with the type test reports.

10.4 Constructional Features

The features and constructional details of breakers shall be in accordance with requirements stated hereunder:

10.4.1 Contacts

All making and breaking contacts' shall be sealed and free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have a life expectancy so that frequent replacement due to excessive burning will not be necessary. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

10.4.2 Any device provided for voltage grading to damp oscillations or, to prevent re-strike prior to the complete interruption of the circuit or to limit over voltage on closing, shall have a life expectancy comparable of that of the breaker as a whole.

10.4.3 Breakers shall be so designed that when operated within their specified rating, the temperature of each part will be limited to values consistent with a long life for the material used. The temperature rise shall not exceed that indicated in IEC-62271-100 under specified ambient conditions.

10.4.4 Provisions shall be made for attaching an operational analyzer to record travel, speed and making measurement of operating timings etc. after installation at site.

10.5 Operating Mechanism

10.5.1 General Requirements:

a) Circuit breaker shall be operated by spring charged mechanism. The mechanism shall be housed in a dust proof cabinet and shall have IP: 42 degree of protection.

b) The operating mechanism shall be suitable for high speed reclosing and other duties specified. During reclosing the breaker contacts shall close fully and then open. The mechanism shall be anti-pumping and trip free (as per IEC definition) under every method of closing.

c) The 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 operating devices.

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

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

f) The bidder shall furnish detailed operation and maintenance manual of the mechanism alongwith the operation manual for the circuit breaker.

10.5.2 Control

a) The close and trip circuits shall be designed to permit use of momentary-contact switches and push buttons.

b) The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However, provisions shall be made for local electrical control. For this purpose a local/remote selector switch and close and trip control switch/push buttons shall be provided in the breaker central control cabinet.
c) The trip coil shall be suitable for trip circuit supervision during both open and close position of breaker.

d) Closing coil and associated circuits shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip and associated circuits shall operate correctly under all operating conditions of the circuit breaker up to 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 and reliability for similar applications on circuit breakers shall be clearly brought out in the additional information schedules. In the absence of adequate details the offer is likely to be rejected.

e) Densimeter contacts and pressure switch contacts shall be suitable for direct use as permissive in closing and tripping circuits. Separate contacts have to be used for each of tripping and closing circuits. If contacts are not suitably rated and multiplying relays are used then fail safe logic/schemes are to be employed. DC supplies for all auxiliary circuit shall be monitored and for remote annunciations and operation lockout in case of dc failures.

f) The auxiliary switch of the breaker shall be positively driven by the breaker operating rod.

10.5.3 Spring operated Mechanism

a) Spring operated mechanism shall be complete with motor in accordance with Section GTR. Opening spring and closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided.

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

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

d) Breaker operation shall be independent of the motor which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided. The motor rating shall be such that it required preferably not more than 60 seconds for full charging of the closing spring.

e) Closing action of circuit breaker shall compress the opening spring ready for tripping.

f) 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.

g) Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition.

h) Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in the closed position.

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.

10.6 Additional Data To Be Furnished Alongwith The Offer:

a) Drawing showing contacts in close, arc initiation, full arcing, arc extinction and open position.

b) Data on capabilities of circuit breakers in terms of time and number of operations at duties ranging from 100 fault currents to load currents of the lowest possible value without requiring any maintenance or checks.

c) Curves supported by test data indicating the opening time under close open operation with variation of trip coil voltage.
10.7 Tests

10.7.1 In accordance with the requirements stipulated under Section GTR the circuit breaker along with its operating mechanism shall conform to the type tests as per IEC-62271-100.

10.7.2 Routine Tests

Routine tests as per IEC: 62271-100 shall be performed on all circuit breakers.

In addition to the mechanical and electrical tests specified by IEC, the following shall also be performed.

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-reclosing (if applicable) and trip free operation under normal as well as limiting operating conditions (control voltage etc.). 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 break make operation etc. This test shall also be performed at site.

The test for getting signature of the dynamic contact resistance measurement shall also be carried out at factory. The test result shall be treated as reference signature for condition monitoring in future.

10.7.3 Technical Parameters - Circuit Breaker

<table>
<thead>
<tr>
<th>Sl.</th>
<th>Technical particulars</th>
<th>33 kV System</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Rated voltage kV (rms)</td>
<td>36</td>
</tr>
<tr>
<td>b)</td>
<td>Rated frequency (Hz)</td>
<td>50</td>
</tr>
<tr>
<td>c)</td>
<td>No. of poles</td>
<td>3</td>
</tr>
<tr>
<td>d)</td>
<td>Type of circuit breaker</td>
<td>Vacuum or SF6</td>
</tr>
<tr>
<td>e)</td>
<td>Rated continuous current (A) at an ambient temperature of</td>
<td>2500/1250</td>
</tr>
<tr>
<td></td>
<td>40°C</td>
<td>- 2500 for bus coupler and incomer bay.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 1250 for outgoing bays.</td>
</tr>
<tr>
<td>f)</td>
<td>Rated short circuit capacity</td>
<td>31.5 kA with percentage of DC component as per IEC-62271-100 corresponding to minimum opening conditions as specified.</td>
</tr>
<tr>
<td>g)</td>
<td>Symmetrical interrupting capability kA (rms)</td>
<td>31.5</td>
</tr>
<tr>
<td>h)</td>
<td>Rated short circuit making current kAp</td>
<td>80</td>
</tr>
<tr>
<td>i)</td>
<td>Short time current carrying capability for one second kA (rms)</td>
<td>31.5</td>
</tr>
<tr>
<td>j)</td>
<td>Rated line charging interrupting current at 90 deg. Leading power factor angle (A rms)</td>
<td>As per IEC</td>
</tr>
</tbody>
</table>

(The breaker shall be able to interrupt the rated line charging current with test)
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Voltage immediately before opening equal to the product of U/√3 and 1.4 as per IEC-62271-100)</td>
<td></td>
</tr>
<tr>
<td>k)</td>
<td>First pole to clear factor</td>
<td>1.5</td>
</tr>
<tr>
<td>l)</td>
<td>Rated break time as IEC (ms)</td>
<td></td>
</tr>
<tr>
<td>m)</td>
<td>Total break time (ms)</td>
<td>Not more than 100</td>
</tr>
<tr>
<td>n)</td>
<td>Total closing time (ms)</td>
<td>Not more than 200</td>
</tr>
<tr>
<td>o)</td>
<td>Rated insulation levels</td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Full wave impulse with stand voltage (1.2x50 micro sec.)</td>
<td>±170 kVp</td>
</tr>
<tr>
<td></td>
<td>- between line terminals and ground</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- between terminals with circuit breaker open</td>
<td>±195 kVp</td>
</tr>
<tr>
<td>ii)</td>
<td>One minute power frequency withstand voltage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- between line terminals and ground</td>
<td>As per IEC</td>
</tr>
<tr>
<td></td>
<td>- between terminals with circuit breaker open</td>
<td>As per IEC</td>
</tr>
<tr>
<td>p)</td>
<td>Max. radio interference voltage for frequency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- between 0.5 MHz and 2 MHz at 156 kV (Micro volts)</td>
<td></td>
</tr>
<tr>
<td>q)</td>
<td>Max. difference in the instants of closing/opening of contacts (ms) between poles</td>
<td>As per IEC</td>
</tr>
<tr>
<td>r)</td>
<td>Trip coil and closing coil voltage</td>
<td>220V DC with variation as specified</td>
</tr>
<tr>
<td>s)</td>
<td>Auxiliary Contacts Auxiliary switch shall also comply with requirements as given. Independent single pole reversible contacts (from NO to NC &amp; vice versa)</td>
<td>Each circuit breaker pole shall be provided with an auxiliary switch with 20% of spare - NO and 20% spare NC contact for use in future.</td>
</tr>
<tr>
<td>i)</td>
<td>Rating of Auxiliary contacts</td>
<td>10A at 220V DC</td>
</tr>
<tr>
<td>ii)</td>
<td>Breaking capacity of Aux. Contacts.</td>
<td>2A DC with the circuit time constant of not less than 20 ms.</td>
</tr>
<tr>
<td>t)</td>
<td>System neutral earthing</td>
<td>Effectively earthed.</td>
</tr>
</tbody>
</table>
11.0 **Disconnectors (Isolators)**

11.1 **General**

Disconnectors shall be of the three-pole, group operated type, installed in the switchgear to provide electrical isolation of the circuit breakers, the transformers, double bus, capacitor bank and transmission lines/cables. The disconnectors shall conform to IEC- 62271-102 and shall have the following ratings as specified.

### Technical Parameter

<table>
<thead>
<tr>
<th>S.N o</th>
<th>Particulars</th>
<th>33 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Rated voltage (rms) Un</td>
<td>36 kV</td>
</tr>
<tr>
<td>b)</td>
<td>Rated frequency</td>
<td>50 HZ</td>
</tr>
<tr>
<td>c)</td>
<td>System earthing</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td>d)</td>
<td>Type</td>
<td>SF6 insulated</td>
</tr>
</tbody>
</table>
| e)    | Rated continuous current (A) at 40°C ambient temp.| 1250/2500  
- 1250 for outgoing bays.  
- 2500 for bus coupler and incomer bays. |
| f)    | Rated short time withstand current of isolator and earth switch | 31.5 kA for 1 Sec |
| g)    | Rated dynamic short circuit withstand current of isolator and earth switch | 80 kAp |
| h)    | Rated insulation level:  One minute power freq.  
Withstand voltage: | As per IEC  
Across isolating distance | As per IEC |
| i)    | Rated mechanical terminal load                   | As per IEC |
| j)    | No. of spare auxiliary contacts on each isolator  | 6 NO and 6 NC |
| k)    | No. of spare auxiliary contacts on each earthing switch | 6 NO and 6 NC |
| l)    | Max. radio interference voltage for frequency between 0.5MHz and 2MHz at 156 kV (Micro volts) | - |

11.2 **Construction & Design**

11.2.1 The three pole group operated disconnectors shall be operated by electric motor suitable for use on 220V DC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.

11.2.2 Disconnectors shall be designed as per relevant IEC. These shall be suitable to make and break the charging currents during their opening and closing. They shall also be able to make and break loop current which appears during transfer between bus bars. The contact shielding shall also be
designed to prevent re-strikes and high local stresses caused by transient recovery voltages when these currents are interrupted.

11.2.3 The disconnecting switches shall be arranged in such a way that all the three phases operate simultaneously. All the parts of the operating mechanism shall be able to withstand starting torque of the motor mechanism without damage until the motor overload protection operates.

11.2.4 It shall be possible to operate the disconnecting switches manually by cranks or hand wheels. The contacts shall be both mechanically and electrically disconnected during the manual operation.

11.2.5 The operating mechanisms shall be complete with all necessary linkages, clamps, couplings, operating rods, support brackets and grounding devices. All the bearings shall be permanently lubricated or shall be of such a type that no lubrication or maintenance is required.

11.2.6 The opening and closing of the disconnectors shall be achieved by either local or remote control. The local operation shall be by means of a two-position control switch located in the bay module control cabinet.

11.2.7 Remote control of the disconnectors from the control room shall be made by means of remote/local transfer switch.

11.2.8 The disconnector operations shall be inter-locked electrically with the associated circuit breakers in such a way that the disconnector control is inoperative if the circuit breaker is closed.

11.2.9 Each disconnector shall be supplied with auxiliary switch having six normally open and six normally closed contacts for future use over and above those required for switchgear interlocking and automation purposes. The auxiliary switch contacts are to be continuously adjustable such that, when required, they can be adjusted to make contact before the main switch contacts.

11.2.10 The signaling of the closed position of the disconnector shall not take place unless it is certain that the movable contacts will reach a position in which the rated normal current, peak withstand current and short-time withstand current can be carried safely.

11.2.11 The signaling of the open position of the disconnector shall not take place unless the movable contacts have reached such a position that the clearance between the contacts is at least 80 percent of the rated isolating distance.

11.2.12 All auxiliary switches and auxiliary circuits shall be capable of carrying a current of at least 10 A DC continuously.

11.2.13 The auxiliary switches shall be capable of breaking at least 2A in a 220V DC circuit with a time constant of not less than 20 milliseconds.

11.2.14 The disconnectors and safety grounding switches shall have a mechanical key (pad locking key) and electrical inter-locks to prevent closing of the grounding switches when isolator switches are in the closed position and to prevent closing of the disconnectors when the grounding switch is in the closed position.

11.2.15 The local control of the Isolator and high-speed grounding switches from the bay module control panel should be achieved from the individual control switches with the remote/local transfer switch set to local.

11.2.16 All electrical sequence interlocks will apply in both remote and local control modes.

11.2.17 Each disconnector shall have a clearly identifiable local, positively driven mechanical position indicator, together with position indicator on the bay module control cabinet and provisions for taking the signals to the control room. The details of the inscriptions and colouring for the indicator are given as under:
11.2.18 All the disconnecting switches shall have arrangement allowing easy visual inspection of the travel of the switch contacts in both open and close positions, from the outside of the enclosure.

11.2.19 The disconnecting switches shall be provided with rating plates and shall be accessible for inspection.

11.2.20 The disconnecting switches shall be capable of being padlocked in both the open and closed positions with the operating motor automatically disengaged. The padlocking device shall be suitable for a standard size lock with a 10 mm shank. The padlock must be visible and directly lock the final output shaft of the operating mechanism. Integrally mounted lock when provided shall be equipped with a unique key for such three phase group. Master key is not permitted.

12.0 Safety Grounding Switches

12.1 Three-pole, group operated, safety grounding switches shall be operated by electric motor for use on 220V DC ungrounded system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over-current and short circuit.

12.2 Each safety grounding switch shall be electrically interlocked with its associated disconnector and circuit breaker such that it can only be closed if both the current breaker and disconnector are in open position. Safety grounding switch shall also be mechanically key interlocked with its associated disconnector.

12.3 Each safety grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay module control cabinet and provision for taking the signal to Control room.

12.4 The details of the inscription and colouring for the indicator are given as under

<table>
<thead>
<tr>
<th>Open position</th>
<th>SIGN</th>
<th>COLOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open</td>
<td>Open</td>
<td>Green</td>
</tr>
<tr>
<td>Closed position</td>
<td>Closed</td>
<td>Red</td>
</tr>
</tbody>
</table>

12.5 Interlocks shall be provided so that manual operation of the switches or insertion of the manual operating device will disable the electrical control circuits.

12.6 Each ground switch shall be fitted with auxiliary switches having six normally open and six normally closed contacts for use by others over and above those required for local interlocking and position indication purposes.

12.7 Provision shall be made for padlocking the ground switches in either the open or closed position.

12.8 All portions of the grounding switch and operating mechanism required for grounding shall be connected together utilizing flexible copper conductors having a minimum cross-sectional area of 50 sq. mm.

12.9 The main grounding connections on each grounding switch shall be rated to carry the full short circuit rating of the switch for 1 sec. and shall be equipped with a silver-plated terminal connector suitable for steel strap of adequate rating for connection to the grounding grid.

12.10 The safety grounding switches shall conform to the requirements of IEC-62271-102

12.11 Mechanical position indication shall be provided locally at each switch and remotely at each bay module control cabinet/ substation automation system.
12.12 The rated Induced Current and Voltage for earth switches for both electrostatic and electromagnetic coupling shall be as per IEC 62271-102.

13.0 High Speed Make Proof Grounding Switches/ Three Position Switches

13.1 Grounding switches located at the beginning of the feeder bay modules shall be of the high speed, make proof type and will be used to discharge the respective charging currents, in addition to their safety grounding function. These grounding switches shall be capable of interrupting the inductive currents and to withstand the associated TRV.

13.2 Single phase switches shall be provided with operating mechanism suitable for operation from a 220V DC.

13.3 The switches shall be fitted with a stored energy closing system to provide fault making capacity.

13.4 The short circuit making current rating of each ground switch shall be at least equal to its peak withstand current rating. The switches shall have inductive/ capacitive current switching capacity as per IEC-62271-102.

13.5 Each high speed make proof grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay module control cabinet and provision for taking the signal Control Room.

13.6 The details of the inscription and colouring for the indicator shall be as under:

<table>
<thead>
<tr>
<th>SIGN</th>
<th>COLOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN POSITION</td>
<td>Open</td>
</tr>
<tr>
<td>CLOSED POSITION</td>
<td>Closed</td>
</tr>
</tbody>
</table>

13.7 High speed ground switch operation should be possible locally from the bay module control cabinet, or remotely from the control room in conjunction with opening of the associated disconnector.

13.8 These high speed grounding switches shall be electrically interlocked with their associated circuit breakers and disconnectors so that the grounding switches can not be closed if the circuit breakers and disconnectors are closed.

13.9 Interlocks shall be provided so that the insertion of the manual operating devices will disable the electrical control circuits.

13.10 Each high speed ground switch shall be fitted with auxiliary switches having six NO & six NC auxiliary contacts for use by others, over and above these required for local interlocking and position indication. All contacts shall be wired to terminal blocks in the local bay control cabinet. Provision shall be made for padlocking the ground switches in their open or closed position.

13.11 All portion of the grounding switches and operating mechanism required for connection to ground shall be connected together utilizing copper conductor having minimum cross-sectional area of 50 sq. mm.

13.12 The main grounding connection on each grounding switch shall be rated to carry the short time withstand current rating of the switch for 1 sec. and shall be equipped with a silver plated terminal connector suitable for steel strap of adequate design for connection to the grounding grid.

13.13 The high speed make proof grounding switches shall confirm to the requirements of IEC-62271-102.

13.14 The rated Induced Current and Voltage for earth switches for both electrostatic and electromagnetic coupling shall be as per IEC 62271-102.
Three Position Switches – Three position switches which have disconnector & earth switch may be used as an alternative to the fault making earth switches; circuit breakers may be used for the earthing. In such case adequate interlocking facilities shall be provided, subject to approval of DTL. The earth switches and disconnector shall employ motor operation mechanism. In addition, emergency hand operation shall be provided.

14.0 Instrument Transformers

14.1 Current Transformers

A) General:
   i) The current transformers and accessories shall conform to IEC: 60044-1 and other relevant standards except to the extent explicitly modified in the specification.
   ii) The particulars of the various cores may change within reasonable limits as per the requirements of protection relay supplier. The manufacturer is required to have these values confirmed from the purchaser before proceeding with design of the cores. The other characteristics of CTs shall be as given in TECHNICAL PARAMETER of Current Transformer.

B) Ratios and Characteristics

The number, rating, ratios, accuracy class, etc. for the individual current transformers secondary cores shall be in accordance with Table-IA.

Where multi-ratio current transformers are required the various ratios shall be obtained by changing the effective number of turns on the secondary winding.

C) Rating and Diagram Plates

Rating and diagram plates shall be as specified in the IEC specification incorporating the year of manufacture. The rated extended current rating voltage and rated thermal current shall also be marked on the name plate.

The diagram plates shall show the terminal markings and the relative physical arrangement of the current transformer cores with respect to the primary terminals (P1 & P2).

The position of each primary terminal in the current transformer section shall be clearly marked by two plates fixed to the enclosure at each end of the current transformer.

D) Constructional Details:

   a) The current transformers incorporated into the GIS will be used for protective relaying and metering. The secondary windings shall be air insulated/Gas insulated with terminals brought out for secondary connection. All the current transformers shall have effective electromagnetic shields to protect against high frequency transients.

   b) Each current transformer shall be equipped with a marshalling box with terminals for the secondary circuits, which are connected to the local control cubicle. The star/delta configuration and the inter connection to the line protection panels will be done at the CT terminal block located in the local control cubicle.

   c) Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

   c) The rated extended primary current shall be 150% at all ratios.

   e) The instrument security factor at all ratios shall be less than five (5) for metering core. ISF shall be verified without use of any auxiliary reactor.

   f) The wiring diagram, for the interconnections of the three single phase CTs shall be provided inside the marshalling box.

   g) The current transformers shall be suitable for high speed auto-reclosing.

   h) Provisions shall be made for primary injection testing either within CT or outside.
i) Electromagnetic shields to be provided against high frequency transients typically 1-30 MHz.

j) The bidder will take care for the compatibility of the CT vis-à-vis burden of relay and connecting leads, however for calculation purpose fault current may be taken as 31.5 kA for 33kV and secondary current may be calculated accordingly.

k) The output burden of cores shall be as table IA. However, burden of each core shall be finalized during detailed engineering.

14.2 Voltage Transformers

A) General
The voltage transformers shall conform to IEC- 60044-2 and other relevant standards except to the extent explicitly modified in the specification.

Voltage transformers shall be of the electromagnetic type. The earth end of the high voltage winding and the ends of the secondary winding shall be brought out in the terminal box.

B) Ratios and Characteristics
The rating, ratio, accuracy class, connection etc. for the voltage transformers shall be in accordance with Table II-A.

C) Rating and diagram plates
Rating and diagram plate shall be provided complying with the requirements of the IEC specification incorporating the year of manufacture and including turns ratio, voltage ratio, burden, connection diagram etc.

D) Secondary Terminals, Earthing and Fuses
The beginning and end of each secondary winding shall be wired to suitable terminals accommodated in a terminal box mounted directly on the voltage transformer section.

All terminals shall be stamped or otherwise marked to correspond with the marking on the diagram plate. Provision shall be made for earthing of the secondary windings inside the terminal box.

E) The transformer shall be able to sustain full line to line voltage without saturation of transformer.

The accuracy class will be at maximum tap.

F) Constructional Details of Voltage Transformers:

a) The voltage transformers shall be located in a separate module. The bus voltage transformer shall be with disconnector on the bus side & no disconnector is required for VT in other bays. The voltage transformers will be connected phase to ground and shall be used for protection, metering and synchronization.

b) The voltage transformers shall be of inductive type, nonresistant and, separated from other parts of installation. The voltage transformers shall be effectively shielded against high frequency electromagnetic transients. The voltage transformers shall have three secondary windings.

c) Voltage transformer’s secondary shall be protected by MCB for all the windings. In addition contacts shall be provided for the protection and metering windings for MCB monitoring scheme. The secondary terminals of the VT’s shall be terminated to the stud type non-disconnecting terminal blocks in the secondary boxes via MCB.

d) The voltage transformer should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens.

e) The accuracy of 0.2 on secondary III should be maintained throughout the entire burden range as per table IIA without any adjustments during operation. However, burden of each core shall be finalized during detailed engineering.
f) The diagram for the interconnection of the VTs shall be provided inside the marshalling box.

14.3 Tests
Current and voltage transformers shall conform to type tests and shall be subjected to routine test in accordance with IEC.

14.4 Technical Parameters:

14.4.1 Current Transformers

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>33kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Rated voltage Un</td>
<td>36kV (rms)</td>
</tr>
<tr>
<td>b)</td>
<td>Rated frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>c)</td>
<td>System neutral earthing</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td>d)</td>
<td>Rated short time thermal current</td>
<td>31.5 kA for 1 second</td>
</tr>
<tr>
<td>e)</td>
<td>Rated dynamic current</td>
<td>80 kAp</td>
</tr>
<tr>
<td>f)</td>
<td>Rated insulation levels</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i) 1.2/50 micro second impulse voltage</td>
<td>±170 kVp</td>
</tr>
<tr>
<td></td>
<td>ii) 1 Minute power frequency withstand voltage</td>
<td>70 kV (rms)</td>
</tr>
<tr>
<td>g)</td>
<td>One minute power frequency withstand voltage</td>
<td>5kV (rms)</td>
</tr>
<tr>
<td>h)</td>
<td>Maximum temperature rise over an ambient temperature of 400C</td>
<td>As per IEC 60044-1</td>
</tr>
<tr>
<td>i)</td>
<td>Radio interference voltage at 1.1 Un/√3 and frequency range 0.5 to 2 MHz</td>
<td>__</td>
</tr>
<tr>
<td>j)</td>
<td>Partial discharge level</td>
<td>__</td>
</tr>
</tbody>
</table>

14.4.2 Voltage Transformers

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Particulars</th>
<th>33 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Rated system voltage (Un)</td>
<td>36 kV (rms)</td>
</tr>
<tr>
<td>b)</td>
<td>Rated frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>c)</td>
<td>System neutral earthing</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td>d)</td>
<td>System fault level</td>
<td>31.5 kA for 1 second</td>
</tr>
<tr>
<td>e)</td>
<td>Rated insulation levels</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i) 1.2/50 micro second impulse voltage</td>
<td>±170 kVp</td>
</tr>
<tr>
<td></td>
<td>ii) 1 Minute power frequency withstand voltage</td>
<td>70 kV (rms)</td>
</tr>
<tr>
<td>f)</td>
<td>One minute power frequency withstand voltage</td>
<td>3kV (rms)</td>
</tr>
<tr>
<td>g)</td>
<td>Radio interference voltage at 1.1 Un/√3 and frequency range 0.5 to 2 MHz</td>
<td>__</td>
</tr>
<tr>
<td>h)</td>
<td>Rated total thermal burden</td>
<td>__</td>
</tr>
<tr>
<td>i)</td>
<td>Partial discharge level</td>
<td>__</td>
</tr>
</tbody>
</table>
15.0 **Incomer and Outgoing Connections**

There shall be provision to connect XLPE cables at incomer and outgoing feeders. The sizes of cable have been defined in the specifications. However, final size will be decided during detailed engineering. In addition, one set of each size of test bushing/plug shall also be provided for testing purpose.

16.0 **Surge Arrestors**

The surge arrestors shall confirm in general to latest IEC –60099-4.

16.1 **Insulation Co-ordination and Selection of Surge Arrestor**

The contractor shall be fully responsible for complete insulation co-ordination of switchyard including GIS. Contractor shall carry out detailed studies and design calculations to evolve the required parameters locations, energy capability etc. of surge arrestors such that adequate protective margin is available between peak impulse, surge and power frequency discharge voltages and BIL of the protected requirement. The locations of surge arrestors shown in single line diagram are indicative only. If the bidders feel that at some more locations the surge arrestors are required to be provided the same should also be included in the offer.

If distance between Surge Arrestor and transformer bushing terminal inclusive of head length is more than 60 m or 170 ft then one surge arrester shall be with GIS System and another shall be with transformer.

The contractor shall perform all necessary studies. The report shall detail the limits of all equipment parameters which could affect the insulation co-ordination the report shall also detail the characteristics of the surge arrester and shall demonstrate that the selected insulators protective and withstand levels, discharge and coordinating currents, and arrester ratings comply with the requirement of this specification.

The contractor shall also consider in the studies the open circuit breaker condition, fast transients generated by slow operation of disconnecting switches. The study report and design calculations shall be submitted for Employer’s approval.

16.2 **Duty Requirements**

a) The surge arrester shall be heavy duty station class and gapless (Metal oxide) type without any series or shunt gaps.

b) The surge arresters shall be capable of discharging over-voltages occurring during switching of unloaded transformers and long lines.

c) The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

d) The surge arresters are being provided to protect the followings whose insulation levels are indicated in the table given below:-

<table>
<thead>
<tr>
<th>Equipment to be protected</th>
<th>Lightning impulse (kVp) for 36 kV system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Transformer</td>
<td>+ 170</td>
</tr>
<tr>
<td>Instrument Transformer</td>
<td>+ 170</td>
</tr>
<tr>
<td>CB/Isolator Phase to ground</td>
<td>+ 170</td>
</tr>
<tr>
<td>Across open contacts</td>
<td>+ 195</td>
</tr>
</tbody>
</table>

16.3 **Constructional Features**

The nonlinear blocks shall be of sintered metal oxide material. These shall be provided in such a way as to obtain robust construction, with excellent mechanical and electrical properties even after repeated operations.
The arrestor enclosure shall be vertically or horizontally mounted to suit the layout of the switchgear as suggested by the manufacturer and shall be fitted with a discharge counter located in an easily accessible position.

The main grounding connection from the surge arrestor to the earth shall be provided by the bidder. The size of the connecting conductor shall be such that all the energy is dissipated to the ground without getting overheated.

16.4 **Fittings and Accessories for outdoor SA**

a) Self contained discharge counters, suitably enclosed and requiring no auxiliary or battery supply for operation shall be provided for each single pole unit. Suitable leakage current meters should also be supplied within the same enclosure. The reading of milli ammeter and counters shall be visible through an inspection glass panel.

b) Microprocessor based instrument for monitoring resistive current or wattloss of the arrester shall also be provided.

16.5 **Tests**

In accordance with the requirements stipulated the surge arrestors shall conform to type tests and shall be subjected to routine and acceptance tests in accordance with IEC document.

Each metal oxide block shall be tested for the guaranteed specific energy capability in addition to the routine/acceptance test as per IEC-60099.

**Test on Surge Monitors:**

The Surge monitors shall also be connected in series with the test specimens during residual voltage and current impulse withstands tests to verify efficacy of the same. Additional routine/functional tests with one 100A and 10 kA current impulse, (8/20 micro sec.) shall also be performed on the surge monitor.

16.6 **Parameters**

Following are the parameters generally adopted by Employer for their installations. These parameters are indicative and not binding. The actual parameters required for the installation shall be evolved by contractor.

**Surge Arrestor**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>33 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Rated system voltage</td>
<td>36 kV</td>
</tr>
<tr>
<td>b)</td>
<td>System neutral earthing</td>
<td>Effectively earthed</td>
</tr>
<tr>
<td>c)</td>
<td>Rated arrestor voltage</td>
<td>30 kV</td>
</tr>
<tr>
<td>d)</td>
<td>Nominal discharge current</td>
<td>10 kA of 8/20 micro second wave</td>
</tr>
<tr>
<td>e)</td>
<td>Rated frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>f)</td>
<td>Minimum discharge capability voltage corresponding to minimum discharge characteristics</td>
<td>__</td>
</tr>
<tr>
<td>g)</td>
<td>Continuous operating voltage at 500C</td>
<td>25 kV</td>
</tr>
<tr>
<td>h)</td>
<td>Min. switching surge residual voltage (1 kA)</td>
<td>__</td>
</tr>
<tr>
<td></td>
<td>Max. switching surge residual voltage (1 kA)</td>
<td>__</td>
</tr>
<tr>
<td>i)</td>
<td>Max. residual voltage at i) 5 kA</td>
<td>__</td>
</tr>
<tr>
<td></td>
<td>ii) 10 kA nominal discharge current</td>
<td>100kVp</td>
</tr>
<tr>
<td></td>
<td>iii) 20 kA nominal discharge current</td>
<td>__</td>
</tr>
<tr>
<td>j)</td>
<td>Long duration discharge class</td>
<td>3</td>
</tr>
<tr>
<td>k)</td>
<td>High current short duration test value (4/10 micro second wave)</td>
<td>100 kAp</td>
</tr>
<tr>
<td>l)</td>
<td>Current for pressure relief test</td>
<td>40 kA rms</td>
</tr>
<tr>
<td>m)</td>
<td>Pressure relief class:</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>n)</td>
<td>RIV at 1.1 Un/$\sqrt{3}$ kV rms (micro volts)</td>
<td>__</td>
</tr>
<tr>
<td>o)</td>
<td>Partial discharge at 1.05 COV</td>
<td>__</td>
</tr>
<tr>
<td>p)</td>
<td>Reference ambient temp.</td>
<td>50°C</td>
</tr>
<tr>
<td>q)</td>
<td>Steep current impulse voltage</td>
<td>110kVp</td>
</tr>
</tbody>
</table>

17.0 **33kV GIS cum Control Room Building**

a) The building shall house 33kV Gas Insulated Switchgear (GIS) and other associated equipments inside in the GIS building.

b) The bidder shall submit the design & construction proposal of the building along with necessary information, data, and drawings in the techno-commercial bid according to the complete requirements.

c) The bidder shall finalize the dimensions for 33kV GIS building according to the equipment offered by them providing enough space & access for erection, operation and maintenance.

18.0 **Seismic Design Criteria:**

The equipment shall be designed for operation in seismic zone for earthquake resistance. The seismic loads are due to the horizontal and vertical acceleration which may be assumed to act non concurrently. Seismic level Zone- IV, as per IS-1893, Year-2002 has to be considered for the design of equipment. The seismic loads shall be equal to static loads corresponding to the weight of the parts multiplied by the acceleration. The equipments along with its parts shall be strong enough and sufficiently well connected to resist total operating stresses resulting from the forces in normal operation but in case of abnormal condition shall also resist with forces superimposed due to earthquakes. The copies of type test reports for similar rated equipment, if tested earlier, should be furnished along with the tender. If the equipment has not been type tested earlier, design calculations of simulated parameters should be furnished along with the offer.

To prevent the movement of GIS sub assemblies i.e. various bay modules during the earthquake, suitable devices shall be provided for fixing the sub assemblies to the foundation. The contractor shall supply necessary bolts for embedding in the concrete foundation. The fixing of GIS sub assemblies to the foundation shall be designed to withstand the seismic events. It will also be ensured that the special devices as well as bolts shall not be over stressed. The details of the devices used and the calculations for establishing the adequacy shall be furnished by the supplier and shall be subject to the purchase’s approval.

19.0 **Partial Discharge Monitoring System & Dew Point Meter**

SF6 Gas Detector Meter, Portable P.D meter & Dew point meter shall be offered as per relevant schedule of BPS and shall be considered for evaluation of bid. The specifications are enclosed at Section-Special Equipment.

20.0 **Quality of SF6 Gas**

a) The SF6 gas insulated metal-clad switchgear shall be designed for use with SF6 gas complying with the recommendations of IEC 376, 376A & 376B, at the time of the first charging with gas. All SF6 gas supplied as part of the contract shall comply with the requirements of IEC as above as a minimum & should be suitable in all respects for use in the switchgear under all operating conditions.

b) The high pressure cylinders in which SF6 gas is supplied & stored at site shall comply with the requirements of following standards & regulations:

| IS: 4379  | Identification of the contents of industrial gas cylinders. |
| IS : 7311 | Seamless high carbon steel cylinders for permanent & high pressure liquefiable gases. The cylinders shall also meet Indian Boilers Regulations. (Mandatory) |

c) Test
SF6 gas shall be tested for purity, dew point, air, hydrolysable fluorides and water contents as per IEC:376, 376A & 376B and test certificates shall be furnished to the Employer indicating all test results as per IEC standards for each lot of SF6 gas. Further site tests for moisture, air content, flash point and dielectric strength to be done during commissioning of GIS. Gas bottles should be tested for leakage during receipt at site.

d) The bidder shall indicate diagnostic test methods for checking the quality of gas in the various sections during service. The method proposed shall, as a minimum check the moisture content & the percentage of purity of the gas on annual basis.

e) The bidder shall also indicate clearly the precise procedure to be adopted by maintenance personnel for handling equipment that are exposed to the products of arcing in SF6 Gas so as to ensure that they are not affected by possible irritants of the skin and respiratory system. Recommendations shall be submitted for suitable protective clothing, method of disposal of cleaning utensils and other relevant matters.

f) The bidder shall also indicate the details and type of filters used in various gas sections, and should also submit the operating experience with such filters.

21.0 SF6 Gas Monitoring Devices and Alarm Circuits

21.1 Dial type temperature compensated gas density or density monitoring devices with associated pressure gauge will be provided. The devices shall provide continuous & automatic monitoring of the state of the gas & a separate device shall be provided for each gas compartment so that each compartment can be monitored simultaneously as follows:-

1) Compartments except circuit breaker

   a) Gas Refill level

   This will be used to annunciate the need for the gas refilling. The contractor shall provide a contact for remote indication.

   b) 'Zone Trip' level

   This is the minimum level at which the manufacturer will guarantee the insulation rating of the assembly. Contacts shall be in accordance with requirement.

   The bidder should furnish temperature v/s pressure curves for each setting of density monitor along with details of the monitoring device.

   It shall be possible to test all gas monitoring relays/devices without de-energizing the primary equipment & without reducing pressure in the main section. Plugs & sockets shall be used for test purposes. It shall also damp the pressure pulsation while filling the gas in service, so that flickering of the pressure switch contacts does not take place.

21.2 a) Gas Leakage

   The maximum gas leakage shall not exceed 0.5% (half percent) per year for the whole equipment and for any individual gas compartment separately.

   b) Gas Supply

   The contractor shall include the supply of all SF6 gas necessary for filing & putting into operation the complete switchgear installation being supplied. In addition 20% of total gas requirement shall be supplied in separate cylinders as spare requirement, over & above the requirement of gas for successful commissioning. Pl. refer list of mandatory spares in this connection.

22.0 Gas Filling and Evacuating Plant

   All the plant necessary for filling and evacuating the SF6 gas in the switchgear shall be supplied with the contract to enable any maintenance work to be carried out. This shall include all the necessary gas cylinders for temporarily storing the evacuated SF6 gas. The capacity of the temporary storage facilities shall at least be sufficient for storing the maximum quantity of gas that could be removed when carrying out maintenance or repair work on the switchgear and associate equipment of at least one complete bay.
Where any item of the filling and evacuating plant is of such a weight that it cannot easily be carried by maintenance personnel, it shall be provided with lifting hooks for lifting and moving with the overhead cranes.

The capacity of the plant should be such that it is capable of excavation/filling of maximum quantity of gas contained in a compartment could be removed/filled within 30 minutes while carrying out maintenance/repair work.

The evacuation equipment shall be provided with all the necessary pipes, couplings, flexible tubes and valves for coupling up to the switchgear for filling or evacuating all the gases.

The gas compartments shall preferably be fitted with permanent non-return valves through which the gas is pumped into or evacuated from the compartments.

Details of the filling and evacuating plant that will be supplied, as well as the description of the filling and evacuating procedures shall be provided along with the bid.

23.0 SF6 GIS to XLPE Cable Termination

The 33kV underground cables are to be connected to 33kV GIS by the interfacing of XLPE cable sealing end to GIS Cable termination enclosure for making connection 2x3Cx 400 sq. mm 33kV XLPE cables. This interface section shall be designed in a manner which will allow ease of operation and maintenance. However, exact size of interfacing of cable will be finalized during detailed engineering.

The SF6 GIS to XLPE cable termination shall conform to IEC-859 (latest edition). The provision shall be made for a removable link. The gap created when the link is removed should have sufficient electric strength to withstand the switchgear high voltage site tests. The bidder may suggest alternative arrangements to meet these requirements. The corona rings/stress shields for the control of electrical field in the vicinity of the isolation gap shall be provided by the GIS manufacturer.

All supporting structures for the connections between the XLPE cable sealing ends and the GIS shall be supplied by the supplier. The supplier may specify alternative connecting & supporting arrangements for approval of the purchaser.

The opening for access shall be provided in each phase terminal enclosures as necessary to permit removal of connectors to isolate the XLPE cables to allow carrying out the insulation tests. The typical arrangement drawing of interconnecting cables from GIS bay module to XLPE cable termination end shall be submitted along with offer.

24.0 Transformer Termination Module

For 33kV system, the bidder could go bus duct/cable connection between the transformer and GIS to meet the system requirement.

25.0 Electric Overhead Crane (If Applicable)

EOT Crane of suitable capacity shall be provided for erection & maintenance of largest GIS component/assembly. The crane shall consist of all special requirements for erection & maintenance of GIS equipments.

The crane shall be possible to be operated through the cable & through the pendant control, which shall be easily accessible from the floor of GIS building.

EOT crane shall be supplied for 33KV GIS

26.0 Painting of Enclosure

All enclosures shall be painted externally as per manufacturer’s painting procedure. The painting procedures as followed shall be enclosed with the bid.
27.0 Heaters
Wherever required, heaters shall be provided to prevent moisture condensation. Heaters are not allowed inside the main circuit.

28.0 Identification & Rating Plate
i) Each bay shall have a nameplate showing
   a) A listing of the basic equipment from air entrance bushing to air entrance bushing (such as a breaker, disconnectors, grounding switches, current transformers, voltage transformers, and bushings).
   b) A schematic diagram indicating their relative locations.
   c) DTL Contract Number.
ii) Each module will have its own Identification & rating plate.
    The rating plate marking for each individual equipment like circuit breaker, disconnectors, grounding switches, current transformer, voltage transformers, surge arrester etc shall be as per their relevant IEC.
### TABLE-I-A
**REQUIREMENTS FOR 36kV CURRENT TRANSFORMER**

<table>
<thead>
<tr>
<th>No. of cores</th>
<th>Core no.</th>
<th>Application</th>
<th>Current ratio</th>
<th>Output Burden (VA)</th>
<th>Accuracy Class as Per IEC: 44-1</th>
<th>Min.Knee pt. Voltage Vk</th>
<th>Instrument security factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>METERING</td>
<td>*</td>
<td>10</td>
<td>0.2</td>
<td>-</td>
<td>Less than 5</td>
</tr>
<tr>
<td>2</td>
<td>PROTECTION/ O/C &amp; E/F</td>
<td>*</td>
<td>-</td>
<td>*</td>
<td>Vk&gt;K.I.(Rc+R)V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Back-up Protection</td>
<td>*</td>
<td>-</td>
<td>*</td>
<td>Vk&gt;K.I.(Rc+R)V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* NOTE:-
  
  i) All relaying CTs shall be of accuracy class PS as per IS: 2705
  
  ii) 33kV C.T. of ratio 2000/1-1-1 A for incoming from 100 MVA Trf. and for bus coupler.
  
  iii) 33kV C.T. ratio 800-400/1-1-1 A for feeder protection.

### TABLE-II-A
**REQUIREMENT OF 33kV VOLTAGE TRANSFORMERS**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>PARTICULARS</th>
<th>33 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Rated primary voltage</td>
<td>36/√3 kV</td>
</tr>
<tr>
<td>2.</td>
<td>Type</td>
<td>Electromagnetic</td>
</tr>
<tr>
<td>3.</td>
<td>No. of secondaries</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Rated voltage factor</td>
<td>1.2 continuous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.5-30 seconds</td>
</tr>
<tr>
<td>5.</td>
<td>Phase angle error</td>
<td>±20 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Rated voltage (V)</td>
<td>110/√3</td>
</tr>
<tr>
<td>7.</td>
<td>Application</td>
<td>Metering</td>
</tr>
<tr>
<td>8.</td>
<td>Accuracy</td>
<td>0.2</td>
</tr>
<tr>
<td>9.</td>
<td>Output burden (VA) (minimum)</td>
<td>50</td>
</tr>
</tbody>
</table>
SECTION : 3

GENERAL TECHNICAL REQUIREMENTS (GTR)

1.0  FOREWORD
1.1 The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other sections of tender documents and is not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

2.0  GENERAL REQUIREMENT
2.1 The bidders shall submit the technical requirements, data and information as per the technical data sheets provided in the Volume III of bid documents.
2.2 The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification.
2.3 It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different from those specified herein. Alternate proposals offering similar equipment based on the manufacturer’s standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser’s. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the specific requisite schedule, will not be considered as valid deviation.
2.4 Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures, makes shall be as defined in Section- Lighting System
2.5 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard/substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment provided, shall be inter-changeable with one another.

3.0  STANDARDS
3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.
3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the date of bid opening) of standard specified under Annexure-C of this section, unless specifically mentioned in the specification.
3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.
3.4 The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.
3.5 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
3.6 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified under Annexure-C/ individual sections for various equipments shall also, be accepted, however the salient points of difference shall be clearly brought out in additional information schedule of Vol III along with English language version of such standard. The equipment conforming to standards other than specified under Annexure-C/ individual sections for various equipments shall be subject to Purchaser’s approval.
3.7 The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

4.0  SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED
4.1 The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc under such over voltage conditions.
4.2 All equipments shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

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

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

4.5 The equipment shall also comply to the following:
   a) All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing.
   b) To facilitate erection of equipment, all items to be assembled at site shall be “match marked”.
   c) All piping, if any between equipment control cabinet/ operating mechanism to marshalling box of
      the equipment, shall bear proper identification to facilitate the connection at site.

4.6 Operating times of circuit breakers and protective relays have been specified in respective
   sections. However, the bidder is allowed to have minor variations on the individual equipment
   timings subject to the condition that overall fault clearing time remains within 160 milli seconds at
   220 kV level under comparable conditions.

4.7 EHV equipments and system shall be designed to meet the following major technical parameters
   as brought out hereunder.

4.7.1 System Parameter

<table>
<thead>
<tr>
<th>S. No</th>
<th>Description</th>
<th>220 kV System</th>
<th>66kV System</th>
<th>33 kV System</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>System operating voltage</td>
<td>220kV</td>
<td>66kV</td>
<td>33kV</td>
</tr>
<tr>
<td>2.</td>
<td>Rated frequency</td>
<td>50Hz</td>
<td>50Hz</td>
<td>50Hz</td>
</tr>
<tr>
<td>3.</td>
<td>No. of phase</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Rated Insulation levels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>i) Full wave impulse withstand</td>
<td>1050 kVp</td>
<td>325kVp</td>
<td>170 kVp</td>
</tr>
<tr>
<td></td>
<td>voltage (1.2/50µs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ii) One minute power frequency</td>
<td>460kV</td>
<td>140kV</td>
<td>80kV</td>
</tr>
<tr>
<td></td>
<td>dry and wet withstand voltage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(rms)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Corona extinction voltage</td>
<td>156kV</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6.</td>
<td>Max. radio Interference voltage</td>
<td>1000 µV</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>for frequency b/w 0.5MHz and 2 MHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>at 156kV rms for 220kV system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Minimum creepage distance</td>
<td>25 mm/kV</td>
<td>25 mm/kV</td>
<td>25 mm/kV</td>
</tr>
<tr>
<td></td>
<td>(6125 mm)</td>
<td>(1812.5 mm)</td>
<td>(900 mm)</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Min. clearances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>i) Phase to phase</td>
<td>2100mm</td>
<td>630mm</td>
<td>320mm</td>
</tr>
<tr>
<td></td>
<td>ii) Phase to earth</td>
<td>2100mm</td>
<td>630mm</td>
<td>320mm</td>
</tr>
<tr>
<td></td>
<td>iii) Sectional clearances</td>
<td>5000 mm</td>
<td>3000mm</td>
<td>3000mm</td>
</tr>
<tr>
<td></td>
<td>(These clearances are mentioned for air clearance)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Rated short circuit current for 1 sec. duration</td>
<td>40 kA</td>
<td>31.5kA</td>
<td>31.5 kA</td>
</tr>
<tr>
<td>10.</td>
<td>System neutral earthing</td>
<td>Effectively earthed</td>
<td>Effectively earthed</td>
<td>Effectively earthed</td>
</tr>
</tbody>
</table>

Note: The insulation and RIV levels of the equipments shall be as per values given in the respective chapter of the equipments.

4.7.2 Major Technical Parameters
   The major technical parameters of the equipments are given below. For other parameters and
   features respective technical sections should be referred.

(A)-I For 220/66/11 kV Power Transformer

<table>
<thead>
<tr>
<th>Description</th>
<th>220/66/11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage ratio (kV)</td>
<td>220/66/11</td>
</tr>
<tr>
<td>Rated frequency (Hz)</td>
<td>50</td>
</tr>
<tr>
<td>Max. Design Ambient Temp. (°C)</td>
<td>50</td>
</tr>
</tbody>
</table>

Windings | HV | IV | LV |
(i) System Fault level (kA) | 40 | 31.5 | 18.35  
(ii) 1.2/50 micro sec. impulse withstand voltage kVp ±1050 | ±325 | ±170  
(iii) One minute power frequency voltage kV(rms) ±460 | ±140 | ±70  
(iv) Winding connection | Star | Star | delta  
(v) Neutral | - Solidly grounded -  
(vi) Insulation | - Solidly grounded -  
(vii) Vector Group | - YN yn0 d11 -  

(A)-II For 220/33/11 kV Power Transformer  
Voltage ratio (kV) | 220/33/11  
Rated frequency (Hz) | 50  
Max. Design Ambient Temp. (°C) | 50  

<table>
<thead>
<tr>
<th>Windings</th>
<th>220kV</th>
<th>33kV</th>
<th>11kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) System Fault level (kA)</td>
<td>40</td>
<td>31.5</td>
<td>18.35</td>
</tr>
<tr>
<td>(ii) 1.2/50 µsec. impulse withstand voltage kVp</td>
<td>±1050</td>
<td>±170</td>
<td>±170</td>
</tr>
<tr>
<td>(iii) One minute power frequency voltage kV rms</td>
<td>±460</td>
<td>±70</td>
<td>±70</td>
</tr>
<tr>
<td>(iv) Winding connection</td>
<td>Star</td>
<td>Star</td>
<td>delta</td>
</tr>
</tbody>
</table>
| (v) Neutral | - Solidly grounded -  
| (vi) Insulation | - Solidly grounded -  
| (vii) Vector Group | - YN yn0 d11 -  

(B) For 245 kV, 72.5kV & 36kV Circuit Breaker and Isolator  

<table>
<thead>
<tr>
<th>Rated voltage kV (rms)</th>
<th>245</th>
<th>66</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated frequency (Hz)</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>No. of Poles</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Design ambient temperature (°C)</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

**Rated insulation levels:**  
1) Full wave impulse withstand voltage (1.2/50 µsec.)  
   - between line terminals and ground ± 1050 kVp | ±325 kVp | ±170 kVp  
   - between terminals with circuit breaker open ± 1200 kVp | ±375 kVp | ±195 kVp  
   - between terminals with isolator open ± 1200 kVp | ±375 kVp | ±195 kVp  
2) One minute power frequency dry and wet withstand voltage  
   - between line terminals and ground 460 kV (rms) | ±140 kVp | ±70kV (rms)  
   - between terminals with circuit breaker open 530 kV (rms) | As per IEC | As per IEC  
   - between terminals with Isolator open 530 kV (rms) | As per IEC | As per IEC  
3) Max. radio interference voltage (µV) | 1000 | - | - |  
   for frequency between 0.5 MHz and 2 MHz in all positions of the equipments.  
4) Minimum creepage distance :-  
   - Phase to ground (mm) | 6125 | 1812.5 | 900  
   - Between CB Terminals (mm) | 6125 | 1812.5 | 900  
5) System neutral earthing  
   - Effectively earthed  
6) Seismic acceleration | - 0.3g horizontal -  
7) Rating of Auxiliary Contacts | - 10 A at 220 V DC -  

Section 3 : GTR  
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8) Breaking capacity of Auxiliary contacts 2 A DC with circuit time constant of not less than 20 ms.

Auxiliary Switch shall also comply with other clauses of this chapter.

(C) FOR 245 kV, 72.5kV & 36kV CT/CVT/SA

<table>
<thead>
<tr>
<th>Rated voltage kV (rms)</th>
<th>245</th>
<th>72.5</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated frequency (Hz)</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>No. of poles</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Design ambient temperature (°C)</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

Rated insulation levels :
1) Full wave impulse withstand voltage (1.2/50 micro sec.)
   - between line terminals and ground ± 1050 kVp ±325 kVp ±170 kVp
   - for CT and CVT
   - for arrester housing ± 1050 kV peak ±325 kVp ±170 kVp
2) One minute power frequency dry and wet withstand voltage
   - between line terminals and ground ±460 kV rms ±140 kVp ±70 kV rms
   - for CT and CVT
   - for arrester housing ±460 kV rms ±140 kVp ±70 kV rms
3) Max. radio interference voltage (µV)
   - for CT/CVT 1000 for CT/CVT 500
   - for frequency between 0.5 MHz and 2 MHz in all positions of the equipment (at 156 kV rms)
   - 500 for SA
4) Minimum creepage distance :-
   - Phase to ground (mm) 6125 1812.5 900
5) System neutral earthing - Effectively earthed -
6) Seismic acceleration - 0.3g horizontal -
7) Partial discharge for :-
   - Surge arrester at 1.05 COV - Not exceeding 50 pc. -
   - for CT/CVT - Not exceeding 10 pc. -

(D) Technical Parameters of Bushings/Hollow Column insulators/support insulators:

<table>
<thead>
<tr>
<th>(a) Rated Voltage (kV)</th>
<th>220 kV</th>
<th>66kV</th>
<th>33 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>245</td>
<td>72.5</td>
<td>36</td>
</tr>
<tr>
<td>(b) Impulse withstand voltage (Dry &amp; Wet) (kVp)</td>
<td>±1050</td>
<td>±325</td>
<td>±170</td>
</tr>
<tr>
<td>(c) Power frequency withstand voltage (dry and wet) (kV rms)</td>
<td>±460</td>
<td>±140</td>
<td>±70</td>
</tr>
<tr>
<td>(d) Total creepage distance (mm)</td>
<td>6125</td>
<td>1812.5</td>
<td>900</td>
</tr>
<tr>
<td>(e) Pollution Class-III Heavy (as per IEC 71) and as specified Section-2 for all class of equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) Insulator shall also meet requirement of and IEC-815 for 220 kV system, as applicable having alternate long &amp; short sheds.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.0 ENGINEERING DATA AND DRAWINGS

5.1 The engineering data shall be furnished by the Contractor in accordance with the Schedule for each set of equipment as specified in the Technical Specifications.

5.2 The list of drawings/documents which are to be submitted to the Purchaser shall be discussed and finalised by the Purchaser at the time of award. The Contractor shall necessarily submit all the drawings/documents unless anything is waived. The Contractor shall submit 4 (four) sets of drawings/design documents/data/test reports as may be required for the approval of the Purchaser.
5.3 Drawings

5.3.1 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.

5.3.2 Each drawing submitted by the Contractor shall be clearly marked with the name of the Purchaser, 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.

5.3.3 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 Purchaser, if so required.

5.4 The review of these data by the Purchaser will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Purchaser 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 purchaser 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.

5.5 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 Purchaser. Approval of Contractor’s drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

5.6 All engineering data submitted by the Contractor after final process including review and approval by the Purchaser 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 Purchaser in Writing.

5.7 Approval Procedure

The scheduled dates for the submission of the drawings as well as for, any data/information to be furnished by the Purchaser would be discussed and finalised at the time of award. The following schedule shall be followed generally for approval and for providing final documentation.

i) Approval/comments by Purchaser on initial submission
   As per agreed schedule

ii) Resubmission (whenever from date of Comments required including both ways postal time).
    Within 3 (three) weeks

iii) Approval or comments
     Within 3 weeks of receipt of resubmission.

iv) Furnishing of distribution copies in bound volume (5 copies per substation and one copy for Corporate Centre)
    2 weeks from the date of final approval

v) Furnishing of distribution copies of test reports

(a) Type test reports (one copy per substation plus one copy for corporate centre)
    2 weeks from the date of final approval

(b) Routine Test Reports (one copy for each substation)
    -do
vi) Furnishing of instruction/ operation manuals (4 copies per substation and two copies for corporate centre) As per agreed schedule

vii) RTFs of drawings (one set substation and one set for corporate centre) -do

(viii) Video Cassette (VHS-PAL) - highlighting installation and maintenance techniques/ requirements of circuit breaker & isolators (one per substation plus one for corporate centre) -do

(ix) As built drawings & RTFs (Two sets per substation plus one set for corporate centre) On completion of entire works

(x) ROM optical disks for all As built drawings (one per substation plus one for corporate) -do

NOTE:
(1) The contractor may please note that all resubmissions must incorporate all comments given in the earlier submission by the Purchaser or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

(2) The drawings which are required to be referred frequently during execution should be submitted on cloth lined paper. The list of such drawings shall be finalised with the Contractor at the time of Award.

(3) All major drawings should be submitted in Auto Cad Version 12 or better.

(4) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

(5) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Purchaser.

(6) The Contractor shall furnish to the Purchaser catalogues of spare parts.

5.8 The list of major drawings and General Technical Parameters shall be as per Annexure – D.

6.0 MATERIAL/ WORKMANSHIP

6.1 General Requirement

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

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

6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the
component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads.

The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

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

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

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

6.1.7 All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

6.1.8 A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of design with pads for anchoring the units, shall have a raised up all around and shall have threaded in air connections, if so required.

6.1.9 Corona and radio interference voltage test and seismic withstand test procedures for equipments shall be in line with the procedure given at Annexure-A and B respectively.

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

6.2.1 Space Heaters
6.2.1.1 The heaters shall be suitable for continuous operation at 240 V as supply voltage. On-off switch and fuse shall be provided.

6.2.1.2 One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

6.2.1.3 Suitable anti condensation heaters with the provision of thermostat shall be provided.

6.2.2 FUNGI STATIC VARNISH
Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of
nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

6.2.3 Ventilation opening
Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air / dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

6.2.4 Degree of Protection
The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

a) Installed out door: IP- 55  
b) Installed indoor in air conditioned area: IP-31  
c) Installed in covered area: IP-52  
d) Installed indoor in non air conditioned area where possibility of entry of water is limited: IP-41.  
e) For LT Switchgear (AC & DC distribution Boards) : IP-52  
The degree of protection shall be in accordance with IS:13947 (Part-I)/ IEC-947 (Part-I)/ IS 12063 / IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS
6.3.1 Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

6.3.2 All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators and C & R panels shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

6.4 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS
All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into successful Operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

7.0 DESIGN IMPROVEMENTS / COORDINATION
7.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the Purchaser or the Contractor may propose changes in the specification of the equipment or quality thereof and if the Purchaser & contractor agree upon any such changes, the specification shall be modified accordingly.

7.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

7.3 The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, subassemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

7.4 The Contractor has to coordinate designs and terminations with the agencies (if any) who are Consultants/Contractor for the Purchaser. The names of agencies shall be intimated to the successful bidders.
7.5 The Contractor will be called upon to attend design co-ordination meetings with the Engineer, other Contractor’s and the Consultants of the Purchaser (if any) during the period of Contract. The Contractor shall attend such meetings at his own cost at New Delhi or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

8.0 QUALITY ASSURANCE PROGRAMME

8.1 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 Purchaser’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 finalised after discussions before the award of contract. The detailed programme shall be submitted by the contractor after the award of contract and finally accepted by DTL after discussion. However, in case detailed valid programme approved by DTL for the equipment already exist, same would be followed till its validity. A quality assurance programme of the contractor shall generally cover the following:

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

The Purchaser or his duly authorised 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.

8.2 Quality Assurance Documents

The contractor would be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of purchaser’s inspection of equipment/material.

9.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

9.1 All equipment being supplied shall conform to type tests including additional type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Purchaser reserves the right to witness any or all the type tests. The Contractor shall intimate the Purchaser the detailed program about the tests atleast three (3) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

9.2 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 DTL or Utility. The test reports submitted shall be of the tests conducted within last 5 (five) years prior to the date of bid opening. In case the test reports are of the test conducted earlier than 5 (five) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to the purchaser.
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 Purchaser.

9.3 The Purchaser intends to repeat the type tests and additional type tests on transformers, cables and battery chargers for which test charges shall be payable as per provision of contract. The price of conducting type tests and additional type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal Sheets. These Type test charges would be considered in bid evaluation. In case Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected.

9.3.1 The bidder is required to quote the Type Test charges for various items as specified in the relevant schedule of the Price schedule, in line with the provisions of technical specification and same shall be considered for the purpose of evaluation of bids.

9.4 The Purchaser, his duly authorised representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractor/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 authorised 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, despatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

9.5 The Contractor shall give the Purchaser /Inspector thirty (30) days written notice of any material being ready for joint testing including contractor and DTL. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Purchaser / 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.

9.6 The Purchaser 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 Purchaser /Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

9.7 When the factory tests have been completed at the Contractor’s or Sub-Contractor’s works, the Purchaser/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 Purchaser /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 Purchaser /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 Purchaser 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 CIP by the Purchaser.

9.8 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 Purchaser /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser /Inspector or to his authorised representative to accomplish testing.
9.9 The inspection by Purchaser 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.

9.10 The Purchaser 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.

9.11 The Purchaser 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 equipments for these tests shall be provided by the Purchaser.

10. TESTS

10.1 Pre-commissioning Tests
On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Purchaser 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 are given in respective chapters and shall be included in the Contractor’s quality assurance programme.

10.2 Commissioning Tests
10.2.1 The testing equipments required for testing and commissioning shall be arranged by the Contractor.
10.2.2 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.
10.3 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by DTL on production of requisite documents.

11.0 PACKAGING & PROTECTION
11.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Purchaser, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Purchaser to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Purchaser takes no responsibility of the availability of the wagons.

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

12.0 FINISHING OF METAL SURFACES
12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & bolts and spring washers shall be electro galvanized to service condition 4. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

12.2 HOT DIP GALVANISING
12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq. m and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

12.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The
presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

12.2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

12.2.4 The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

12.3 PAINTING
12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 “Code of practice for phosphating iron and sheet”. All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

12.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be “flash dried” while the second coat shall be stoved.

12.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

12.3.4 The exterior colour of the paint shall be as per shade no: 697 (for outdoor) & 692 (for indoor) of IS-5 and inside shall be glossy white for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

12.3.5 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted alongwith the Bids for Purchaser’s review & approval.

12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

<table>
<thead>
<tr>
<th>S.No</th>
<th>PIPE LINE</th>
<th>Base colour</th>
<th>Band colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hydrant and Emulsifier system pipeline</td>
<td>FIRE RED</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Emulsifier system detection line water</td>
<td>FIRE RED</td>
<td>Sea Green</td>
</tr>
<tr>
<td>3</td>
<td>Emulsifier system detection line Air</td>
<td>FIRE RED</td>
<td>Sky Blue</td>
</tr>
<tr>
<td>4</td>
<td>Pylon support pipes</td>
<td>FIRE RED</td>
<td></td>
</tr>
</tbody>
</table>
Air Conditioning System

<table>
<thead>
<tr>
<th></th>
<th>Refrigerant gas pipeline – at compressor suction</th>
<th>Canary Yellow</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Refrigerant gas pipeline – at compressor discharge</td>
<td>Canary Yellow</td>
<td>Red</td>
</tr>
<tr>
<td>6</td>
<td>Refrigerant liquid pipeline</td>
<td>Dark Admiralty Green</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Chilled water pipeline</td>
<td>Sea Green</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Condenser water pipeline</td>
<td>Sea Green</td>
<td>Dark Blue</td>
</tr>
</tbody>
</table>

The direction of flow shall be marked by → (arrow) in black colour.

**Base Colour Direction of flow Band Colour**

13.0 **HANDLING, STORING AND INSTALLATION**

13.1 In accordance with the specific installation instructions as shown on manufacturer’s drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

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

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

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

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

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

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

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

13.9 The words ‘erection’ and ‘installation’ used in the specification are synonymous.
13.10 Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

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

13.12 Equipment Bases
A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

14.0 TOOLS AND TACKLES
The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

15.0 AUXILIARY SUPPLY
15.1 The sub-station auxiliary supply is normally met through a system indicated under section “Electrical & Mechanical Auxiliaries” having the following parameters. The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation shall also conform the parameters as indicated in the following.

<table>
<thead>
<tr>
<th>Normal Voltage connection</th>
<th>Variation in Voltage</th>
<th>Frequency in HZ</th>
<th>Phase/Wire</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>415V</td>
<td>+/- 10%</td>
<td>50 +/- 5%</td>
<td>3/4 Wire</td>
<td>Solidly Earthed</td>
</tr>
<tr>
<td>240V</td>
<td>+/- 10%</td>
<td>50 +/- 5%</td>
<td>1/2 Wire</td>
<td>Solidly Earthed</td>
</tr>
<tr>
<td>220V</td>
<td>190V to 240V</td>
<td>DC</td>
<td></td>
<td>Isolated 2 wire System</td>
</tr>
<tr>
<td>50V</td>
<td></td>
<td>DC</td>
<td></td>
<td>2 wire system (+) earthed</td>
</tr>
</tbody>
</table>

Combined variation of voltage and frequency shall be limited to +/-10%.

16.0 SUPPORT STRUCTURE
The Contractor is required to supply standard structures of various equipments. Bidder may also refer relevant Clauses of Section (Civil) in this regard.

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS
17.1 All power clamps and connectors shall conform to IS:5561 & NEM CC1 and shall be made of materials listed below:

a) For connecting ACSR conductors
   Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617

b) For connecting equipment terminals made of copper with ACSR conductors
   Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS 617 with 2mm thick bimetallic liner and all test shall conform to IS:617

c) For connecting G.I wire
   Galvanised mild steel shield
i) Bolts, nuts & Plain, washers
ii) Spring washers for items ‘a’ to ‘c’

i) Electrogalvanised for sizes below M12, for others hot dip galvanised.
ii) Electro-galvanised mild steel suitable for atleast service condition-3 as per IS:1573

17.2 Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor terminations of equipment shall be either expansion, sliding or rigid type suitable for 4” IPS (OD : 114.2 mm, ID: 97.18 mm) aluminum tube or suitable for Quad/Twin ACSR / AAAC Conductor (250 mm Sub-Conductor spacing for 220 kV). The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

17.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Purchaser by the Contractor.

17.4 Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.

17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body for Bi-metallic clamps.

17.6 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blured and rounded off.

17.7 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 4” IPS AL. tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.

17.8 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.

17.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

17.10 Clamps and connectors shall be designed to be corona controlled. Corona extinction voltage for 220 kV class clamps shall not be less than 156 kV and R.I.V. level shall not be more than 1000 micro volts at the test voltage specified in respective sections.

17.11 Tests

17.11.1 Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports on three samples of similar type shall be submitted for approval as per clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last five years shall not be applicable).

i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)
ii) Short time current test
iii) Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)
iv) Resistance test and tensile test
18.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

18.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-439, as applicable, and the clauses given below:

18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

18.3 Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.

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

18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged/cracked during the ten years of operation of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

18.6 All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

18.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

18.8 For illumination of a 20 Watts flourscent tube or 15 watts CFL shall be provided. The switching of the fittings shall be controlled by the door switch.

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

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

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

18.12 a) The following routine tests alongwith the routine tests as per IS:5039 shall also be conducted:
   i) Check for wiring
   ii) Visual and dimension check
   b) The enclosure of bay marshalling kiosk, junction box, terminal box shall conform to IP-55 as per IS:13947 including application of, 2.5 KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.
19.0 **Auxiliary Switches (Applicable for isolators and circuit breakers)**

The following type test reports on auxiliary switches shall be submitted for approval:

(a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual defects/temperature rise test.

(b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.

(c) Heat run test on contacts.

(d) IR/HV test etc.

20.0 **TERMINAL BLOCKS AND WIRING**

20.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.

20.2 Terminal blocks shall be 650 V grade and have continuous rating to carry the maximum expected current on the terminals. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wago or equivalent.

20.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

20.4 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.

20.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.

20.6 The terminal blocks shall be of extensible design.

20.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

20.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating 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.

20.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

   a) All circuits except Minimum of two of 2.5 sq mm CT circuits copper flexible.
   
   b) All CT circuits Minimum of 4 nos. of 2.5 sq mm copper flexible.

20.10 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.

20.11 Atleast 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

20.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

20.13 The Contractor shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.

20.14 All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.
21.0 LAMPS AND SOCKETS

21.1 Lamps
All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

21.2 Sockets
All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

21.3 Hand Lamp:
A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

21.4 Switches and Fuses:
21.4.1 Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

21.4.2 All fuses shall be of HRC cartridge type conforming to IS: 9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

22.0 Bushings, Hollow Column Insulators, Support Insulators:

22.1 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 5621. The support insulators shall be manufactured and tested as per IS 2544/IEC 168 and IEC 273. The insulators shall also conform to IEC 815 as applicable. The bidder may also offer composite silicon insulator, conforming to IEC-61109.

22.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

22.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

22.4 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.

22.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

22.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and 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.

22.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up 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.

22.8 Tests
In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS: 2544 & IS : 5621. The type test reports shall be submitted for approval.
23.0 Motors
Motors shall be “Squirrel Cage” three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

23.1 Enclosures
a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP 55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP 44 as per IS: 4691.
b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs other means to facilitate lifting.

23.2 Operational Features
a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

23.3 Starting Requirements:
 a) All induction motors shall be suitable for full voltage direct-online starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
c) The locked rotor current shall not exceed six (6) times the rate full load current for all motors, subject to tolerance as given in IS: 325.
d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.
e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

23.4 Running Requirements:
a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS: 325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

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

(a) Insulation resistance.
(b) Phase sequence and proper direction of rotation.
(c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

24.0 TECHNICAL REQUIREMENT OF EQUIPMENTS

24.1 Circuit Breakers
a. The manufacturer(s) whose Circuit Breaker are offered should have designed, manufactured tested as per IEC/IS or equivalent standard supplied the same for the specified system voltage and which are in satisfactory operation for at least 2 (two) years as on the date of bid opening.

Or

b. The manufacturer(s) whose Circuit Breaker are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 24.1.a given above.

And
Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And
Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

24.2 Isolators
The manufacturer whose isolators are offered, should have designed, manufactured, tested as per IEC/IS or equivalent standard and supplied the isolator for the specified system voltage and fault level and should be in satisfactory operation for at least 2 (two) years as on the date of bid opening.

24.3 Instrument Transformers
The manufacturer whose instrument transformers are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the same for the specified system voltage for CT & CVT and fault level in case of CT. These equipment should be in satisfactory operation for at least 2 (two) years as on the date of bid opening.

24.4 Surge Arresters
The manufacturer whose Surge Arresters are offered should have designed, manufactured and tested as per IEC/IS or equivalent standard and supplied the Surge Arrester for the specified energy capability with rated system voltage and which are in satisfactory operation for at least 2 (two) years as on the date of bid opening.

24.5 1.1 kV Grade Power & Control Cables
24.5.1 Applicable for PVC Control Cable
The manufacturers, whose PVC control cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 Kms of 1.1 kV grade PVC insulated control cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 27C x 2.5 Sq.mm or higher size as on the date of bid opening.

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

24.5.3 Applicable for XLPE Power Cables
The Manufacturer, whose XLPE Power cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 25 Kms of 1.1 kV or higher grade XLPE insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 630 Sq. mm or higher size as on the date of bid opening.
24.6  LT Switchgear
24.6.1  The Manufacturer whose LT Switchgear are offered, should be a manufacturer of LT Switchboards of the type and rating being offered. He should have designed, manufactured, tested and supplied at least 50 nos. draw out circuit breaker panels, out of which at least 5 nos. should have been with relay and protection schemes with current transformer. He should have also manufactured at least 50 nos. motor control center panels of the type and rating being offered which should be in successful operation as on date of bid opening.

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

24.7  Battery and Battery Charger

24.7.1  Requirements for Battery Manufacturers  
The manufacturer whose Batteries are offered should have designed, manufactured and supplied DC Batteries of the type specified and being offered, having a capacity of at least 600 AH and these shall be operating satisfactorily for two years in power sector and/or industrial installations as on date of bid opening.

24.7.2  Requirements for Battery Charger Manufacturers  
The manufacturer, whose Battery Chargers are offered, should have designed, manufactured and supplied Battery Chargers generally of the type offered, with static automatic voltage regulators and having a continuous output of atleast ten (10) KW and these should be in successful as on the date of bid opening.

24.8  LT Transformers  
The manufacturer, whose transformers are offered should have designed, manufactured, type tested including short circuit test as per IEC/IS or equivalent standards and supplied transformers of at least 33 kV class of 800 kVA or higher. The transformer should have been in successful operation for at least 2 years as on the date of bid opening.

24.9  Fire Fighting System  
Nitrogen Injection Fire Prevention and Extinguishing System shall be used for fire protection of Transformer. In addition fire protection wall shall be erected between the two transformers which have adjacent base. Portable Fire Extinguishers shall also be provided. The manufacturer whose NIFPES are offered, should have a minimum experience of five years in the design, manufacturing, erection, testing and commissioning of nitrogen injection fire protection, system on power transformers of similar or higher rating. At least 6 sets of the system shall be in successful operation on power transformers on similar & higher ratings with at least three different organizations for a minimum period of 2 years.

24.10  Control and Relay Panels  
24.10.1 The manufacturer whose C&R panels and protective relay are offered should have designed, manufactured, tested, installed and commissioned C&R panels including protection relays which must be in satisfactory operation on 220 kV system for atleast 2 (two) years on the date of bid opening.

24.10.2 The C&R Panel from a manufacturer whose have designed, manufactured, tested, installed and commissioned C&R panels which are in satisfactory operation on 220 kV system for atleast 2 (two) years on the date of bid opening can also be offered, provided the protective relay schemes should be offered from a Contractor who fully meets the requirements stipulated under clause 24.10.1 above. Further, in such an event the manufacturer shall furnish an undertaking jointly executed by him and his protective relay schemes Supplier, as per the format enclosed in the bid documents for successful performance of the protection system offered.

...
ANNEXURE-A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General
Unless otherwise stipulated, all equipment (except Auto Transformer) together with its associated connectors, where applicable, shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV).

2. Test Levels:
The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3. Test Methods for RIV:
3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 Mhz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 220 kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4.0 Test Methods for Visible Corona
The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130% of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 130 %, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, 115% and 130%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall been such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.
4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.

4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser’s inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser’s inspector if, in his opinion, it will not prejudice other test.

5. **Test Records:**
   In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

   a) Background noise before and after test.
   b) Detailed procedure of application of test voltage.
   c) Measurements of RIV levels expressed in micro volts at each level.
   d) Results and observations with regard to location and type interference sources detected at each step.
   e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
   f) Onset and extinction of visual corona for each of the four tests required shall be recorded.
SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (except Auto Transformer) shall be carried out along with supporting structure. The Bidder shall arrange to transport the structure from his Contractor’s premises/DTL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Purchaser.
**ANNEXURE - C**

**LIST OF SPECIFICATIONS**

**GENERAL STANDARDS AND CODES**

India Electricity Rules  
Indian Electricity Act  
Indian Electricity (Supply) Act  
Indian Factories Act  

IS-5, - Colors for Ready Mixed Paints and Enamels.  
IS-335, - New Insulating Oils.  
IS-617, - Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes  
IS-1448 (P1 to P 145) - Methods of Test for Petroleum and its Products.  
IS-2071 (P1 to P3) - Methods of High Voltage Testing.  
IS-12063 - Classification of degrees of protection provided by enclosures of electrical equipment.  
IS-2165 P1:1997 - Insulation Coordination.  
P2:1983  
IS-3043 - Code of Practice for Earthing  
IS-6103 - Method of Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids  
IS-6104 - Method of Test for Interfacial Tension of Oil against Water by the Ring Method  
IS-6262 - Method of test for Power factor & Dielectric Constant of Electrical Insulating Liquids.  
IS-6792 - Method for determination of electric strength of insulating oils.  
IS-8263 - Methods for Radio Interference Test on High voltage Insulators.  
IS-9224 (Part 1,2&4) - Low Voltage Fuses  
IEC-60060 (Part 1 to P4) - High Voltage Test Techniques  
IEC 60068 - Environmental Test  
IEC-60117 - Graphical Symbols  
IEC-60270, - Partial Discharge Measurements.  
IEC-60865 (P1 & P2) - Short Circuit Current - Calculation of effects.  
ANSI-C.1/NFPA.70 - National Electrical Code  
ANSI-C63.21, - Specification for Electromagnetic Noise and  
C63.3 - Field Strength Instrumentation 10 KHz to 1 GHZ  
C36.4ANSI-C68.1 - Techniques for Dielectric Tests  
ANSI-C76.1/EIE21 - Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings.  
ANSI-SI-4 - Specification for Sound Level Metres  
ANSI-Y32-2/C337.2 - Drawing Symbols
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### TRANSFORMERS AND REACTORS

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<td>Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres.</td>
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### CIRCUIT BREAKERS

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CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS

IS-722, IS-1248, IS-3231 (P-3) - Electrical relays for power system protection
IS-5039 - Distributed pillars for Voltages not Exceeding 1000 Volts.
IEC-6068.2.2 - Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-60529 - Degree of Protection provided by enclosures.
IEC-60947-4-1 - Low voltage switchgear and control gear.
IEC-61095 - Electromechanical Contactors for household and similar purposes.
IEC-60439 (P1 & 2) - Low Voltage Switchgear and control gear assemblies
ANSI-C37.20 - Switchgear Assemblies, including metal enclosed bus.
ANSI-C37.50 - Test Procedures for Low Voltage Alternating Current Power Circuit Breakers

ANSl-C39 - Electric Measuring instrument
ANSl-C83 - Components for Electric Equipment
IS: 8623: (Part I to 3) - Specification for Switchgear & Control Assemblies.
NEMA-AB - Moulded Case Circuit and Systems
NEMA-CS - Industrial Controls and Systems
NEMA-PB-1 - Panel Boards
NEMA-SG-5 - Low voltage Power Circuit breakers
NEMA-SG-3 - Power Switchgear Assemblies
NEMA-SG-6 - Power switching Equipment
NEMA-SG6 - Power switching equipment
1248 (P1 to P9) - Direct acting indicating analogue electrical measuring instruments & their accessories.

Disconnecting switches

IEC-60129 - Alternating Current Disconnectors (Isolators) and Earthing switches
IEC-1129 - Alternating Current Earthing Switches Induced Current switching
IEC-60265 (Part 1 & Part 2) - High Voltage switches
ANSI-C37.32 - Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories
ANSI-C37.34 - Test Code for high voltage air switches
NEMA-SG6 - Power switching equipment

PLCC and line traps

IS-8792 - Line traps for AC power system.
IS-8793 - Methods of tests for line traps.
IS-8997 - Coupling devices for PLC systems.
IS-8998 - Methods of test for coupling devices for PLC systems.
IEC-60353 - Line traps for A.C. power systems.
IEC-60481 - Coupling Devices for power line carrier systems.
IEC-60495 - Single sideboard power line carrier terminals
IEC-60683 - Planning of (single Side-Band) power line carrier systems.
CIGRE - Teleprotection report by Committee 34 & 35.
CCIR - International Radio Consultative Committee
CCITTT - International Telegraph & Telephone Consultative Committee
EIA - Electric Industries Association

Protection and control equipment

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

**MOTORS**
IS-325 - Three phase induction motors.
IS-4691 - Degree of protection provided by enclosure for rotating electrical machinery.
IEC-60034 (P1 to P19:) - Three phase induction motors (Central Office) NEMA-MGI Motors and Generators

**Electronic equipment and components**
MIL-21B, MIL-833 & MIL-2750 - Environmental testing
IEC-60068 (P1 to P5) - Printed boards Material and workmanship standards
IEC-60068 (P1 to P5) - Printed boards Material and workmanship standards
IEC-60326 (P1 to P2) - Hexagon headbolts, screws and nuts of product grade C.
IS-1363 (P1 to P3) - Hexagon head bolts, screws and nuts of grades A and B.
IS-1364 (P1 to P5) - Hexagonal Bolts and Nuts (M42 to M150)
ISO-898 - Fasteners: Bolts, screws and studs
ASTM - Specification and tests for materials

**Clamps & connectors**
IS-5561 - Electric power connectors.
NEMA-CC1 - Electric Power connectors for sub station
NEMA-CC 3 - Connectors for Use between aluminium or aluminum- Copper Overhead Conductors

**Bus hardware and insulators**
IS: 2121 - Fittings for Aluminum and steel cored Al conductors for overhead power lines.
IS-731 - Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V.
IS-2486 (P1 to P4) - Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V.
IEC-60120 - Dimensions of Ball and Socket Couplings of string insulator units.
IEC-60137 - Insulated bushings for alternating voltages above 1000 V.
IEC-60168 - Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V.
IEC-60233 - Tests on Hollow Insulators for use in electrical equipment.
IEC-60273 - Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
IEC-60305 - Insulators for overhead lines with nominal voltage above 10000V-ceramic or glass insulator units for a.c. systems Characteristics of String Insulator Units of the cap and pintype.
IEC-60383 (P1 and P2) - Insulators for overhead lines with a nominal
IEC-60433 - Characteristics of string insulator units of the long rod type.
IEC-60471 - Dimensions of Clevis and tongue couplings of string insulator units.
ANSI-C29 - Wet process procelain insulators
ANSI-C29.1 - Test methods for electrical power insulators
ANSI-C29.2.2 - For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8 - For wet-process porcelain insulators apparatus, post-type
ANSI-G.8 - Iron and steel hardware
CISPR-7B - Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153 - Zinc Coating (Hot-Dip) on iron and steel hardware

Strain and rigid bus-conductor

IS-2678 - Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube.
IS-5082 - Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical purposes.
ASTM-B 230-82 - Aluminum 1350 H19 Wire for electrical purposes conductors
ASTM-B 231-81 - Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221 - Aluminum - Alloy extruded bar, road, wire, shape
ASTM-B 236-83 - Aluminum bars for electrical purpose (Busbars)
ASTM-B 317-83 - Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)

Batteries and batteries charger Battery

IS:1651 - Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652 - Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146 - Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071 - Synthetic Separators for Lead-Acid Batteries
IS:266 - Specification for Sulphuric Acid
IS:1069 - Specification for Water for Storage Batteries
IS:3116 - Specification for Sealing Compound for Lead-Acid Batteries
IS:1248 - Indicating Instruments

Battery Charger

IS:3895 - Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS:4540 - Mono-crystalline Semiconductor Rectifier Assemblies and Equipment.
IS:6619 - Safety Code for Semiconductor Rectifier Equipment
IS:2026 - Power Transformers
IS:2959 - AC Contactors for Voltages not Exceeding 1000 Volts
IS:1248 - Indicating Instruments
IS:2208 - HRC Fuses
IS:13947 (Part-3) - Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC
IS:2147 - Degree of protection provided by enclosures for low voltage switchgear and controlgear.
IS:6005 - Code of practice for phosphating of Iron and Steel
IS:3231 - Electrical relays for power system protection
IS:3842 - Electrical relay for AC Systems
IS:5 - Colours for ready mix paint
IEEE-484 - Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations.
IEEE-485 - Sizing large lead storage batteries for generating stations and substations

Wires and cables
ASTMD-2863  - Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)

IS-694  - PVC insulated cables for working voltages upto and including 1100 Volts.

IS-1255  - Code of practice for installation and maintenance of power cables, upto and including 33 kV rating

IS-1554 (P1 and P2)  - PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V.
   - Part (2) for working voltage from 3.3 kV upto and including 11kV.

IS:1753  - Aluminium conductor for insulated cables

IS:2982  - Copper Conductor in insulated cables.

IS-3961 (P1 to P5)  - Recommended current ratings for cables.

IS-3975  - Mild steel wires, formed wires and tapes for armouring of cables.

IS-5831  - PVC insulating and sheath of electric cables.

IS-6380  - Elastometric insulating and sheath of electric cables.

IS-7098  - Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts.

IS-7098  - Cross-linked polyethylene insulated PVC sheathed cables for working voltage from 3.3kV upto and including 33 kV.

IS-8130  - Conductors for insulated electrical cables and flexible cords.

IS-1753  - Aluminum Conductors for insulated cables.

IS-10418  - Specification for drums for electric cables.

IEC-60096 (part 0 to p4)  - Radio Frequency cables.

IEC-60183  - Guide to the Selection of High Voltage Cables.

IEC-60189 (P1 to P7)  - Low frequency cables and wires with PVC insulation and PVC sheath.

IEC-60227 (P1 to P7) - Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V.

IEC-60228  - Conductors of insulated cables

IEC-60230  - Impulse tests on cables and their accessories.

IEC-60287 (P1 to P3)  - True of the continuous current rating of cables (100% load factor).

IEC-60304  - Standard colours for insulation for low frequency cables and wires.

IEC-60331  - Fire resisting characteristics of Electric cables.

IEC-60332 (P1 to P3)  - Tests on electric cables under fire conditions.

IEC-60502  - Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV

IEC-754 (P1 and P2)  - Tests on gases evolved during combustion of electric cables.

AIR conditioning and ventilation

IS-659  - Safety code for air conditioning

IS-660  - Safety code for Mechanical Refrigeration

ARI:520  - Standard for Positive Displacement Refrigeration Compressor and Condensing Units

IS:4503  - Shell and tube type heat exchanger

ASHRAE-24  - Method of testing for rating of liquid coolers

ANSI-B-31.5  - Refrigeration Piping

IS:2062  - Steel for general structural purposes

IS:655  - Specification for Metal Air Dust

IS:277  - Specification for Galvanised Steel Sheets

IS-737  - Specification for Wrought Aluminium and Aluminium Sheet & Strip

IS-1079  - Hot rolled cast steel sheet & strip

IS-3588  - Specification for Electrical Axial Flow Fans

IS-2312  - Propeller Type AC Ventilation Fans

BS-848  - Methods of Performance Test for Fans

BS-6540 Part-I  - Air Filters used in Air Conditioning and General Ventilation

BS-3928  - Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors)

US-PED-2098  - Method of cold DOP & hot DOP test

MIL-STD-282  - DOP smoke penetration method

ASHRAE-52  - Air cleaning device used in general ventilation for removing particle matter

IS:3069  - Glossary of Terms, Symbols and Units Relating to Thermal Insulation Materials.
IS:4671 - Expanded Polystyrene for Thermal Insulation Purposes
IS:8183 - Bonded Mineral Wool
IS:3346 - Evaluation of Thermal Conductivity properties by means of guarded hot plate method
ASTM-C-591-69 - Standard specification for rigid preformed cellular urethane thermal insulation
IS:4894 - Centrifugal Fans
BS:848 - Method of Performance Test for Centrifugal Fans
IS:325 - Induction motors, three-phase
IS:4722 - Rotating electrical machines
IS:1231 - Three phase foot mounted Induction motors, dimensions of
IS:2233 - Designations of types of construction and mounting arrangements of rotating electrical machines
IS:2254 - Vertical shaft motors for pumps, dimensions of
IS:7816 - Guide for testing insulation resistance of rotating machines
IS:4029 - Guide for testing three phase induction motors
IS:4729 - Rotating electrical machines, vibration of, Measurement and evaluation of
IS:469 - Degree of protection provided by enclosures for rotating electrical machinery
IS:7572 - Guide for testing single-phase a.c. motors
IS:2148 - Flame proof enclosure for electrical apparatus
BS:4999 - Noise levels

Galvanizing
IS-209 - Zinc Ingot
IS-2629 - Recommended Practice for Hot-Dip galvanizing on iron and steel.
IS-2633 - Methods for testing uniformity of coating of zinc coated articles.
ASTM-A123 - Specification for zinc (Hot Galvanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.
ASTM-A-121-77 - Zinc-coated (Galvanized) steel barbed wire

Painting
IS-6005 - Code of practice for phosphating of iron and steel.
ANSI-Z551 - Gray finishes for industrial apparatus and equipment
SSPEC - Steel structure painting council

Fire protection system
Fire protection manul issued by tariff advisory committee (TAC) of India

HORIZONTAL CENTRIFUGAL PUMPS
IS:1520 - Horizontal centrifugal pumps for clear, cold and fresh water
IS:9137 - Code for acceptance test for centrifugal & axial pumps
IS:5120 - Technical requirement - Rotodynamic special purpose pumps
API-610 - Centrifugal pumps for general services
- Hydraulic Institutes Standards
BS:599 - Methods of testing pumps
PTC-8.2 - Power Test Codes - Centrifugal pumps

DIESEL ENGINES
IS:10000 - Methods of tests for internal combustion engines
IS:10002 - Specification for performance requirements for constant speed mpression ignition engines for general purposes (above 20 kW)
BS:5514 - The performance of reciprocating compression ignition (Diesel) engines, utilising liquid fuel only, for general purposes
ISO:3046 - Reciprocating internal combustion engines performance
IS:554 - Dimensions for pipe threads where pressure tight joints are required on threads
ASME Power Test Code - Internal combustion engine PTC-17
- Codes of Diesel Engine Manufacturer’s Association, USA
PIPING VALVES & SPECIALITIES
IS:636  - Non percolating flexible fire fighting delivery hose
IS:638  - Sheet rubber jointing and rubber inserting jointing
IS:778  - Gun metal gate, globe and check valves for general purpose
IS:78  - Sluice valves for water works purposes (50 to 300 mm)
IS:901  - Couplings, double male and double female instantaneous pattern for fire fighting
IS:902  - Suction hose couplings for fire fighting purposes
IS:903  - Fire hose delivery couplings branch pipe nozzles and nozzle spanner
IS:1538 - Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903 - Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062 - SP for weldable structural steel
IS:2379 - Colour Code for the identification of pipelines
IS:2643 - Dimensions of pipe threads for fastening purposes
IS:2685 - Code of Practice for selection, installation and maintenance of sluice valves
IS:2906 - Sluice valves for water-works purposes (350 to 1200 mm size)
IS:3582 - Basket strainers for fire fighting purposes (cylindrical type)
IS:3589 - Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038 - Foot valves for water works purposes
IS:4927 - Unlined flax canvas hose for fire fighting
IS:5290 - Landing valves (internal hydrant)
IS:5312 - Swing check type reflex (non-return) valves (Part-I)
IS:5306 - Code of practice for fire extinguishing installations and equipment on premises
Part-I - Hydrant systems, hose reels and foam inlets
Part-II - Sprinkler systems
BS:5150 - Specification for cast iron gate valves

MOTORS & ANNUNCIATION PANELS
IS:325  - Three phase induction motors
IS:900  - Code of practice for installation and maintenance of induction motors
IS:996  - Single phase small AC and universal electric motors
IS:1231 - Dimensions of three phase foot mounted induction motors
IS:2148 - Flame proof enclosure of electrical apparatus
IS:2223 - Dimensions of flange mounted AC induction motors
IS:2253 - Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254 - Dimensions of vertical shaft motors for pumps
IS:3202 - Code of practice for climate proofing of electrical equipment
IS:4029 - Guide for testing three phase induction motors
IS:4691 - Degree of protection provided by enclosure for rotating electrical machinery
IS:472  - Rotating electrical machines
IS:4729 - Measurement and evaluation of vibration of rotating electrical machines
IS:5572 - Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362 - Designation of methods of cooling for rotating electrical machines
IS:6381 - Construction and testing of electrical apparatus with type of protection 'e'
IS:7816 - Guide for testing insulation for rotating machine
IS:4064 - Air break switches
IEC DOCUMENT 2 (Control Office) 432
VDE 0530 Part I/66 - Three Phase Induction Motor
IS:9224 - HRC Fuses (Part-II)
IS:6875 - Push Button and Control Switches
IS:694  - PVC Insulated cables
IS:1248 - Indicating instruments
IS:375 - Auxiliary wiring & busbar markings
IS:2147 - Degree of protection
IS:5 - Colour Relay and timers
IS:2959 - Contactors

PG Test Procedures
NFPA-13 - Standard for the installation of sprinkler systems.
NFPA-15 - Standard for water spray fixed system for the fire protection
NFPA-12A - Standard for Halong 1301 Fire Extinguishing System.
NFPA-12 - Standard on Carbon dioxide extinguisher systems.
IS:3034 - Fire of industrial building: Electrical generating and distributing stations code of practice
IS:2878 - CO2 (Carbon dioxide) Type Extinguisher
IS:2171 - DC (Dry Chemical Powder) type
IS:940 - Pressurised Water Type

D.G. SET
IS:10002 - Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes
IS:10000 - Method of tests for internal combustion engines
IS:4722 - Rotating electrical machines-specification
IS:12063 - Degree of protection provided by enclosures
IS:12065 - Permissible limit of noise levels for rotating electrical machines.

Steel structures
IS-228 (1992) - Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P1 to 3:) - Code of practice for use of structural steel in overhead transmission line towers.
IS-806 - Code of practice for use of steel tubes in general building construction
IS-808 - Dimensions for hot rolled steel beam, column channel and angle sections.
IS-814 - Covered electrodes for manual arc welding of carbon and manganese steel.
IS-816 - Code of Practice for use of metal arc welding for general construction in Mild steel
IS-875 (P1 to P4) - Code of practice for design loads (other than earthquake) for buildings and structures.
IS-1161 - Steel tubes for structural purposes.
IS-1182 - Recommended practice for radiographic examination of fusion welded butt joints in steel plates.
IS-1363 (P1 to P3) - Hexagonal head bolts, screws & nuts of products grade C.
IS-1364 - Hexagon headbolts, screws and nuts of product grades A and B.
IS-1367 (P1 to P18) - Technical supply condition for threaded steel fasteners.
IS-1599 - Methods for bend test.
IS-1608 - Method for tensile testing of steel products.
IS-1893 - Criteria for earthquake resistant design of structures.
IS-1978 - Line Pipe.
IS-2062 - Steel for general structural purposes.
IS-2595 - Code of practice for Radiographic testing.
IS-3063 - Single coil rectangular section spring washers for bolts, nuts and screws.
IS-3664 - Code of practice for ultrasonic pulse echo testing by contact and immersion methods.
IS-7205 - Safety code for erection of structural steel work.
IS-9595 - Recommendations for metal arc welding of carbon and carbon
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IS-383  -  Coarse and fine aggregates from natural sources for concrete.
IS-432 (P1 and P2)  -  Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement.
IS-800  -  Code of practice for general construction in steel.
IS-806  -  Steel tubes for structural purposes.
IS-1172  -  Basic requirements for water supply, drainage and sanitation.
IS-1199  -  Methods of sampling and analysis of concrete.
IS-1742  -  Code of Practice for Building drainage.
IS-1785  -  Plain hard-drawn steel wire for prestressed concrete.
IS-1786  -  High strength deformed Steel Bars and wires for concrete reinforcement.
IS-1811  -  Methods of sampling Foundry sands.
IS-1893  -  Criteria for earthquake resistant design of structures.
IS-2062  -  Steel for general structural purposes.
IS-2064  -  Selection, installation and maintenance of sanitary appliances- code of practices.
IS-2065  -  Code of practice for water supply in buildings.
IS-2090  -  High tension steel bars used in prestressed concrete.
IS-2140  -  Standard Galvanized steel wire for fencing.
IS-2470 (P1 & P2)  -  Code of practice for installation of septic tanks.
IS-2514  -  Concrete vibrating tables.
IS-2645  -  Integral cement waterproofing compounds.
IS-3025 (Part 1 to Part 48)  -  Methods of sampling and test (Physical and chemical) for water and waste water.
IS-4091  -  Code of practice for design and construction of foundations for transmission line towers and poles.
IS-4111 (Part 1 to P5)  -  Code of practice for ancillary structures in sewerage system.
IS-4990  -  Plywood for concrete shuttering work.
IS-5600  -  Sewage and drainage pumps.

National building code of India 1970

USBR E12  -  Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81  -  Zinc/Coated steel chain link fence fabric
ASTM-D1557-80  -  test for moisture-density relation of soils using 10-lb (4.5 kg) rame land 18-in. (457 mm) Drop.
ASTM-D1586  -  Penetration Test and Split-Barrel (1967) - Sampling of Soils
ASTM-D2049-69  -  Test Method for Relative Density of Cohesionless Soils
CPWD  -  Latest CPWD specifications

ACSR MOOSE CONDUCTOR

Mass of zinc coating on zinc coated Iron and Steel Articles
NEMA:107-1964
CISPR
IS:209  -  Zinc Ingot BS:3436-1961
Part – V  -  Overhead Transmission Purposes
BS:215(Part-II)  -  Aluminium Conductors galvanized IEC:209-forced extra high
BS:215(Part-II) voltage (400 kV and above)
IS:1778 Reels and Drums for BS:1559-1949
Bare Conductors
IS:1521 Method for Tensile Testing ISO/R89-1959
of steel wire
IS:2629 Recommended practice for Hot dip Galvanising on Iron and Steel.
IS:2633 Method for Testing Uniformity of coating of zinc Coated Articles.
IS:4826 Hot dip galvanised coatings on round steel wires ASTM-A472-729

GALVANISED STEEL EARTHWIRE
IS:1521 Method for Tensile Testing ISO/R:89-1959
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IS:1778 Reels and Drums for Bare Conductors
IS:2629 Recommended practice for Hot Dip Galvanising on Iron and Steel.
IS:2633 Methods for testing Uniformity of Coating of Zinc Coated Articles.
IS:4826 Hot dip Galvanised Coatings ASTM A475-72 on Round Steel Wires BS:443-1969
IS:209 Zinc ingot BS:3463-1961

Lighting Fixtures and Accessories

(i) IS:1913 General and safety requirements for electric lighting fittings.
(ii) IS:3528 Water proof electric lighting fittings.
(iii) IS:4012 Dust proof electric lighting fittings.
(iv) IS:4013 Dust tight proof electric lighting fittings.
(v) IS:10322 Industrial lighting fittings with metal reflectors.
(vi) IS:10322 Industrial lighting fittings with plastic reflectors.
(vii) IS:2206 Well glass lighting fittings for use under ground in mines (non-flameproof type).
(viii) IS:10322 Specification for flood light.
(ix) IS:10322 Specification for decorative lighting outfits.
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(xi) IS:2418 Tubular fluorescent lamps
(xii) IS:9900 High pressure mercury vapour lamps.
(xiii) IS:1258 Specification for Bayonet lamp fluorescent lamp.
(xiv) IS:3323 Bi-pin lamp holder tubular fluorescent lamps.
(xv) IS:1534 Ballasts for use in fluorescent lighting fittings. (Part-I)
(xvi) IS:1569 Starters for fluorescent lamps.
(xvii) IS:2215 Holders for starters for tubular fluorescent lamps
(xviii) IS:418 GLS lamps
(xix) IS:3553 Water tight electric fittings
(xx) IS:2713 Tubular steel poles
(xxi) IS:280 MS wire for general engg. purposes

Conduits, Accessories and Junction Boxes

(1) IS:9537 Rigid steel conduits for electrical wiring
(2) IS:3480 Flexible steel conduits for electrical wiring
(3) IS:2667 Fittings for rigid steel conduits for electrical wiring
(4) IS:3837 Accessories for rigid steel conduits for electrical wiring
(5) IS:4649 Adaptors for flexible steel conduits.
(6) IS:5133 Steel and Cast Iron Boxes
(7) IS:2629 Hot dip galvanising of Iron & Steel.

Lighting Panels
(1) IS:13947  LV Switchgear and Control gear(Part 1to 5)
(2) IS:8828  Circuit breakers for over current protection for house hold and similar installations.
(3) IS:5  Ready mix paints
(4) IS:2551  Danger notice plates
(5) IS:2705  Current transformers
(6) IS:9224  HRC Cartridge fuse links for voltage above 650V(Part-2)
(7) IS:5082  Wrought aluminium and Al. alloys, bars, rods, tubes and sections for electrical purposes.
(8) IS:8623  Factory built Assemblies of Switchgear and Control Gear for voltages upto and including 1000V AC and 1200V DC.
(9) IS:1248  Direct Acting electrical indicating instrument

Electrical Installation

(1) IS:1293  3 pin plug
(2) IS:371  Two to three ceiling roses
(3) IS:3854  Switches for domestic and similar purposes
(4) IS:5216  Guide for safety procedures and practices in electrical work.
(5) IS:732  Code of practice for electrical wiring installation
(system voltage not exceeding 650 Volts.)
(6) IS:3043  Code of practice for earthing.
(7) IS:3646  Code of practice for interior illumination part II & III.
(8) IS:1944  Code of practice for lighting of public through fares.
(9) IS:5571  Guide for selection of electrical equipment for hazardous areas.
(11) IS:2633  Methods of Testing uniformity of coating on zinc coated articles.
(12) IS:6005  Code of practice for phosphating iron and steel.
(13) INDIAN ELECTRICITY ACT
(14) INDIAN ELECTRICITY RULES

LT SWITCHGEAR

IS:8623 (Part-I) Specification for low voltage switchgear and control gear assemblies
IS:13947 (part-3) Specification for low voltage switchgear and control gear.
Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4) Specification for low voltage switchgear and control Gear.
Part 4 Contactors and motors starters.
IS:13947 (part-5) Specification for low voltage switchgear and control gear.
Part 5 Control-circuit devices and switching elements
IS:13947 (part-6) Specification for low voltage switchgear and control gear.
Part 6 Multiple function switching devices.
IS:13947 (part-7) Specification for low voltage switchgear and control gear.
Part 7 Ancillary equipments
IS:12063  Degree of protection provided by enclosures
IS:2705  Current Transformers
IS:3156  Voltage Transformers
IS:3231  Electrical relays for power system protection
IS:1248  Electrical indicating instruments
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SECTION : 4

SPECIAL EQUIPMENTS

TECHNICAL SPECIFICATION FOR SPECIAL EQUIPMENTS
This part of the document covers detailed technical requirement for the diagnostic tools complete with associated components and accessories including required software for storage of data and interpretation of results etc.

1.0 DEW POINT METER.
The meter shall be capable of measuring the dew point of SF6 gas of the circuit breaker/GIS equipment. It should be portable and adequately protected for outdoor use. The meter shall be provided with dew point hygrometer with digital indication to display the dew point temperature in degree C, degree F or PPM. It should be capable of measuring the corresponding pressure at which dew point is being measured.

The measurement and use of the instrument must be simple, direct without the use of any other material /chemical like dry ice/acetone etc. It should be battery operated with rechargeable batteries.

TECHNICAL SPECIFICATION:
1. Measuring Range: Upto-100 º C dew point.
2. Accuracy : ± 2 º C.
3. Display : 4 digit LCD , 0.5 inch high.

2.0 PORTABLE PD MONITORING SYSTEM FOR GAS INSULATED SWITCHGEAR

2.1 GENERAL
The equipment shall be used for detecting different types of defects in Gas Insulated Stations (GIS) such as Particles, Loose shields and Partial Discharges as well as for detection of Partial discharges in other types of equipment such as Cable Joints, CTs and PTs.

2.1.1 It shall be capable for measuring PD in charged GIS environment as EHV which shall have bandwidth in order of 10 KHz – 500 KHz with possibility to select a wide range of intermediate bandwidths for best measurement results. The principal of operation shall be on acoustic technique and the method of measurement shall be non-intrusive. The instrument is able to detect partial discharges in cable joints, terminations, CTs and PTs etc., with the hot sticks.

2.1.2 Detection and measurement of PD and bouncing particles shall be displayed on built in large LCD display and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc.

2.2 TECHNICAL SPECIFICATION:
2.2.1 Measurement shall be possible in noisy environment.

2.2.2 Stable reading shall be possible in presence of vibrations within complex GIS assemblies, which can produce signals similar to PD.

2.2.3 Equipment should have necessary synchronizing circuits to obtain PD correlation with power cycle and power frequency.

2.2.4 The equipment shall be battery operated with built-in-battery charger. It shall also be suitable for 230V AC/50 Hz input.
2.2.5 Measurement shall be possible in the charged switchyard in the presence of EMI/EMC. Supplier should have supplied similar detector for GIS application to other utilities. Performance certificate and the list of users shall be supplied along with the offer.

2.2.6 Instrument shall be supplied with standard accessories i.e., re-locatable sensors with mounting arrangements, connecting cables (duly screened) to sensors, Lap-top PC, diagnostic software, carrying case, rechargeable battery pack with charger suitable for 230V AC, 50Hz supply connecting cables (duly screened) to view in storage.

2.2.7 The function of software shall be covering the following:
- Data recording, storage and retrieval in computer
- Data base analysis
- Template analysis for easy location of fault inside the GIS
- Evaluation of PD measurement i.e, Amplitude, Phase Synchronization etc.
- Evaluation of bouncing/loose particles with flight time and estimation on size of particle.
- Report generation

2.2.8 To prove the suitability in charged switchyard condition, practical demonstration shall be conducted before acceptance.

2.2.9 Supplier shall have “Adequate after sales service” facility in India.

2.2.10 Necessary training may be accorded to personnel to make use of the kit for locating PD sources inside the GIS

2.2.11 Instrument shall be robust and conform to relevant standard.

3.0 THREE PHASE AUTOMATION RELAY TEST KIT.

The test kit/set should be capable of performing the following functions in automatic as well as in manual mode.

1. “Steady state” testing of current, voltage, frequency and impedance relays to test the characteristic of protective relays.
2. Testing of over fluxing relay and check synchronizing relay.
3. Testing of electro-mechanical backup over-current relays for operating current upto 2x, 5x and 10x rated current (minimum pickup instantaneous and time delayed characteristics).
4. Testing of frequency relays for rate of change of frequency, minimum pickup, pickup to drop out ratio, under/over frequency setting and time characteristics.
5. Testing of distance relays of three phase including features such as power swing blocking, switch on to fault and when connected to weak system.
6. Testing of voltage relay for pickup to drop out ratio, instantaneous and time delayed characteristics.
7. Testing of three winding differential relays (9 current sources) including checking of Percentage Bias, Inrush stability, Over excitation stability.
8. Programmable Relay test kit should work as—
   i) Relay test tool for all type of relays mentioned.
   ii) “Database” to document relay settings.
   iii) Storage of test history.
9. Software programme should be menu driven and should run on Microsoft Windows(98, NT,2000 or latest version).
10. The test programme/plan should allow user to define the control parameters to control changes to magnitude, phase and frequency of selected source values and allow user to:
    i) Ramp up/down (at user defined rates) to test the pick up/ dropout values.
    ii) Step up/step down the magnitude, phase angle of frequency.
    iii) Quickly find the pick up value.
    iv) Test the characteristic angle for impedance relays/ directional relays.
11. The programmable/automatic Relay test kit should be capable of doing simulation of power system states like pre-fault, fault and post fault conditions for dynamic state testing.
12. Test program/plan should enable user of creating a number of system states to test protection scheme/relay for realistic fault conditions and should be capable to calculation voltage and current phasors during fault conditions.
13. Suitable ANSI-SQL 92 complaint RDBMS Database system to allow user to store historical test parameters and result.
14. For observing the performance of distance relay under various grid conditions. The transient and Dynamic testing shall be possible.
15. Reply of Distance recorder output through COMTRADE format should be possible.
16. Through Report generation software, it shall be possible to compare previous test result and deviations can be brought out with permissible tolerance in the report.
17. Through test set –
   It shall be possible to generate conditions such as breaker failure. Carrier fail etc.
18. Test kit shall have provision to carryout end test using GPS receivers available at both local and remote S/tn.

Features of Software :
Licensed, latest version of automatic testing software certified by manufacturer only to be supplied to DTL. It shall be WINDOW based and can be customized by user without knowledge of programming language. All operation using software shall be through user friendly GUI (Graphical User Interface). Calibration Software & Hardware to be supplied to DTL.

Output Requirements :
(i) Voltage Output : 3 phase, 0-300 V per phase, accuracy : 0.1% or better
(ii) Current Output : 3 phase, 10 amps per phase, 400 VA at 40 Volts.
                    Accuracy : 0.1 or better
(iii) Phase angle : 0 to 360 degrees.
(iv) Frequency : DC to 200 Hz.

Other Essential Requirements :
(i) Equipment shall be capable of upgrading to latest version manufactured for next 5 Years.
(ii) An adequate calibration box provided to calibrate the current and voltage of the test kit. This should be apart from the software calibration.

4.0 CONTACT RESISTANCE METER

General
The equipment shall measure and display the static contact resistance of circuit breaker, isolator, bus bar joints and earth switches etc: directly in micro-ohms under live switchyard conditions.

Technical Specification
Resolution: 0.1 micro ohm, 1 ohm, and 10 micro ohm.

Accuracy: Value : ±1% : ± 2 digits.
Current : 200 ADC,
Display : Two,3½ digit ½ inch LCD, for current and resistance Values.
Power : 220 VAC ± 10% 50 Hz ± 5%, 30VA
Battery : Instrument operation on input rechargeable battery (12 V, 7 AH Maintenance free).

5.0 CIRCUIT BREAKER OPERATIONAL ANALYSER

General : Main Equipment
(i) The Computer Aided CB Analyzer system comprising of CB operation unit, programme unit, travel analyzer unit & analysis software should be capable to perform close, open ,close-open, open-close, open-close, open operation on CB under test, with a facility to introduce time delays between composite operation.
(ii) The CB Analyzer should be capable to measure, record and analyze the CB operation timing.
(iii) The CB Analyzer should be able to measure and record current rise and fall of tripping coils as well as of closing coils of all three poles of CB simultaneously.
(iv) The CB Analyzer should be capable to measure and record travel and speed of movement of operating mechanism of CB.
(v) The CB Analyzer should be capable to measure and record dynamic contact resistance of main and arcing contacts of CB with injection of minimum 100 Amp. DC current.
(vi) The CB Analyzer should be capable to measure pole discrepancy timing.
(vii) The CB Analyzer should be capable of measuring contact closing & opening timing up to four (04) main and four(04) no. PIR contact.
(viii) The CB Analyzer should be capable to calculate and print all contact closing & opening tuning in tabular form also.
(ix) Suitable mounting kits for transducers and sensors, alongwith sensor cable of suitable length should be supplied with CB analyzer system.
(x) Test leads with suitable clamp and connectors and having length suitable for leads with suitable clamp and connectors and having length suitable for connection to EHV CBs should be supplied with CB Analyzer system for
(xi) Necessary custom built travel transformer cum fixtures suitable for mounting on BHEL/ABB/CGL/Siemens/ALSTOM (132 KV and above) makes of CBs, to monitor travel related parameters like contact gap. Contact insertion, over travel etc. should be supplied with CB Analyzer.

System Operation hardware/software, peripherals and analysis software.
(i) The test report for recording motion should provide test results both in form of curve and tables. The tables should consist of calculated CB parameters such as closing/opening speed etc.
(ii) The entry of various data/parameters (pertaining to CB) be possible sing built in display of menu.
(iii) The battery backup and real time clock should be provided for automatic date and time functions.
(iv) a) The computer aided analysis software should have sampling frequency upto 40 KHz or more.
   b) The analyzer should be capable to record transient phenomenon for a duration at least 500 ms.
(v) The binary channel accuracy and analogue channel accuracy should be suitable meet all desired functions(stated above).
(vi) The CB analyzer should be provided with facility of down loading data to a IBM compatible PC.
(vii) The printer provided with CB analyzer should be preferably a plain paper printer.
(viii) The computer aided CB analysis software should be supported with suitable report generation.
(ix) It should be possible to change scale factor of time axis to enable enlarged view of part of diagram.
(x) It should be possible to change amplitude scale to make best use of available space.
(xi) It should be possible to study on speed curve, the damping and speed variations at CB opening and closing time.
(xii) The CB analyzer should be supplied with portable memory bank to store test result taken by test kit to enable further down loading to centrally located PC.
(xiii) Window based PC down loading software should be provided with CB analyzer to facilities downloading test result from memory bank to PC where it can be analyzed and stored in proper directory/file.
(xiv) It should be possible to compare present results with previous one. The feature of Zooming the graph and moving the cursors on graph, thereby indicating instantaneous values of test parameters should also be provided.
(xv) The latest version of CB analyzer system (hardwares and softwares) to be supplied and time to time updating of software should be offered.
(xvi) As and when required, technical support for analysis of critical test result to be offered, on regular basis.

Other Essential Requirements.
(i) The CB analyzer should operate on power supply of 220 volts(± 10%) at 50 Hz (± 5%) frequency.
(ii) The CB analyzer should be capable of working in high electro-magnetic and electrostatic conditions.
(iii) The CB analyzer should be capable of functioning accurately in environmental condition of temperature 0° to 50° C and humidity (RH) up to 95 % (non-condensing).
(iv) The CB analyzer should be portable so as to facilitate moment from one site to other and supplied with suitable transportation case.
(v) The supplier should have adequate after sale service facility.
(vi) As per ISO:9001 requirement, celebration certificates for each instrument should be supplied.
(vii) Installation :
    a) Indoor/outdoor
    b) The equipment should be portable easy to handle robust and sturdy, for field applications.

6.0 **SF6 Gas leak Detector**
The SF6 gas leak detector shall comprise of transducers and other accessories.

a) The detector shall be free from induced voltage effects.
b) The sensing probe shall be such that it can reach all the points on the breaker where leakage is to be sensed.

7.0 **Transformer Oil Filtration Plant - 6000 LPH Capacity**

7.1 **Introduction**
Delhi Transco Limited intends to procure a mobile/stationary type 6000 LPH capacity high vacuum type transformer Mineral oil Filtration plant for its transformers for 220/33kV Rajghat Power House.

7.2 **Scope**
The Scope covers supply of mobile/stationary type 6000 LPH capacity high vacuum type transformer Mineral oil Filtration plant.

The plant basically performs coarse and fine size filtration follower by degassing and dehumidification by processing transformer oil spread over a large surface area under the principle of low temperature and high vacuum after which the oil is delivered for use.

7.3 **General Technical Requirements (GTR):**
The Plant shall be suitable for treating Transformer oil by first heating it and then passing it through specially designed filter and then subjecting it to high vacuum treatment which dehydrates and degasifies the oil to following specifications after completion of the process.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>After Processing</th>
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<tbody>
<tr>
<td>Break Down Voltage (Across 2.5 mm Gap)</td>
<td>80 KV</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>5 PPM</td>
</tr>
<tr>
<td>Suspended Particles</td>
<td>1 Micron</td>
</tr>
<tr>
<td>Gas Content</td>
<td>0.1% by Volume</td>
</tr>
<tr>
<td>Acidity</td>
<td>0.08 mg KOH/gms of Oil</td>
</tr>
</tbody>
</table>

The Plant shall generally conform to IS: 6034-1989 and its latest revision. The Oil Filtration Plant shall be designed for high vacuum and low temperature of oil for achieving required results.

The Oil Filtration Plant shall be Mobile, mounted on an under carriage with Four Pneumatic wheels. Automatic brakes and towing arrangement shall be provided. The Plant shall be weather proofed and shall be suitable for outdoor use. The casing shall be provided with doors of CRCA Sheets, hinged on fabricated Framework, Angles and Channels to have access to the operational Controls and inspection windows etc. The equipment shall be enclosed and protected against climatic conditions. The Screw Jacks for relieving pressure on wheels at stationary conditions shall be provided.

All components shall have adequate strength and rigidity to withstand normal conditions of handling transport and usage and shall be free from edges or corners to avoid injury to Operating Personnel in normal conditions of use. The design of the Plant shall be such that if required the part/s can easily be replaced. Proper guarding arrangement shall be provided on all such parts which due to their position and nature of operation are liable to cause accidents.
7.4 **Constructional Details**
The Plant shall consist of the following:

7.4.1 **Inlet Pump**
A positive displacement gear type Pump with a capacity of 6000 LPH shall be provided. The Pump shall be thoroughly tested for vacuum and shall be suitable for continuous trouble free operation. The Pump shall be provided with automatic protection against over-pressure build-up.

Interlocking arrangement shall be provided in between the Oil Inlet Pump and the heater so that heater can not be energised unless Inlet Pump is on. Interlocking arrangement shall be provided in the Filter Plant between the Inlet Pump and High Level Float Switch (located into Degassing Column) to avoid excessive rise of oil in the Degassing Column. Flow Control Valve for adjustment of flow rate through Filter, a Flow Control Valve shall be provided across the Gear Pump. The Suction Head of the Inlet Feed Pump at atmospheric condition at Inlet shall be 4 to 5 mtrs.

7.4.2 **Heaters**
Heaters shall be provided in Protection Tubes to avoid localised overheating, hot spot & breaking oil. Heaters shall be capable of heating oil from 30°C to 60°C. Temperature during degassing and dehydration for good results should not exceed 60°C. Heaters shall be thermostatically controlled. Total Heater Power shall be 132 KW. Heaters shall be divided into Three Groups.

Heater Elements shall be of Nichrome/ Kanthal wire filament, inserted in Refractory Formers which are located in Protection Tubes. Construction of the Heat Exchanger shall be such that the replacement of Heaters shall be easy and shall not require any special tools.

Heaters shall be interlocked with Gear Pump and shall not be in ON position, unless the Inlet Pump is working. Heater Tank shall be adequately thermally insulated to minimise loss of heat. Heater Pipe surface density shall not be more than 2.0 Watts/cm².

Each group of Heaters shall be controlled by individual Thermostat. A Safety Thermostat shall be provided to take care of any accidental rise of temperature of oil and shall put off the Heaters in such eventuality. This Thermostat shall be set at slightly higher temperature than that of controlling Thermostats.

One suitable Pressure Relief Valve shall be provided on the Heater Chamber to prevent any pressure rise above the acceptable limit. A Drain Plug for the Heater Tank shall be provided.

7.4.3 **Ionic Reaction Column (100 Kgs)**
An Ionic Reaction Column of 100 Kgs capacity shall be provided to reduce the acidity in the oil as mentioned in the specification. First filling shall be provided along with the column.

7.4.4 **Filtration System**
Filtration System shall consist of the following:

A) **Preliminary Filter**
The main function of this Filter shall be to prevent any damage to the Inlet Pump. It shall have strainers capable of retaining all particles above 1 mm size and also magnetic particles. Incoming oil shall pass through this Filter. It shall be possible to clean the strainer without dismantling the Filter from the pipeline.

B) **Filter Press**
Filter Press shall consist of Filters held between Metallic Discs. Filters shall be easily changeable. It shall be suitable for removal of particles bigger than 50 Microns. This shall be useful for removal of sludge content in the used oil. A Drain Plug shall be provided for the Filter.
C) **Cartridge Filter**

Non-hygroscopic throw away type Cartridge Filters of one Micron rating shall be provided. This Cartridge Elements shall have large dust holding capacity.

The replacement of Cartridge Elements shall be very easy and could be done without any special tools. The Housing / Vessel shall be suitable for high vacuum and pressure applications. Compound (Pressure / Vacuum) Gauge shall be provided on Filter Vessel for inlet pressure indication in order to ascertain condition of Cartridge Elements. Aeration shall be provided on the Filter Vessel to aerate the Vessel during draining. The Cartridge type Filter shall facilitate to achieve desired value of particle size in micron.

### 7.4.5 Degassing and Dehydration Chamber - Two Stage

The Degassing Chamber shall function as degasser and dehumidifier & shall be capable of removing dissolved gases and moisture from the oil. It shall be of M.S. and shall have welded construction. The Chamber shall be able to withstand the vacuum to which it shall be subjected. Efficiently spread Raschig Rings shall be placed in the Degassing Columns. The surface area offered by the Raschig Rings shall be sufficient to form a thin film of oil and shall facilitate removal of dissolved gases and moisture at the rated flow rate of oil. A Sight Glass with Illuminating Lamp shall be provided for observation of oil flow.

One Float Switch on the Degassing Chamber shall be provided for preventing excess rise of level. It shall be electrically interlocked with Inlet Pump. Another Float Switch to control the low level of the oil in Degassing Chamber shall be provided and it shall be electrically interlocked with the Discharge Pump.

Two stages shall be separated by a Siphon Seal.

### 7.4.6 Vacuum Pumping System (For Degassing Column)

A Roots-Rotary combination of Vacuum Pumps shall be provided for evacuation of Degassing Chamber. For matching of Vacuum Pump performance both - Roots & Rotary Vacuum Pumps shall be of same manufacturer only meeting following specifications:

**First Stage - Rotary Oil Sealed Pump (1 No.)**

- Nominal Pumping Speed: 3700 Ltrs/Min.
- Ultimate Vacuum with G.B. Closed: 5 x 10^-3 Torr
- Ultimate Vacuum with G.B. Open: 5 x 10^-1 Torr

**Second Stage - Mechanical Booster Pump (Roots Pump) - 1 No.**

- Nominal Pumping Speed: 1200 M3/Hr
- Ultimate Vacuum: 10^-4 Torr

The Vacuum Pumping System shall have a McLeod Vacuum Gauge (Range: 10 Torr to 10 Microns), a Bourdon Gauge (Range: 0 to 760 Torr), Isolation Valve, Airing Valve Mechanical Non Return Valve and Automatic bypass Valve for Roots Pump.

### 7.4.7 Transformer Evacuation System

A Roots-Rotary combination of Vacuum Pumps shall be provided for evacuation of Transformer. For matching of Vacuum pump performance both - Roots & Rotary Vacuum Pumps shall be of same manufacturer only meeting following specifications:

**Rotary Oil Sealed Pump (1 No.)**

- Nominal Pumping Speed: 1500 Ltrs/Min.
- Ultimate Vacuum with G.B. Closed: 5 x 10^-3 Torr
- Ultimate Vacuum with G.B. Open: 5 x 10^-1 Torr

**Mechanical Booster Pump (Roots Pump) - 1 No.**

- Nominal Pumping Speed: 500 M3/Hr
- Ultimate Vacuum: 10^-4 Torr
The Vacuum Pumping System shall have a McLeod Vacuum Gauge (Range: 10 Torr to 10 Microns) and a Bourdon Gauge (Range: 0 to 760 Torr), Isolation Valve, Airing Valve Mechanical Non Return Valve and Automatic bypass Valve for Roots Pump.

The Transformer Evacuation System shall be mounted on the Plant chassis.

7.4.8 Discharge Pump
A Centrifugal Glandless type Discharge Pump with a capacity of 6000 LPH, suitable for sucking oil from the Degassing Chamber held under vacuum, shall be provided. This shall be fully tested for pressure and vacuum leak rate.

Interlocking arrangement shall be provided between Low Level Float Switch (located in Degassing Column) and Discharge Pump to prevent dry running of Discharge Pump. The Discharge Head of the Outlet Pump shall be 8 Mtrs.

7.4.9 Solenoid Valve At Inlet & Outlet
One no. Solenoid Valve at Inlet and One no. at Outlet shall be provided. Valve at the Inlet & Outlet shall open automatically. The moment oil Inlet & Outlet Pump is switched ON. In case of power failure, these valves shall be capable of preventing the oil from entering into the Plant and thus avoiding the possibility of mixing processed oil with unprocessed oil.

7.4.10 Oil Sampling Valve
This valve shall be provided to collect the sample of oil for testing during operation.

7.4.11 Airing Valve
One Airing Valve for airing the Degassing Chamber shall be provided.

7.4.12 Gauges & Instruments
A Dial type Thermometer shall be provided at Outlet & Inlet at the Heater Tank for indication of oil temperature.

Pressure Gauge
One Pressure Gauge before Cartridge Filter and One Compound Gauge shall be provided near Degassing Column.

Independent Drives
Independent Drives for Oil Discharge Pump, Oil Inlet Pump & Vacuum Pumps shall be provided. Motors shall conform generally to IS: 325 (Testing) shall be of Class ‘F’ Insulation. Starters shall be of direct On-line type. Motors shall be of preferably NGEF / JYOTI (JMP) / ALSTOM / ABB / CROMPTON / SIEMENS make.

7.4.13 Control Panel
All Electrical Control Gear, Mains Isolating Arrangement, Starters, Contactors, Pilot Lamp, Push Buttons, HRC Fuses, Relays, Indicating Lamps and Interlocking shall be housed in a Compact Control Panel and made of CRCA Sheets. A Mimic diagram with Indicating Lamps shall be provided on the Control Panel.

All Wiring shall be neatly routed and all wire termination shall be suitably identified with ferrules.

All HRC Fuses shall be of English Electric make and Switchgear shall be of preferably Telemechanic / ABB / BCH / SIEMENS / L&T / GE POWER make. Mains Isolating Switch shall be of ICTPN type.

The Plant shall be suitable for operation on 415 V, 3 Ph, 4 Wire, 50 Hz, A.C. Supply.

7.4.14 Oil Hoses - 2 Nos.
Two Nos. Nitrile Rubber Hoses each 10 Mtrs long with flanged end connection on both sides shall be provided. One for Oil Inlet & one for Oil Outlet. Oil Hoses shall be capable of handling the transformer oil at 100°C (max.) and vacuum.
7.4.15 Pipe Line & Valves
The Valves in Oil Line & Vacuum Line shall be of Ball type. All Pipes shall be of ERW and all joints in Oil & Vacuum Line shall be flanged & shall have ‘O’ Ring Sealing. ‘O’ Rings shall be of Nitrile Rubber & shall be of round shape.

The entire Plant along with all components mounted shall be tested for a total vacuum leak rate of less than 1 torr Ltrs/Sec

The supplier should confirm availability of testing facilities at their works for carrying out the following tests on the oil:

1. Break down Voltage
2. Moisture Content
3. Suspended Particles
4. Gas Content
5. Acidity
6. Plant flow rate confirmation

7.4.16 Lifting Hooks
Lifting Hooks for Plant shall be provided to facilitate ease of Plant Loading / Unloading.

7.5 Additional Requirements:
• Additional one Vacuum pump of same capacity for evacuation of transformer.
• Online PPM Measurement.
• BDV Test kit up to 100kV.

7.6 Cleaning & Painting
Before despatch from Supplier’s works, all exposed surfaces shall be cleaned off Rust, Dirt, Scale and foreign matter and shall be applied with a coat of rust preventive compound before being painted in single paint from outside.

7.7 Inspection & Testing
The Plant shall be offered for Inspection & Testing with Transformer Oil at Supplier’s works. Supplier shall demonstrate the Plant performance as per parameters mentioned in the specifications.

7.8 Instruction Manual
Two copies Instruction Manual containing details of Plant Operation & Maintenance along with all relevant drawings shall be supplied with the Plant.

7.9 Commissioning
Vendor shall depute their Engineer to our site for commissioning of the Plant.
SECTION VA

POWER TRANSFORMER & NEUTRAL CURRENT TRANSFORMER

SECTION – I : CONSTRUCTIONAL DETAILS & DETAILED DESCRIPTION

1.1 CONSTRUCTION DETAILS
The features and construction details of each power transformer shall be in accordance with the requirements stated herein under.

1.2 TANK CONSTRUCTION
1.2.1 Tank shall be of welded construction and fabricated from tested quality, low carbon steel of adequate thickness.
1.2.2 All seams and joints not required to be opened at site shall be factory welded and wherever possible they shall be double welded.
1.2.3 Each tank shall be provided with lifting lugs suitable for lifting the transformer complete with oil. A minimum of four jacking Pads in accessible position are to be provided to enable the transformer complete with oil, to be raised or lowered using hydraulic or mechanical screw jacks.
1.2.4 Tank stiffeners shall be provided for general rigidity and these shall be so designed as to prevent any retention of water.
1.2.5 The tank shall be designed to withstand:
   i) Mechanical shocks during transportation
   ii) Vacuum of 760mm of Hg.
   iii) Continuous internal pressure over normal hydrostatic pressure of oil as well as the pressure developed due to abnormal condition which may arise during service.
   iv) Earthquake forces as per Seismic zone
   v) Short Circuit forces
1.2.6 The base of each tank shall be so designed that it shall be possible to move the complete transformer unit by skidding in any direction without injury when using plates or rails.
1.2.7 The transformer tank and its accessories shall be so designed as to avoid collection of gas/air.
1.2.8 Bolted inspection opening shall be provided on the sides of the tank near the bottom to observe the position of the core.
1.2.9 Inspection opening shall be provided on the tank to facilitate inspection of Core, assembly fittings and fixtures etc.
1.2.10 Adequate space shall be provided at the bottom of the tank for collection of sediments.
1.2.11 Transformer shall have the provision for installation of the Fire Prevention and Extinguishing System offered by the tenderer.

1.3 TANK COVER:
1.3.1 The tank cover shall be sloped to prevent retention of rain water and shall not distort when lifted. Suitable lifting arrangement shall be provided.
1.3.2 At least two adequately sized bolted inspection openings one at each end of the tank shall be provided for easy access to bushings and earth connections. The inspection covers shall not weigh more than 25 kg. and shall be provided with suitable lifting arrangements.
1.3.3 The tank covers shall be fitted with pockets at the position of maximum oil temperature at C.M.R. for bulbs of oil and winding temperature indicators. It shall be possible to remove these bulbs without lowering the oil in the tank.
1.3.4 The thermometer pocket shall be fitted with a captive screwed top to prevent the ingress of water.
1.3.5 Bushings, turrets cover of inspection openings, thermometer pockets etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.
1.3.6 All bolted connections shall be fitted with weather proof, hot oil resistant gasket in between for complete oil tightness. If gasket is compressible, metallic stops shall be provided to prevent over compression.

1.3.7 Neoprene gaskets shall be used.

1.4 AXLES AND WHEELS
1.4.1 The transformers shall be provided with flanged, bi-directional wheels and axles. These shall be so designed that under both the directions of movement they shall not deflect as to interfere with the movement of the transformer. Wheels shall be provided with suitable bearings which shall be rust corrosion resistant. Fittings/nipples for lubrication shall also be provided or the bearing shall be of permanently lubricated type.

1.4.2 All wheels should be detachable and shall be made of cast iron or steel as required.

1.4.3 Suitable locking arrangement shall be provided for the wheels to prevent accidental movement of transformer.

1.4.4 The wheels are required to swivel and they shall be arranged so that they can be turned through an angle of 90° when the tank is jacked up clear off the rails. Means shall be provided for locking the swivel movements in positions parallel to or at right angels to the longitudinal axis of the tank.

1.4.5 The wheel centre in both directions shall be 1676 mm to facilitate placement of transformer on rails spaced 1676 mm centre to centre.

1.5 CONSERVATOR TANK
1.5.1 The conservator tank shall have adequate capacity between highest and lowest visible levels to meet the requirement of expansion of the total cold oil volume, in the transformer and cooling equipment from minimum ambient temperature to 90° C.

1.5.2 Conservator shall be provided with sump and drain valve so that it can be completely drained by means of the drain valve, when mounted in service position.

1.5.3 The conservator shall be bolted into position so that it can be removed for cleaning purposes.

1.5.4 The conservator shall be fitted with magnetic oil level gauge with low level electrically insulated alarm contacts.

1.5.5 Conservator shall be provided in such a position as not to obstruct the electrical connections to the transformers.

1.6 PRESSURE RELIEF DEVICE
1.6.1 The pressure relief valve provided shall be of sufficient size for rapid release of any pressure that may be generated within the tank and which may result in damage to the equipment. The device shall operate at a static pressure of less than the hydraulic test pressure of transformer tank. The device shall have two micro switches having contacts which shall close for actuating trip circuits in the event of operation of the pressure relief device. The pressure relief device shall be spring loaded type with detachable type diaphragm. Means shall be provided to prevent the ingress of rain water. Terminal box of PRD should confirm to degree of protection as per IP-55 of IS

1.7 GAS AND OIL ACTUATED RELAYS
1.7.1 The transformer shall be fitted with gas and oil actuated relay as per specification hereunder.

1.7.2 Each gas and oil actuated relay shall be provided with a test cock to take a flexible pipe connection for checking the operation of the relay.

1.7.3 A double float type Buchholz relay shall be provided between the main conservator and tank. All gas evolved in the transformer shall collect in this relay. A copper tube shall be connected from the gas collector to a valve located about 1200 mm. above ground level, to facilitate sampling, with the transformer in service. The device shall be provide with two electrically independent ungrounded contacts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure.

1.7.4 A machined surface shall be provided on the top of each relay to facilitate the setting of the relays and to check the mounting angle in the pipe and the cross level of the relay.
1.7.5 The design of the relay mounting arrangements, the associated pipe work and the cooling plant shall be such that mal-operation of the relays shall not take place under normal service condition.

1.7.6 The pipe work shall be so arranged that all gas arising from the transformer shall pass into the gas and oil-actuated relay. The oil circuit through the relay shall not form a delivery path in parallel with any circulating oil pipe, nor shall it be tied or connected through the pressure relief vent. Sharp bends in the pipe work shall be avoided.

1.7.7 A sudden pressure relay shall be fitted on main tank to detect a sharp rise in internal pressure. An electrically insulated trip contact shall be provided in sudden pressure relay.

1.7.8 A surge relay shall also be provided between OLTC and conservator tank to detect a sharp rise in internal pressure. An electrically insulated trip contact shall be provided in the surge relay.

1.7.9 Provision shall be made for parallel wiring of all the alarm & trip events for separate annunciation on Employer panel.

1.8 CORE

1.8.1 The core shall be constructed from high grade non-ageing, cold rolled grain oriented silicon steel laminations. Provision of core belts shall be preferred in place of core bolts to avoid hot spots. The manufacturer who has in house cutting facility for core laminations shall be preferred.

1.8.2 The design of the magnetic circuit shall be such as to avoid static discharges, developments of short circuit paths within itself or to the earthed clamping structure and production of flux component at right angles to the plane of laminations which may cause local heating.

1.8.3 The insulation structure for core to core bolts and core to clamp plates shall be able to withstand a voltage of 2 KV rms for 1 minute.

1.8.4 Core and windings shall be capable of withstanding shocks during transport, installation, service and adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions including short circuit condition.

1.8.5 All steel sections used for supporting the core shall be thoroughly sand blasted, after cutting, drilling and welding.

1.8.6 With bell type tank construction suitable projecting guides shall be provided on core assembly to facilitate removal from the tank.

1.8.7 Every care shall be exercised in the selection, treatment and handling of core steel to ensure that as far as practicable, the laminations are flat and finally assembled core is free from distortion.

1.8.8 Oil ducts shall be provided wherever necessary to ensure adequate cooling. The winding structure and major insulation shall not obstruct the free flow of oil through such ducts.

1.8.9 Adequate lifting lugs shall be provided to enable the core and windings to be lifted.

1.8.10 The supporting frame work of the cores shall be so designed as to avoid the presence of pockets which would prevent complete emptying of the tank through the drain valve.

1.8.11 The air core reactance of HV winding of transformer shall not be less than 20%.

1.9 EARTHING TERMINALS

Two earthing pads suitable for connecting mild steel flat shall be provided at positions close to each of the two bottom corners of the tank. These grounding terminals should be suitable for bolted connections. The earthing terminals shall be capable of carrying for 4 seconds the full load voltage, short circuit current of the transformer.

1.10 WINDINGS

1.10.1 The tenderer shall ensure that windings are made in dust proof, conditioned atmosphere. The tenderer shall furnish the facilities available at his works alongwith the Bid.

1.10.2 The conductors shall be of electrolytic copper. Current density in all the windings should not be more than 2.5 Amps/mm².

1.10.3 The insulation of transformer windings and connections shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse and be non-catalytic and chemically inert in transformer oil during service.
1.10.4 Coil assembly and insulating spacers shall be so arranged as to ensure free circulation of oil and to reduce hot spot of the winding.

1.10.5 220kV and 33kV star connected winding shall have graded insulation as defined in IEC-60076/IS-2026. The tertiary delta connected winding wherever applicable shall be insulated for the voltage specified in clause 3.7 of section-3. In the event the tenderer recommends to adopt higher insulation level of the tertiary, the offer should give complete detailed justification and calculations related thereto. Protection scheme shall be so designed that tertiary can be loaded for auxiliary supply.

1.10.6 The windings shall be designed to withstand impulse and power frequency test voltages as specified in IEC-60076/IS-2026 and clause 3.7 of Section-3 of the specification.

1.10.7 The windings shall be designed to reduce to a minimum the out of balance forces in the transformer at all voltage ratios.

1.10.8 The stacks of windings shall receive adequate shrinkage treatment before final assembly. Adjustable devices shall be provided for taking up possible shrinkages of coils in service.

1.10.9 No strip conductor shall have a width on edge exceeding six times its thickness.

1.10.10 The conductors shall be transposed at sufficient intervals in order to minimize eddy currents and equalize the distribution of currents and temperatures along the windings.

1.10.11 Core and winding shall be capable of withstanding the shock during transport, installation and service. Adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions.

1.10.12 Coil clamping rings, if provided, shall be of steel or of suitable insulating material. Axial laminated material other than bakelised paper shall not be used.

1.10.13 All threaded connections shall be provided with locking facilities. All leads from the winding to terminal board & bushings shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used where practicable.

1.11 TEMPERATURE INDICATING DEVICES

1.11.1 Oil Temperature Indicator (OTI):
The transformer shall be provided with a 150mm dial type thermometer for top oil temp, indication. The thermometer shall have adjustable, electrically independent ungrounded alarm and trip contacts, maximum reading pointer and resetting device. The thermometer shall be mounted on body of the transformer at a height of 1200 mm above rail top level.

1.11.2 Winding Temperature Indicator (WTI)
In the case of two winding transformers, winding temperature indicator shall be provided on LV side only and in case of three winding transformers winding temperature indicators shall be provided separately on all the three windings. It shall comprise the following:
   i) Temperature Sensing element
   ii) Thermal Image coil
   iii) Current Transformer
   iv) 150mm dial type temperature indicating instrument mounted on the transformer with maximum reading pointer and two adjustable electrically independent ungrounded contacts, one for high winding temperature alarm and one trip besides those required for control of cooling equipment.
   vi) Automatic ambient temp compensation.
   In addition to the above, the following remote indication equipment shall be provided for each of the winding:
   a) Single transmitter (for recording windings) temp.
   b) Remote winding temp. indicator shall be mounted on OLTC panel.

1.11.3 The tripping contacts of winding temperature indicators shall be adjustable to close between 60°C and 120°C and alarm contacts to close between 50°C and 100°C and both shall re-open when the temperature has fallen by about 10°C.
1.11.4 The contacts used to control the cooling plant motors on the above devices shall be adjustable
to close between 50°C and 100°C and to re-open when the temperature has fallen by 20°C.
1.11.5 All contacts shall be adjustable on a scale and shall be accessible on removal of the cover.
1.11.6 The temperature indicators shall be so designed that it shall be possible to check the operation
of the contacts and associated equipment.
1.11.7 Connections shall be brought from the temperature indicators to terminals placed inside the
marshalling box.
1.11.8 Cooler failure and oil flow alarm indication shall also be provided at local and remote end.

1.12 ANTI-EARTHQUAKE CLAMPING DEVICE
To prevent transformer movement during earthquake a clamping device should be provided
for fixing the transformer to the foundation. The tenderer shall supply necessary bolts for
embedding in the concreting.

1.13 INSULATING OIL
1.13.1 The insulating oil shall conform to the requirement of IS:335, IS:1448  IS: 6103, IS:6104,
IS:6792, IS:6262, IS:2362 & IS:1866. No inhibitors shall be used in the oil.
1.13.2 The necessary first filling of oil alongwith 10% extra oil for topping up shall be supplied, in
non-returnable containers suitable for outdoor storage.
1.13.3 The manufacturer shall dispatch the transformer filled in an atmosphere of dry inert nitrogen
gas. In this case necessary arrangement shall be ensured to take care of pressure drop of
nitrogen during transit and storage, till completion of oil filling, during erection. A gas
pressure testing valve with necessary pressure gauge and adaptor valve shall be provided.
1.13.4 In case the manufacture dispatches the transformer completely filled with oil, free from air
pockets, a specific relaxation may be requested.

1.14 OIL PRESERVATION EQUIPMENT
Tenderer can offer diaphragm type oil sealing in conservator to prevent oxidation and
contamination of oil due to contact with moisture/air.

1.14.1 DIAPHRAGM TYPE OIL SEALING
Each conservator shall be fitted with a dehydrating filter breather when diaphragm seal type
oil preservation system is provided. It shall be so designed that:
i) Passage of air is through a dust filter and silica-gel.
ii) Silica-gel is isolated from atmosphere by an oil seal.
iii) Moisture absorption indicated by a change in colour of the tinted crystals can be easily
observed from a distance.
iv) Breather is mounted not more than 1200mm above rail top level.

1.15 BUSHING INSULATORS AND TERMINALS
1.15.1 The electrical characteristics of bushings shall be in accordance with IEC-60137, IS: 2099 and
IS: 3347.
1.15.2 Bushing terminals shall be provided with terminal connectors of approved type and size for
connections of external parts. Details shall be got approved before manufacture. The flexible
bimetallic terminal connectors with laminated contacts at the bushings shall be designed to
withstand the electrical and mechanical stresses, arising out of temperature variations and fault
conditions. The terminal connectors shall conform to IS: 5561 and relevant IEC and also to
clause 3.13 of Section-III of this specification.
1.15.3 No arching horns/rod gaps shall be provided on the Transformer bushings.
1.15.4 Bushings for 220 KV side shall be oil filled condenser type and shall preferably be of the draw
lead type to facilitate removal.
For 33 KV side oil communicating type bushing may be used and for 11KV side porcelain
type bushing may be used.
1.15.5 Oil Filled Condenser type bushings shall be provided with
i) Oil level gauge
ii) Oil filling plug and drain valve if not hermetically sealed.

iii) Tap for capacitance test.

1.15.6 When bushings have an under-oil end of re-entrant form, the associated pull through lead shall be fitted with a gas bubble deflector.

1.15.7 Clamps for fittings of iron and steel shall be hot dip galvanized as per IS:2633 and relevant IEC.

1.15.8 The creep age distance of the bushing shall in no case be less than 25 mm / KV, suitable for heavily polluted atmosphere.

1.15.9 Tenderer shall provide details of Bushing CT’s at the time of detailed engineering.

1.15.10 Bushing details are as under:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Bushing</th>
<th>HV</th>
<th>LV</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>Rated Voltage (kV)</td>
<td>245</td>
<td>36</td>
<td>17.5</td>
</tr>
<tr>
<td>ii.</td>
<td>Rated current (Amp.)</td>
<td>800</td>
<td>3150</td>
<td>3150</td>
</tr>
<tr>
<td>iii.</td>
<td>1.2/50 micro sec. lightning impulse withstand voltage (kVp)</td>
<td>1050</td>
<td>170</td>
<td>170</td>
</tr>
<tr>
<td>iv.</td>
<td>250/2500 micro sec. Switching impulse withstand voltage (kVp.)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>v.</td>
<td>One minute power frequency withstand voltage kV (rms.)</td>
<td>460</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>vi.</td>
<td>Minimum total creepage distances (mm)</td>
<td>6125</td>
<td>900</td>
<td>438</td>
</tr>
</tbody>
</table>

1.16 **PROTECTIVE DEVICES**

The protective relaying of the power transformer shall be as under:-

a) Pressure relief valve for the main tank.

b) Buchholz Protection for main tank.

c) Sudden pressure relay for the main tank.

d) Surge relay for OLTC tank conservator.

e) Thermal Protection (Oil and windings with high temp.).

f) Tap changer out of step trip.

1.17 **TERMINAL MARKING**

The terminal marking and their physical position shall be in accordance with IEC-60076/IS: 2026.

1.18 **NEUTRAL EARTHING ARRANGEMENT**

1.18.1 The neutral terminal of transformer shall be connected to Neutral Current Transformer through brass/tinned copper bar and then brought to the ground level by a G.S. Flat, supported from the tank by using porcelain insulators. The end of the G.S. Flat shall be brought to the bottom of the tank, at a convenient point, for making bolted connection to two (2) 75x12 mm galvanized steel flats connected to Employer’s grounding mat.

1.19 **ON-LOAD TAP-CHANGING MECHANISM (O.L.T.C.)**

1.19.1 Each transformer shall be provided with an on-load tap changing mechanism. This shall be designed suitable for remote control operation from switch boards in the control room in addition to being capable of local manual as well as local electrical operation.

1.19.2 It shall not be possible to use the electric drive when manual gear is in use and it shall be possible to use only one electrical control at a time. Operation of the local or remote control switches shall cause one tap movement only until the control switch is returned to the off position for the next operation.

1.19.3 The local electrical control switches shall be mounted in the out door cubicle.

1.19.4 The equipment shall be so arranged as to ensure that when a tap change operation has been commenced it shall be completed independently of the operation of the control relays and switches. If a failure of the auxiliary supply during a tap change or any other contingency result in that movement not being completed, adequate means shall be provided to safeguard...
the transformer and its auxiliary equipment from damage. Supervisory indication shall be provided to indicate “The change incomplete” foul.

1.19.5
Limit switches may be connected in the control circuit of the operation motor provided that a mechanical de-clutching mechanism is incorporated. Otherwise it shall be directly connected to the operating motor circuit and mechanical stop provided.

1.19.6
Thermal devices or other means shall be provided to protect the motor and control circuits. All relays switches, fuses etc. shall be mounted in the marshalling box and shall be clearly marked to indicate their purpose.

1.19.7
The control circuit shall operate at 110 V single phase to be supplied from a transformer having a ratio of 230/55-0-55 V with the centre point earthed through a removable link mounted in the marshalling box.

1.19.8
The whole of the apparatus shall be of robust design and capable of giving satisfactory service without undue maintenance under the conditions to be met in service, including frequent operation.

1.19.9
A five-digit counter shall be fitted to the tap changing mechanism to indicate the number of operations completed by the equipment.

1.19.10
A permanently legible lubrication chart shall be fitted within the driving mechanism chamber.

1.19.11
The ON-LOAD Tap Changer shall include the following :-

a) An oil immersed tap selector and arcing switch or arc-suppressing tap selector, provided with resistor for reduction of make and break arcing voltage, overload and short circuits.

b) Motor driven mechanism.

c) Control and Protection devices.

d) Local and remote tap-changer position indicator.

e) Manual operating device.

1.19.12
The on-load tap changer shall be designed so that the contacts shall not interrupt arc within the main tank of the transformer. The tap selector and arcing switch or arc suppressing tap selector switch shall be located in one oil filled compartment. The compartment shall be provided with a means of releasing the gas produced by the arcing. It shall be designed so as to prevent the oil in the tap selector compartment from mixing with the oil in the transformer tank.

1.19.13
The oil in those compartments of the main tap-changing apparatus which do not contain contacts used for making or breaking current shall be maintained under conservator head by means of an adequate diameter pipe corresponding dia of OLTC oil surge relays connection from the highest point of the chamber connection corresponding to the dia. of OLTC oil surge relay from the highest point of the chamber to the conservator. This connection shall be controlled by a suitable valve and shall be arranged so that any gas leaving the chamber will pass into the gas and oil actuated relay.

1.19.14
The tap changer shall be capable of permitting parallel operation with other transformers for which necessary wiring and accessories, if any, shall be provided.

1.19.15
The centre of manual operating device shall be located at a height of 1000 mm from rail top so that it can be operated by a person standing at the ground level. The arrangement shall be strong and robust in construction. The transformer shall give full load output on all tap positions.

1.19.16
The control scheme for the tap changer shall be provided for independent control of the tap changers when the transformers are in independent service. In addition, provision shall be made to enable parallel operation control also at time so that the tap changer will be operated simultaneously when one unit is in parallel with another will not become out of step and this will eliminate circulating current.

Additional features like Master / Follower and visual indication during the operation of motor shall also be incorporated.

1.19.17
Necessary interlock, blocking independent control when the units are in parallel, shall be provided.

1.19.18
Under abnormal conditions such as may occur if the contactor controlling one tap changer sticks, the arrangement must be such as to switch off supply to the motor so that an out of step
condition is limited to one tap difference between the units. Details of out of step protection provided for the taps should be furnished in the bid.

1.19.19 The contactor and associated gear for the tap change driving motors shall be housed in a local kiosk mounted adjacent to the transformer. The motors shall be suitable for operation on 230 V single phase or 3-phase 440 V, 50 cycle external power supply. The kiosk having space heater, shall be dust and vermin proof and suitable protected against corrosion or deterioration due to condensation, fungi etc.

1.19.20 The supplier shall furnish, in addition to the above equipment, one indoor cubicle (RTCC panel) for installation in the Employer’s control room which shall contain:

a) Indication of the transformer ratio in use on each transformer and the number designating the tap in use by means of digital type indicators.
b) Raise and lower push Button switch and AVR Relay.
c) Independent/Master/Follower selector switch.
d) Remote tap position indicator with indicating lamp.
e) Repeater dial of winding temperature indicator for remote indication with a device for indicating hottest spot winding temperature in addition to a pointer to register the highest temperature reached.
f) An indication lamp showing tap change in progress.
g) Necessary audible and visual alarms.
h) Pressure relief device operation alarm.
i) Out of step relay with two spare contacts (2 NC and 2 NO).
j) The remote indoor cubicle in addition to the above indications shall also have the following trip and non-trip alarm windows facias with 5 spare windows suitable for 220V DC supply.

i) Oil Temperature alarm
ii) Winding Temperature alarm
iii) Winding temperature trip
iv) Buchholz alarm
v) Buchholz trip
vi) Sudden Pressure trip (Main tank)
vii) Surge Relay trip (OLTC Gear)
viii) Tap changer out of step alarm
ix) Low oil level alarm
x) Cooling fans working indication
xi) Oil pumps on and off indication
xii) Failure of group of fans alarm
xiii) Failure of group of oil pumps alarm
xiv) Failure of supply
 xv) Oil flow alarm

Each relay for tripping function shall have two normally open and two normally closed contacts for connection.

1.19.21 The OLTC shall be provided on the conservator side of the Power Transformer and not in front of H.V. Bushings.

1.19.22 OLTC shall be suitable for bi-directional power flow.

1.20 COOLING EQUIPMENT

1.20.1 Cooling fans for each radiator bank shall be housed in fan box to prevent ingress of rain water. Each fan shall be suitably protected by galvanized wire mesh guard. It shall be possible to remove the cooling fan with motors without disturbing and dismantling the cooler structural frame work.

1.20.2 Where OFAF cooling is applicable, two numbers of centrifugal oil pumps shall be used. Measures shall be taken to prevent mal-operation of Buchholz relay or sudden pressure relay when all oil pumps are simultaneously put into service. The pumps shall be so designed that on failure of power supply to the pump motor, the pump impeller will not limit the natural circulation of oil.
1.20.3 Cooling fans and oil pump motors shall be of squirrel cage, totally enclosed whether proof type suitable for operation on 400 volts, three phase, 50 Hz power supply. All motors having ball and roller bearings and grease lubricators shall be fitted with hexagonal nipples conforming to relevant Indian Standard.

1.20.4 An oil flow indicator with alarm contacts shall be provided for the confirmation of the oil pump operating in a normal state. An indication shall be provided on the control panel to indicate that the pump is running.

1.20.5 The coolers and their accessories shall be hot dip galvanized or corrosive resistant painted.

1.20.6 The supporting arrangement for the cooler units or for radiator banks shall be in such a manner that the stresses if developed, shall not be transferred to the flanges of the butterfly valves.

1.20.7 The shut off valves shall be provided on the tank at each point of connection of cooler units radiators to the transformer tank. Removable blanking plates shall be provided to permit blanking off the oil connection to cooler radiators.

1.20.8 All valves shall be of gun metal or cast steel or may have cast iron bodies with gun metal fittings. They shall be of full way type with internal screw and shall be opened by turning counter clock-wise when facing the hand wheel.

1.20.9 Means shall be provided for pad locking of valves in the open and closed position.

1.20.10 Every valve shall be provided with indicator to show clearly the position of the valve whether open or closed.

1.20.11 All valves shall be provided with flanges having machined faces.

1.20.12 The drilling of valve flanges shall comply with the requirements of IS:3639.

1.21 CONTROL OF COOLER OPERATION

1.21.1 Each motor or group of motors shall be provided with an electrically operated contactor and with control gear of suitable design both for starting and stopping the motor manually and also automatically from the contacts on the winding temperature indicating device as specified. Additional terminal for remote manual electrical control of motors shall be provided. Overload and single phasing protection shall be provided. HRC fuses shall be provided for short circuit protection. This equipment shall be accommodated in the marshalling box. The power supply shall be adequately and properly fused.

1.21.2 Where small motors are connected in groups, the group protection shall be arranged so that it operates satisfactorily in the event of a fault occurring on a single motor.

1.21.3 Where fans and oil pumps are provided, the connection shall be arranged as to allow the motors or groups of motors to be started up and shutdown either collectively or individually.

1.21.4 All motor contactors and their associated apparatus shall be capable of holding in and operating satisfactorily and without over heating for a period of ten minutes if the supply voltage falls for that period, to 75% of normal value and at normal frequency. The motor contactors and associated apparatus shall be capable of normal operation with a supply voltage of 85% of the normal value and at normal frequency.

1.21.5 All contacts and other parts which may require renewal, adjustment or inspection shall be readily accessible.

1.21.6 The control arrangements are to be so designed as to prevent the simultaneous starting of motors of total rating of more than 20 HP where such an eventually may arise, two step operation shall be preferred.

1.21.7 Alarm indication for failure of group of fans and oil pump shall be provided.

1.21.8 Alarm indication shall be provided to indicate failure of power supply.

1.21.9 Provision in the cooler control circuit may be made such that tripping of transformer breaker on Differential or Sudden Pressure should lead to supply disconnection to motor of the cooler pump.

1.22 MARSHALLING BOX

1.22.1 A sheet steel, vermin, dust proof, galvanized, well ventilated and weather-proof marshalling box of a suitable construction shall be provided for the transformer ancillary apparatus. The box shall have domed or sloping roofs and the interior and exterior painting shall be in
accordance with clause-1.25. Sheet thickness of the box shall not be less than 3.15mm and it shall be provided with lockable doors.

1.22.2 The marshalling box shall accommodate the following:
   a) Control and protection equipment for the local electrical control of tap changer.
   b) Control and protection equipment for the cooling plant.
   c) Terminal blocks and gland plates with electroplated brass glands for incoming and outgoing cables.

1.22.3 All the above equipments except(c) shall be mounted on panels and back of panel wiring shall be used for interconnection.

1.22.4 The temp. indicators shall be so mounted on the body of the transformer at a height of 1200 mm above rail top level.

1.22.5 Terminal block shall be adequate and suitable to adopt at least 4mm sq. control wires and loop connections. One piece moulded from non inflammable plastic material only with insulation barriers, stud type terminals, washers, nuts, lock nuts and identification strips. Separate studs shall be provided for incoming and outgoing wires. Making on the terminal strip shall correspond to the wire numbers on the wiring diagram.

Wire termination shall be made with solderless crimping type tinned cooper, lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire.

Supplier shall indicate the no. and size of control cables terminating at the marshalling box.

1.22.6 To prevent internal condensation an approved type of metal clad space heater shall be provided, controlled by a suitable switch. Cubicle lighting with door switch and ventilation louvers shall be provided. HRC cartridge fuse protection shall be provided for space heater and light. Supply shall be 230 V single phase 50 Hz AC.

1.22.7 All incoming cables shall enter the cubical from the bottom and the gland plate shall be not less than 450mm from the base of box. The gland plate and associated compartment shall be sealed in suitable manner to prevent the ingress of moisture from the cable trench. The marshalling box front and back shall be flushed with the ground level.

1.22.8 Drilled gland plate with proper blanking plates shall be provided for accommodating glands for incoming and outgoing cables. Sizes and number of glands to be provided shall correspond to the no. the control cables. Also the gland shall be suitable for earthing of armour.

1.23 CONTROL CONNECTIONS AND INSTRUMENT WIRING TERMINAL BOARD AND FUSES:

1.23.1 All wiring connections, boards, fuses and links shall be suitable for tropical atmosphere. Any wiring liable to be in contact with oil shall have oil resisting insulation and the bared ends of standard wire shall be sweated together to prevent creepage of oil along the wire.

1.23.2 There shall be no possibility of oil entering connection boxes used for cables or wiring.

1.23.3 Panel connections shall be neatly and squarely fixed to the panel. All instruments and panels wiring shall be run in PVC cleats of the limited compression or in ‘C’ type channels. All wiring to a panel shall be taken from suitable terminal boards.

1.23.4 Where conduits are used, the runs shall be laid with suitable falls, and the lowest parts 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.

1.23.5 Danger plates wherever necessary shall be provided.

1.23.6 All box wiring shall be in accordance with the relevant IS. All wiring shall be of high grade PVC or polythene insulated stranded copper of 1100V grade and size not less than 2.5 sq.mm. The cables shall be suitable for tropical climate and shall be vermin and fire proof.

1.23.7 All wires shall be suitably terminated with ferruled numbers in accordance with the schematic and wiring diagram for ease of identification and tracing of faults.

1.23.8 All those paints of interconnection between the wiring carried out on control equipments, 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.

1.23.9 The same ferrule number shall not be used on wires in different circuits on the same panel.
1.23.10 Ferrules shall be of insulated 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 damp or oil.

1.23.11 Stranded wires shall be terminated with tinned Ross Countney terminals, claw washers or crimped tubular lugs. Separate washers shall be used for each wire. The size of the washers shall be suitable to the size of the wire terminated. Wiring shall in general be accommodated on the sides of the box and the wires for each circuit shall be separately grouped and name plates fixed for each type of circuits.

1.23.12 Wires shall not be jointed or tied between terminal points.

1.23.13 Wherever practicable, 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.

1.23.14 Where apparatus is mounted on panels all metal cases shall be separately earthed by means of copper wire or strip having a cross-section of not less than 2 sq.mm where strip is used, the joints shall be suitably ferruled and crimped.

1.23.15 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 service. All diagrams shall show which view is employed.

1.23.16 Multicore cable tails shall be so bound that each wire may be traced without difficulty to its location.

1.23.17 The screens or screen pairs of multi-core cables shall be earthed at one end of the cable only. The position of earthing connections shall be shown clearly on the diagrams.

1.23.18 All terminal boards shall be mounted obliquely towards the rear door to give easy access to terminators and to enable ferrules numbers to be read without difficulty.

1.23.19 Terminal boards rows should be spaced not less than 100mm apart to permit convenient access to wires and terminations.

1.23.20 Terminal boards shall be so placed with respect to the cable gland (at a min. distance of 200 mm) as to permit satisfactory arrangement of multicore cable tails.

1.23.21 Terminal boards shall have pairs 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.

1.23.22 No live metal shall be exposed at the back of the terminal boards.

1.23.23 All fuses shall be of the cartridge type.

1.23.24 Fuses and links shall be labeled.

1.24 CLEANING AND PAINTING

1.24.1 Before painting or filling with oil or compound all un-galvanised parts shall be completely cleaned and freed from rust, scale and grease by pickling, degreasing process and all external surface cavities on castings shall be filled by metal deposition.

1.24.2 The interior of all transformer tanks and other oil filled chambers and internal structural steel works shall be cleaned of all scale and rust by shot blasting or other approved method. These surfaces shall be spray painted with hot oil resisting varnish or paint. Unexposed welds need not be painted.

1.24.3 Except for nuts, bolts and washers, which may have to be removed for maintenance purposes, all external surfaces shall receive a minimum of three coats of spray paint.

1.24.4 The primary coat shall be applied immediately after cleaning. The second coat shall be of an oil and weather resisting nature and preferably of a shade or colour easily distinguishable from the primary and final coats and shall be applied after the primary coat has been touched up where necessary. The final coat shall be of a glossy oil and whether resisting non-fading paint of shade No. 631 of IS:5. Primer paint shall be ready make zinc chrome as per IS:104; intermediate and final coats of paint shall be as per IS:2932.

1.24.5 Nuts, bolts and washers which may have to be removed for maintenance purposes shall receive a minimum of one coat of paint after erection.
1.24.6 All interior surfaces of mechanism chambers and kiosks except those which have receive anticorrosion – treatment shall receive three coats of paint applied to the thoroughly cleaned metal surface. The final coat shall be of an approved light coloured anti-condensation mixture.

1.24.7 Any damage to paint work incurred during transport and erection shall be made good by the supplier by thoroughly cleaning the damaged portion and applying the full number of coats of paint that had been applied before the damage was caused.

1.24.8 One coat of additional paint shall be given at site to the purchase. Supplier will also supply the requisite quantity of paint.

1.24.9 Cubical and marshalling kiosk sheets shall be phosphated before application of enamel paint.

1.25 BOLTS AND NUTS

1.25.1 Steel bolts and nuts exposed to atmosphere shall have suitable finishers like cadmium plated or zinc plated for diameters above 6mm.

1.25.2 All nuts/bolts and pins shall be locked in position with the exception of those external to the transformer.

1.25.3 On outdoor equipments all bolts, nuts and washers in contact with non-ferrous parts, which a carry curt shall be phosphor-bronze, where transfer of current is through the bolts.

1.25.4 If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, suitable special spanners shall be provided by the supplier.

1.26 PACKING

The packing shall be in accordance with the tenderer’s standard practice but he shall give full particulars of packing for the approval of the Employer. All parts shall be adequately marked to facilitate field erection. Boxes and crates shall be marked with the contract number and shall have a packing list enclosed showing the parts contained therein.

1.27 LABELLING

The transformer shall be labeled with the name of the substation where proposed to be installed. The label plate shall be fixed adjoining the name and plate and shall be of similar design so as to match with the name plate. The transformer should only be dispatched with the name plate and the labeling plate indicating the name of the sub station thereon.

1.28 TRANSPORTATION

1.28.1 Transportation of power transformer shall be done on Hydraulic trailer. It is mandatory condition which the supplier is bound to follow.
SECTION – II : INSPECTION AND TESTING

2.0 INSPECTION AND TESTING
The Contractor shall carry out a comprehensive inspection and testing programme during manufacture of the equipment. An indication of inspection envisaged by the Employer is given under Clause 2.1. This is however not intended to form a comprehensive programme as it is Contractor’s responsibility to draw up and carry out such a programme in the form of detailed quality plan duly approved by Employer for necessary implementation.

2.1 Inspection
2.1.1 Tank and Conservator
2.1.1.1 Certification of chemical analysis and material tests of plates.
2.1.1.2 Check for fitness.
2.1.1.3 Electrical interconnection of top and bottom by braided tinned copper flexible.
2.1.1.4 Welder’s qualification and weld procedure.
2.1.1.5 Testing of electrodes for quality of base materials and coatings.
2.1.1.6 Inspection of major weld preparation.
2.1.1.7 Crack detection of major strength weld seams by dye penetration test.
2.1.1.8 Measurement of film thickness of:
   i). Oil insoluble varnish.
   ii). Zinc chromate paint.
   iii). Finished coat.
2.1.1.9 Check correct dimensions between wheels; demonstrate turning of wheels through 90° C and further dimensional check.
2.1.1.10 Check for physical properties of materials for lifting lugs, jacking pads, etc. All load bearing welds including lifting lug welds shall be subjected to Non Destructive Testing (NDT).
2.1.1.11 Leakage test of the conservator.
2.1.1.12 Certification of all test results.

2.1.2 Core
2.1.2.1 Sample testing of core materials for checking specific loss, bend properties, magnetization characteristics and thickness.
2.1.2.2 Check on the quality of varnish if used on the stampings:
   i). Measurement of thickness and hardness of varnish on stampings.
   ii). Solvent resistance test to check that varnish does not react in hot oil.
   iii). Check over all quality of varnish by sampling to ensure uniform shining colour, no bare spots,
    no over burnt varnish layer and no bubbles on varnished surface.
2.1.2.3 Check on the amount of burrs.
2.1.2.4 Bow check on stampings.
2.1.2.5 Check for the overlapping of stampings. Corners of the sheet are to be part.
2.1.2.6 Visual and dimensional check during assembly stage.
2.1.2.7 Check for interlaminated insulation between core sectors before and after pressing.
2.1.2.8 Check on completed core for measurement of iron loss and check for any hot spot by exciting the core so as to induce the designed value of flux density in the core.
2.1.2.9 Visual and dimensional checks for straightness and roundness of core, thickness of limbs.
2.1.2.10 High voltage test (2kV for one minute) between core and clamps.
2.1.2.11 Certification of all test results.

2.1.3 Insulation Material
2.1.3.1 Sample check for physical properties of materials.
2.1.3.2 Check for dielectric strength.
2.1.3.3 Visual and dimensional checks.
2.1.3.4 Check for the reaction of hot oil on insulating materials.
2.1.3.5 Dimension stability test at high temperature for insulating material.
2.1.3.6 Tracking resistance test on insulating material.
2.1.3.7 Certification of all test results.

2.1.4 **Winding**

2.1.4.1 Sample check on winding conductor for mechanical properties and electrical conductivity.
2.1.4.2 Visual and dimensional checks on conductor for scratches, dent marks etc.
2.1.4.3 Sample check on insulating paper for pH value, bursting strength and electric strength.
2.1.4.4 Check for the reaction of hot oil on insulating paper.
2.1.4.5 Check for the bonding of the insulating paper with conductor.
2.1.4.6 Check and ensure that physical condition of all materials taken for windings is satisfactory and free of dust.
2.1.4.7 Check for absence of short circuit between parallel strands.
2.1.4.8 Check for brazed joints wherever applicable.
2.1.4.9 Measurement of voltage ratio to be carried out when core/ yoke is completely restacked and all connections are ready.
2.1.4.10 Conductor enamel test for checking of cracks, leakage and pin holes.
2.1.4.11 Conductor flexibility test.
2.1.4.12 Heat shrink test for enameled wire.
2.1.4.13 Certification of all test results.

2.1.5 **Checks Before Drying Process**

2.1.5.1 Check condition of insulation on the conductor and between the windings.
2.1.5.2 Check insulation distance between high voltage connections, cables and earth and other live parts.
2.1.5.3 Check insulating distances between low voltage connections and earth and other parts.
2.1.5.4 Insulation of core shall be tested at 2 kV/ minute between core to bolts and core to clamp plates.
2.1.5.5 Check for proper cleanliness and absence of dust etc.
2.1.5.6 Certification of all test results.

2.1.6 **Checks During Drying Process**

2.1.6.1 Measurement and recording of temperature, vacuum and drying time during vacuum treatment.
2.1.6.2 Check for completeness of drying by periodic monitoring of IR and Tan delta.
2.1.6.3 Certification of all test results.

2.1.7 **Assembled Transformer**

2.1.7.1 Check completed transformer against approved outline drawings, provision for all fittings, finish level etc.
2.1.7.2 Test to check effective shielding of the tank.
2.1.7.3 Jacking test with oil on all the assembled transformers.
2.1.7.4 Dye penetration test shall be carried out after the jacking test.

2.1.8 **Bought Out Items**

2.1.8.1 The makes of all major bought out items shall be subject to Employer’s approval.
2.1.8.2 The Contractor shall also prepare a comprehensive inspection and testing programme for all bought out/ sub-contracted items and shall submit the same to the Employer for approval. Such programme shall include the following components:
   a) Buchholz Relay.
   b) Pressure Relief Valve.
   c) Axles and wheels.
   d) Winding temperature indicators for local and remote mounting.
   e) Oil temperature indicators.
   f) Bushings.
   g) Bushing current transformers.
   h) Cooler control cabinet.
   i) Cooling equipment.
   j) Oil pumps.
   k) Fans/ Air Blowers
   l) Tap change gear.
   m) Terminal connectors.
   n) Transformer Oil.

The above list is not exhaustive and the Contractor shall also include other bought out items in his programme.
2.2 Factory Tests.

2.2.1 Routine Tests

2.2.1.1 All standard routine tests in accordance with IS: 2026 with dielectric tests corresponding to Method 2 shall be carried out on each transformer. Operation and dielectric testing of OLTC shall also be carried out as per IS: 2026.

2.2.1.2 The Routine test should be done in the following sequence of testing:-

1. Transformer turn ratio test.
2. Magnetising current with single phase A.C. supply
4. Short circuit test at 400V, 3 phase A.C. supply
5. D.C. resistance Test.
6. I.R. Value in Mega Ohm by Meggar.

2.2.1.3 Following additional routine tests shall also be carried out on each transformer:

1. Magnetic Circuit Test
   After assembly each core shall be tested for 1 minute at 2000 Volts between core and core belts.
2. Oil leakage test on transformer tank as per Clause 2.2.6.1 below.
3. Magnetic balance test
4. Measurement of no-load current with 415V, 50Hz ac supply on LV side.
5. Frequency response analysis (FRA).
6. High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.

2.2.2 Type Tests

2.2.2(a) Following type test shall be conducted on one Transformer of each rating:

2.2.2.1 Tank vacuum Test as per Cl. No. 2.2.6.2(i) below.
2.2.2.2 Tank pressure Test as per Cl. No. 2.2.6.2 (ii) below.
2.2.2.3 Lightning Impulse withstand test in all phases as per IS: 2026.

2.2.2(b) In addition to above, the following tests shall be perform on each transformer.

2.2.2.1 Temp. Rise Test as per IS: 2026 (Part-II).
   Gas chromatographic analysis on oil shall also be conducted before and after this test and the values shall be recorded in the test report. This sampling shall be in accordance with IEC 567. For the evaluation of the gas analysis in temperature rise test the procedure shall be as per IS:9434 (based on IEC:567) and results will be interpreted as per IS:10593 (based on IEC-599).
   The temperature rise test shall be conducted at a tap for the worst combination of loading on the three windings of the transformer. The Contractor before carrying out such test shall submit detailed calculation showing alternatives possible, on various taps and for the three types of ratings of the transformer and shall recommend the combination that results in highest temperature rise for the test. The Thermo Vision Scanning and Images shall be taken during Heat Run Test.

2.2.2.2 Measurement of capacitance and Tan Delta of Bushing and Winding. The value of Tan Delta should not exceed 1.0%.

2.2.3 Additional type tests

Following additional type tests other than type and routine tests shall also be carried out on one unit of each type:

2.2.3.1 Measurement of zero Seq. reactance (As per IS:2026).
2.2.3.2 Measurement of acoustic noise level.
2.2.3.3 Measurement of power taken by fans and oil pumps.
2.2.3.4 Measurement of harmonic level in no load current.
2.2.3.5 Measurement of transferred surge on LV (tertiary) winding due to HV lightning impulse and IV lightning impulse.

2.2.4 Routine tests on bushings

The following tests shall be conducted on bushings

2.2.4.1 Test for leakage on internal fillings.
2.2.4.2 Measurement of creepage distance, dielectric dissipation factor and capacitance.
2.2.4.3 Dry power frequency test on terminal and tapping.
2.2.4.4 Partial discharge test followed by dielectric dissipation factor and capacitance measurement.
2.2.5 Type Tests on fittings:
All the following fittings shall conform to type tests and the type test reports shall be furnished by the contractor along with the drawings of equipment/ fittings. The list of fittings and the type test requirement is:

1. Bushing (Type Test as per IS:2099/ IEC:137)
2. Buchholz relay (Type Test as per IS:3637 and IP-55 Test on terminal box)
3. OLTC (Temperature Rise of contact, Short circuit current test, Mechanical test and Dielectric Test as per IEC:214 and IP-55 test on driving mechanism box)
4. Cooler control Cabinet (IEC-55 test)
5. Pressure Relief device Test
   The pressure Relief Device of each size shall be subjected to increase in oil pressure. It shall operate before reaching the test pressure specified in transformer tank pressure test at Cl. No. 2.2.6.2 (ii) below. The operating pressure shall be recorded. The device shall seal off after excess pressure has been released.
   The terminal box/ boxes of PRD should conform to degree of protection as per IP-55 of IS: 13947.
6. Magnetic Oil Level gauge & Terminal Box for IP-55 degree of protection.
7. Air Cell (Flexible air separator)- Oil side coating, Air side under Coating, Air side outer coating and coated fabric as per IS:3400/BS:903/ IS:7016.
8. OTI & WTI – Switch setting & operation, Switch differential, Switch rating.
9. Oil pump – Vacuum Test at 250 torr maximum, oil pressure test at 1 kg/cm2 for 24 hrs. Temperature rise test by resistance method. IP -55 degree of protection for terminal box.
10. Cooling fan and motor assembly- Free air delivery, Temperature rise, sound level, running at reduced voltage, IP-55 degree of protection for terminal box.

2.2.6 Tank Test
2.2.6.1 Routine Tests
   Oil Leakage Test
   All tanks and oil filled compartments shall be tested for oil tightness by being completely filled with air or oil of a 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/Sq.m ( 5 psi) measured at the base of the tank. The pressure shall be maintained for a period of not less than 12 hours for oil and one hour for air during which time on leak shall occur.

2.2.6.2 Type Tests
   (i) Vacuum Test
   One transformer tank of each size shall be subjected to the specified vacuum. The tank designed for full vacuum shall be tested at an internal pressure of 3.33 KN/Sq.m absolute (25 torr) for one hour. The permanent deflection of flat plate after the vacuum has been released shall not exceed the values specified below:

<table>
<thead>
<tr>
<th>Horizontal Length of flat plate( in mm)</th>
<th>Permanent deflection ( in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto and including 750</td>
<td>5.0</td>
</tr>
<tr>
<td>751 to 1250</td>
<td>6.5</td>
</tr>
<tr>
<td>1251 to 1750</td>
<td>8.0</td>
</tr>
<tr>
<td>1751 to 2000</td>
<td>9.5</td>
</tr>
<tr>
<td>2001 to 2250</td>
<td>11.0</td>
</tr>
<tr>
<td>2251 to 2500</td>
<td>12.5</td>
</tr>
<tr>
<td>2501 to 3000</td>
<td>16.0</td>
</tr>
<tr>
<td>Above 3000</td>
<td>19.0</td>
</tr>
</tbody>
</table>

   (ii) Pressure Test
   One transformer tank of each size, its radiator, conservator vessel and other fittings together or separately 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, the permanent deflection of flat plates after the excess pressure has been released shall not exceed the figure specified above for vacuum test.

**Pre-Shipment Checks at Manufacturer’s Works**

2.2.6.3 Check for interchangeability of components of similar transformers for mounting dimensions.
2.2.6.4 Check for proper packing and preservation of accessories like radiators, busings, dehydrating breather, rollers, buchholz relay, fans, control cubicle, connecting pipes, conservator etc.
2.2.6.5 Check for proper provision for bracing to arrest the movement of core and winding assembly inside the tank.
2.2.6.6 Gas tightness test to confirm tightness.
2.2.6.7 Derivation of leakage rate and ensure the adequate reserve gas capacity.

**2.3 Inspection and Testing at Site**
The Contractor shall carry out a detailed inspection and testing programme for field activities covering areas right from the receipt of material stage upto commissioning stage. An indicative programme of inspection as envisaged by the Employer is given below. However, it is contractor’s responsibility to draw up and carry out such a programme duly approved by the Employer. Testing of oil sample at site shall be carried out for BDV, Moisture content, Tan Delta at 90 deg C, Resistivity at 90 deg C and interfacial tension.

**2.3.1 Receipt and Storage Checks**
2.3.1.1 Check and record condition of each package, visible parts of the transformer etc. for any damage.
2.3.1.2 Check and record the gas pressure in the transformer tank as well as in the gas cylinder.
2.3.1.3 Visual check for wedging of core and coils before filling up with oil and also check conditions of core and winding in general.
2.3.1.4 Check and record reading of impact recorder at receipt and verify the allowable limits as per manufacturer’s recommendations.

**2.3.2 Installation Checks**
2.3.2.1 Inspection and performance testing of accessories like tap changers, cooling fans, oil pumps etc.
2.3.2.2 (i) Check the direction of rotation of fans and pumps.
(ii) Check the bearing lubrication.
2.3.2.3 Check whole assembly for tightness, general appearance etc.
2.3.2.4 Oil leakage test
2.3.2.5 Test on Oil Sample.
2.3.2.6 Capacitance and tan delta measurement of busing before fixing/ connecting to the winding, contractor shall furnish these values for site reference.
2.3.2.7 Leakage test on bushing before erection.
2.3.2.8 Measure and record the dew point of nitrogen in the main tank before assembly.

**2.3.3 Commissioning Checks**
2.3.3.1 Check the colour of silica gel in silica gel breather.
2.3.3.2 Check the oil level in the breather housing, conservator tanks, cooling system, condenser bushing etc.
2.3.3.3 Check the bushing for conformity of connection to the lines etc.
2.3.3.4 Check for correct operation of all protection devices and alarms:
(i) Buchholz relay.
(ii) Excessive winding temperature.
(iii) Excessive oil temperature.
(iv) Low oil flow.
(v) Low oil level indication.
(vi) Fan and pump failure protection.
2.3.3.5 Check for the adequate protection on the electric circuit supplying the accessories.
2.3.3.6 Check resistance of all windings on all steps of the tap changer. Insulation resistance measurement for the following:
(i) Control Wiring
(ii) Cooling system motor and control
(iii) Main windings
(iv) Tap changer motor and control.
2.3.3.7 Check for cleanliness of the transformer and the surroundings.
2.3.3.8 Continuously observe the transformer operation at no load for 24 hours.
2.3.3.9 Gradually put the transformer on load, check and measure increase in temperature in relation to the load and check the operation with respect to temperature rise and noise level etc.
2.3.3.10 Phase out and vector group test.
2.3.3.11 Ratio test on all taps.
2.3.3.12 Magnetizing current test.
2.3.3.13 Capacitance and Tan delta measurement of winding and busing after assembly of transformer. It will provide a base data which would act as guideline for maintenance staff for subsequent condition monitoring of the transformer.
2.3.3.14 DGA of oil just before commissioning and after 24 hours energisation at site.
2.3.3.15 Frequency response analysis (FRA).
2.3.3.16 Contractor shall prepare a comprehensive commissioning report including all commissioning test results and forward to Employer for future record.
3.0 **TYPE & RATING**

The power transformer shall be of core or shell type construction oil immersed, ONAN/ONAF/OFAF cooled, 3 phase unit suitable for outdoor service as step up/step down transformer. The rating and electrical characteristics shall be as follows:

<table>
<thead>
<tr>
<th>SYSTEM PARAMETERS</th>
<th>220 KV</th>
<th>33 KV</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Rated Voltage of Equipment (KV)</td>
<td>245</td>
<td>36</td>
</tr>
<tr>
<td>ii) Rated impulse voltage withstand level (peak) (KV)</td>
<td>1050</td>
<td>170</td>
</tr>
<tr>
<td>iii) Rated one-minute power frequency withstand voltage (r.m.s.) (KV)</td>
<td>460</td>
<td>70</td>
</tr>
<tr>
<td>iv) Rated short time current rating for 1 sec. (r.m.s.) (KA)</td>
<td>40</td>
<td>31.5</td>
</tr>
</tbody>
</table>

3.1 **NORMAL CONTINUOUS RATING IN M.V.A.**

- a) H.V. Winding summation of (b) and (c), limited to 100MVA
- b) L.V. Winding 100 MVA
- c) Tertiary Winding 100/3 MVA

- c) In case of star/star connected transformer where a specified the stabilizing winding (tertiary winding) shall be capable of carrying continuously the capacitive load to 100% rating of tertiary as specified.

The stabilizing winding shall be designed with particular attention to the suppression of harmonic voltage, especially the third and fifth, so as to eliminate wave-form distortion and possibility of high frequency disturbances, including switching surges, inductive effects or of circulating currents between the neutral points at different transforming stations reaching such a magnitude as to cause interference with communication circuits. The percentage of third and fifth harmonic shall be specified. The stabilizing winding shall be designed for 170 KV peak B.I.L. Also refer clause 1.10.5.

Windings shall be capable to withstand short circuit currents resulting from different types of system faults that can arise in service associated with relevant system earthing conditions.

3.2 **RATED VOLTAGE**

- a) H.V. Winding 220 KV
- b) L.V. Winding 33 KV
- c) Tertiary winding 11 KV

3.3 **CONNECTIONS**

- a) H.V. Winding Star neutral solidly earthed
- b) L.V. Winding Star neutral solidly earthed
- c) Tertiary Winding Delta

3.4 **VECTOR GROUP**

YNyn0d11

3.5 **TYPE OF COOLING AND RATING**

- a) ONAN 60%
- b) ONAF 80%
3.6 **IMPEDEANCE VOLTAGE AT RATED CURRENT FOR THE PRINCIPAL TAPPINGS**

- a) HV to LV: 16% allowable variances as per IS
- b) HV to Tertiary: 24% allowable variances as per IS
- c) LV to Tertiary: 12% allowable variances as per IS

The value of impedance on other taps shall be indicated subject to the approval of the Employer at the time of order.

3.7 **INSULATION LEVEL:**

<table>
<thead>
<tr>
<th>Nominal Voltage For equipment KV rms.</th>
<th>Highest system Voltage for equipment KV rms.</th>
<th>Lightening impulse withstand voltage KV peak</th>
<th>Induced over voltage withstand voltage KV rms</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>12</td>
<td>170*</td>
<td>70</td>
</tr>
<tr>
<td>33</td>
<td>36</td>
<td>170</td>
<td>70</td>
</tr>
<tr>
<td>220</td>
<td>245</td>
<td>1050</td>
<td>460</td>
</tr>
</tbody>
</table>

* Also refer clause 1.10.5

The bay width of the 220kV yard is 16.65 metres and as such the bidder may specifically note that the length of the transformer along with the bay width shall not be more than 12.5 Metres. The electrical clearance should be suitable for erecting transformers in two adjacent bays. If adjacent transformers are separated by a distance more than minimum clearance required but less than 35 meters, fire protection wall will be provided between them.

The barrier wall of brick or reinforced cement concrete shall be provided for separation of transformer wherever adequate space is not available. The barrier shall extend at least 300 mm above the transformer bushing and pressure relief vent and length wise 600 mm beyond the transformer including any radiators and tap changer enclosure.

3.8 **Service:**

- a) Rated Frequency: 50 Hz
- b) Number of phases: 3 (three)

3.9 **On load tap-changer:**

The on load tap-changer shall be in the steps of 1.1/4% on HV winding for HV variation from +5% to -15% in 16 equal steps. Tap No. 5 shall be the Principal Tap.

3.10 **CLEARANCES:**

The clearances in air between live conductive parts and between live conductive parts to earthed structure shall be as follows:-

<table>
<thead>
<tr>
<th>Nominal system Voltage KV rms</th>
<th>Test Impulse Voltage kV peak</th>
<th>clearances (mm)</th>
<th>Phase to phase</th>
<th>Phase to earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>170</td>
<td>280</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>170</td>
<td>350</td>
<td>320</td>
<td></td>
</tr>
</tbody>
</table>
3.11 Temperature Rises:-
With reference to ambient temperatures adopted for purpose of this specification, the temperature rise shall be as under:-

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Part</th>
<th>External Cooling Winding (Air)</th>
</tr>
</thead>
</table>
| i)    | Winding (temp.) | (i) 55°C when the oil circulation is natural rise by resistance or forced non-directed.  
|       |                | (ii) 60°C when the oil circulation is forced directed. |
| ii)   | Top oil (Temp. rise 50°C) | when the transformer is equipped with conservator. |

3.12 PARALLEL OPERATION:
The power transformers with O.L.T.C. shall be suitable for parallel operation.

3.13 Bushing
Each bushing shall be capable to carry at least 200% current at C.M.R. and to withstand short circuit current of not less then ten times of the nominal current of three seconds.

220KV Terminals & 33KV Terminals: Bidder shall provide the proper arrangements/ techniques for connection of transformer with GIS as detailed out in the technical specifications.

11KV Terminals: Oil communicating type porcelain bushing on top of transformer tank. Arrangement of connecting Single ACSR conductor/ bus bar to Aux. LT Transformer through Isolator, C.T., P.T and Circuit breaker, shall be provided.

3.14 FLUX DENSITY
i) The maximum designed continuous flux density in any part of the cored and yoke at normal voltage and frequency shall not exceed 1.6 TESLA.

ii) The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall be such that the flux density on any tap position with plus 10% voltage variation from voltage corresponding to the tap shall not exceed 1.9 TESLA

3.15 RADIO INFLUENCE AND NOISE LEVEL:
i) The transformer shall be designed with particular attention to the suppression of maximum harmonic voltage, especially the third and fifth, so as to minimize interference with communication circuit.

ii) The noise-level when energized at normal voltage and frequency with fans and pumps running shall not be more than 0.5 db above the NEMA Standard Publication TR-1.

3.16 CONTINUOUS MAXIMUM RATING & OVERLOAD
a) Transformer specified for mixed cooling shall be capable of operating under the natural cooled condition upto the specified load. The forced cooling equipment shall come into operation by contacts of winding temperature indicator and the transformer shall operate as a forced cooled unit.

b) Total cooling system of transformer with oil forced and air forced (OFAF) cooling shall be so designed that during total failure of power supply to cooling fans and oil pumps the transformer shall be able to operate at full load for atleast ten minutes without the calculated winding hot spot temperature exceeding 150°C. Also stopping of one or two cooling fans should not have any effect on the cooling system. For
transformer with oil natural and air forced (ONAF) cooling a similar cooling system should be designed in case of a total loss of power supply to cooling fans.

c) The transformers shall be capable of being loaded in accordance with IS:6600. There shall be no limitations imposed by bushings, tap changer etc. Please refer clause 3.13.

d) The transformer shall be capable of being operated without danger on any tapping at the rated KVA, with voltage variation of ± 10% corresponding to the voltage of the tapping.

e) The transformers and all its accessories shall be designed to withstand without injury, the thermal and mechanical effects of any external short circuit to earth and of short circuits at the terminals of any winding for a period of 3 secs. The short circuit level of the HV & IV system to which the subject transformers will be connected is 40KA for 220KV system and 31.5KA for 33KV system. The calculation in support of short circuit withstand capacity of Transformer is to be submitted by the tender or the Transformer will be subjected to short circuit test, if desired by DTL.

3.17 FITTINGS AND ACCESSORIES

The fittings and accessories as per annexure ‘A’ shall be provided with each transformer covered in this specification.

3.18 GUARANTEE, EVALUATION OF LOSSES & PENALTIES:

3.18.1 The Indian Standards specification IS:2026 allow certain tolerances for acceptance of the transformer no load and load losses. The bidders are to indicate whether the figures given for guaranteed losses in schedule of guaranteed technical particulars are with or without such tolerances. If tolerances are applicable, the limits for the same should be indicated. In the absence of any information to this effect, the figures for no load and load losses (including auxiliary losses) will be increased by 10% as provided in IEC-60076 & IS:2026). Any changes in the figures assigned for transformer loses will not be permitted after opening of the bids and bid evaluation will be carried out on the basis of information made available at the time of bid opening.

3.18.2 The no load loss in kilo-watts at rated voltage and rated frequency and the total losses in kilo-watts at rated output, rated voltage and rated frequency shall be guaranteed under penalty, For the purpose of penalty computations, the test figures of these losses shall be compared with the corresponding guaranteed figures.

3.18.3 The penalties shall be separately evaluated from the excess of the test figures of the no-load loss in kilo-watts, over the corresponding guaranteed value and the excess of the difference between the test values of the total losses and the no-load loss in kilowatts, over the difference of the corresponding guaranteed values. No tolerance shall be permitted over the test figures of the losses.

3.18.4 The penalties shall be calculated at the rate of Rs.171300/- per kilo-watt for the excess of no-load loss, the rate of Rs.69900/- per kilo watt for the excess of difference in the total and the no-load losses and the rate of Rs.68500/- per KW for cooler Loss. For fraction of kilo-watt, the penalties shall be applied pro-rata.

3.18.5 For the purpose of comparison of tenders, the quoted prices shall be equalized for the transformer losses at the following rates:

   i) No load losses : @ Rs.171300/- per KW  
   ii) Load losses : @ Rs.69900/- per KW  
   iii) Cooler Loss (KW): @ Rs.68500/- per KW

3.18.6 The bidder should note that values assigned for the capitalization of losses are based on the present worth and therefore capitalization of investment will not be made separately.

3.19 GUARANTEE, EVALUATION OF AUXILIARY POWER CONSUMPTION AND PENALTIES:
3.19.1 The power consumed at full load by the fans, oil pumps and any other auxiliary apparatus shall be stated in the offer which shall be guaranteed. Tolerance, if any on this figure shall also be indicated failing which a tolerance of 10% shall be assumed. For the purpose of evaluation of tenders and imposition of penalty the guaranteed figure after taking in account the maximum tolerance if any, shall be assumed.

3.19.2 For the purpose of evaluation of tenders, the power consumption (i.e. installed capacity) of the auxiliaries shall be considered for 20% of the capacity and shall be capitalized to arrive at the final evaluated price for comparison. For the purpose of evaluation, the rates as given in para 3.18.4 above shall be taken.

3.20 **REJECTION**

The Employer may reject any transformer if during tests or service any of the following conditions arise :-

- a) No load loss exceeds the guaranteed value by 15% or more.
- b) Load loss exceeds the guaranteed value by 15% or more.
- c) Total losses exceed the guaranteed value by 10% or more.
- d) Impedance value exceeds the guaranteed value by ±10% or more.
- e) Transformer fails on impulse test.
- f) Transformer fails on power frequency voltage withstand test.
- g) Transformer is proved to have been manufactured not in accordance with the specification.

3.21 **SPARE PARTS & MAINTENANCE EQUIPMENT**

In making a bid for the equipment, the Bidder may offer recommended spare parts and a list of optional accessories, the rates of which will be valid for two years from the date of successful commissioning of sub station.

3.22 **STANDARD**

The transformer shall generally conform to the IEC/IS specification and CBIP recommendations except for certain technical variations as per specification.

3.23 Transformer shall be provided with gas collecting device.
SECTION-IV : NEUTRAL CURRENT TRANSFORMER

4.1 NCT for 220 KV side Neutral for 220/33/11kV Transformers (100MVA)

a) C.T. Ratio 400/1 A
b) Highest voltage for equipment 17.5 KV
c) Rated short duration power frequency withstand voltage 38 KV(r.m.s)
d) Secondary current 1 Amp.
e) Rated impulse withstand voltage 95 KV (P)
f) Purpose Relaying (restricted earth fault protection)
g) Class of accuracy PS
h) Min. Knee point voltage $V_k > K.I_x (R_{ct} + R_b) V$
   (Rct.-Resistance of secondary winding)
i) Max. exciting current at $V_k/2$ 30 mA

4.2 NCT for 33 KV side Neutral of 220/33/11 KV Transformers (100 MVA)

a) C.T. Ratio 2000-1000/1 A
b) Highest voltage for equipment 17.5 KV
c) Rated short duration power frequency withstand voltage 38 KV
d) Rated impulse withstand voltage 95 KV (P)
e) Purpose Relaying (restricted earth fault protection)
f) Secondary current 1 Amp.
g) Class of accuracy PS
h) Min. Knee point voltage $V_k > K.I_x (R_{ct} + R_b) V$
   (Rct.-Resistance of secondary winding)
i) Max. exciting current at $V_k/2$ 30 mA

4.3 CONSTRUCTION DETAILS:

4.3.1 The current transformers shall be oil immersed and self cooled outdoor type suitable for the specified services indicated, completed in all respects and in accordance with best engineering practice design and workmanship.

4.3.2 The core shall be of high grade non ageing, electrical silicon laminated steel of low hysteresis loss high permeability to ensure high accuracy at both normal and over current, extended current conditions and shall produce undistorted secondary current under transient conditions at all ratios.

4.3.3 The oil immersed CT shall be hermetically sealed to eliminate breathing and to prevent air and moisture and shall be provided with a pressure relieving device capable to releasing abnormal internal
pressure. C.T. shall be provided with oil level gauge, and necessary arrangement for replacing the oil shall be provided.

4.3.4 The current transformers shall be suitable for simultaneous 100% full load continuous rating of the winding.

4.3.5 The ratio changing taps if any, shall be provided only on the secondary winding of the C.T.

4.3.6 Current transformers cores to be used for protective relaying purposes shall be of accuracy class specified, suitable for restricted earth fault protection.

4.3.7 The secondary terminals shall be brought out in a weather proof terminal box (with degree of protection IP55) on the side of the current transformer and shall be accessible through a removable cover. The secondary tap shall be adequately reinforced to withstand normal handling without damage. Suitable cable glands shall be provided to accommodate purchaser’s control cables.

4.3.8 The maximum permissible temperature rise of the windings over the ambient shall not exceed 40°C.

4.3.9 The magnetising curve for each core shall be furnished with the tender.

4.3.10 The secondary terminals shall be provided with short circuiting and earthing arrangements at the terminal block.

4.3.12 The C.T.s shall be suitable for horizontal as well as vertical transportation.

4.4 **INSULATING OIL:**

The quality of insulating oil in each transformer shall be best available and the complete specification of the oil shall be furnished in the tender. The current transformers offered shall be hermetically sealed completely filled with insulating oil. The insulating oil shall conform to the latest Indian Standard specification No. 335.

4.5. **BUSHINGS / INSULATORS:**

i) a) Porcelain used in bushing / Insulator manufacture shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might effect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

b) Glazing of the porcelain shall be of uniform brown colour free from blisters, burrs and similar other defects. Bushings shall be designed to have ample insulation, mechanical strength and rigidity for the conditions, under which they will be used.

ii) When operating at normal rated voltage there will be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the bushings/ Insulator when operating at the normal rated voltage.

iii) All iron parts shall be hot dip galvanized and all joints shall air tight. Surfaces of the joints shall be trued up, porcelain parts by grinding and metal parts by machining. Bushing/ Insulator design shall be such as to ensure a uniform compressive pressure on the joints.

iv) The creepage distance of the bushing /Insulator shall in no case be less than 25mm/KV, suitable for heavily polluted atmosphere.

v) Bushing/ Insulator shall be tested for type tests and routine tests in accordance with stipulation of IS-2099/ IS-5621 Routine as well as type tests reports in conformity with IS-2099/ IS-5621 shall be furnished to the purchaser.

4.6 **TERMINAL CONNECTORS:**
4.6.1 The current transformer offered shall be supplied with indigenous rigid type, Die casted, bimetallic (wherever applicable) terminal connectors suitable for single/double ACSR Zebra conductor or 3” / 4”IPS Aluminium tube as per requirement conforming to IS-5561.

Annexure-A

FITTINGS AND ACCESSORIES

The transformer shall be complete with following fittings and accessories :-

i) Set of bushing and terminal connectors for primary winding.
ii) Set of bushing and terminal connectors for secondary winding.
iii) Set of bushings and terminal connectors for tertiary winding.
iv) Neutral bushings with connectors and earth bars.
v) Conservator with oil filling hole, cap and drain valve.
vi) Magnetic type oil gauge with low oil level alarm.
vii) Prismatic oil level gauge.
viii) Oil preservation equipment with necessary arrangements to connect preservation equipment.
ix) a) Buchholz relay with testing and sampling cocks, alarm and trip contacts and one isolating valve on conservator side – size 80 mm.
b) Oil surge relay for OLTC conservator tanks with isolating valve and trip contacts.
c) Sudden pressure relay.
x) Pressure relief device.
xii) Pocket on tank cover for thermometer
xiii) Oil temperature indicator with maximum pointer and two sets of contacts.
xiv) Winding temperature indicators with maximum pointer with 4 sets of contacts (for ONAN/ONAF/ OFAF)
xv) Repeater dials of winding temperature, oil temperature for remote indication.
xvi) VALVES
a) Oil shut off valves between cooler and main tank as specified.
b) Drain valve – size 100 mm.
c) 2 Nos. filter valves on diagonally opposite corners – size 50 mm
d) 2 Nos. sampling valves at top and bottom of main tank.
xvii) Earthing terminals (2 Nos.)
xviii) Rating and diagram plates
xix) Valve Schedule Plate
xx) Jacking pads
xxi) Lifting bollards
xxii) Haulage lugs
xxiii) Cover Lifting lugs
xxiv) Bi-directional flanged rollers with locking and bolting device arranged for rail gauge as specified.
xxv) Marshalling box (Weather proof) for housing control equipment and terminal connections.
xxvi) Air release devices
xxvii) Wiring upto Marshalling Box with PVC Copper cables, 1100 Volts grade.
xxviii) On-load tap changing gear with remote control panel as specified (with AVR Relay)
xxix) Ladder with safety flap.

Cooling Accessories
(a) ONAN/OFAF
i) Oil Pumps
ii) Oil flow indicator with alarm contacts.
iii) Drain valve and sampling device
iv) Air release devices
v) Filter valves.
v) Coolers/Radiators with integral fans and shut off valves.
vii) Brass encased thermometers – Two Nos. of metal encased thermometers for fixing on incoming and outgoing headers on coolers.

xxx) Insulating oil with 10% extra oil (In non returnable M.S. drum)

The fittings and accessories listed above are only indicative and any other fittings and accessories which generally are required for satisfactory operation of the transformer are deemed to be included, unless specifically excluded.

xxxi) Oil Storage Tank and Oil Sampling Bottle

Specification of above is attached in Annexure-B
1.0 OIL STORAGE TANK

1.1 General
This specification covers supply of oil storage tank of 15 cubic meter capacity along with complete accessories.

1.2 Standard: The oil storage tank shall be designed and fabricated as per relevant Indian Standards e.g. IS:803 or other internationally acceptable standards.

1.3 Specifications
Transformer oil storage tanks shall be to cylindrical shape & mounted horizontally and made of mild steel plate of adequate thickness. Size of the storage tank shall be as follows:

Diameter : 2.5 meter and Capacity : 15 cubic metre

The tank shall be designed for storage of oil at a temperature of 100ºC.

1.4 The Bidder may further note that maximum height of any part of the complete assembly of the storage tank shall not exceed 4.0 metres above road top.

1.5 The tank shall have adequate number of jacking pad so that it can be kept on jack while completely filled with oil. The tank shall be provided with suitable saddles so that tank can be rested on ground after removing the pneumatic tyres.

1.6 The tank shall also fitted with manhole, outside & inside access ladder, silicagel breather assembly, inlet & outlet valve, oil sampling valve with suitable adopter, oil drainage valve, air vent etc. Pulling hook on both ends of the tank shall be provided so that the tank can be pulled from either end while completely filled with oil. Bidder shall indicate the engine capacity in horse power to pull one tank completely fitted with oil. Oil level indicator shall be provided with calibration in terms of litre so that at any time operator can have an idea of oil in the tank. Suitable arrangement shall also be provided to prevent overflow in the tank. Four nos. suitable rubber hoses with couplers and unions each not less than 10 metre long shall also be provided.

1.7 The internal & external surfaces to be painted shall be shot or sand blasted to remove all rust and scale of foreign adhering matter or grease. All steel surfaces in contact with insulating oil shall have painted with two coats of heat & oil resistant anti-corrosive paint.

All steel surfaces exposed to weather shall be given a primary coat of zinc chromate, second coat of oil & weather resistant paint of a colour distinct from primary and final two coats of glossy oil & weather resistant light grey paint in accordance with shade no. 631 of IS:5. All paints shall be carefully selected to withstand heat & extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. The minimum thickness of outside painting of tank shall be 20 microns per coat the total thickness shall be within 70 to 100 microns.

1.8 The tank shall contain a self mounted centrifugal oil pump with inlet and outlet valves, with couplers - suitable for flexible rubber hoses and necessary switchgear for its control. There shall be no rigid connection to the pump. The pump shall be electric motor driven, and shall have a discharge of not less than 6.0 kl/hr. with a discharge head of 8.0m. The pump motor and the control cabinet shall be enclosed in a cubical with IP-55 enclosure.

2.0 OIL SAMPLING BOTTLE

2.1 Oil sampling bottles shall be suitable for collecting oil samples from transformers and shunt reactors, for Dissolved Gas Analysis. Bottles shall be robust enough, so that no damage occurs during frequent transportation of samples from site to laboratory.

2.2 Oil Sampling bottles shall be made of stainless steel having a capacity of 1litre.

2.3 Oil Sampling bottles shall be capable of being sealed gas-tight and shall be fitted with cocks on both ends.

2.4 The design of bottle & seal shall be such that loss of hydrogen shall not exceed 5% per week.
2.5 An impermeable oil-proof, transparent plastic or rubber tube of about 5 mm diameter, and of sufficient length shall also be provided with each bottle along with suitable connectors to fit the tube on to the oil sampling valve of the equipment and the oil collecting bottles respectively.
SECTION VB

160 MVA POWER TRANSFORMER

SECTION –I: CONSTRUCTIONAL DETAILS & DETAILED DESCRIPTION

1.1 CONSTRUCTION DETAILS

The features and construction details of each power transformer shall be in accordance with the requirements stated herein under.

1.2 TANK CONSTRUCTION

1.2.1 Tank shall be of welded construction and fabricated from tested quality, low carbon steel of adequate thickness.

1.2.2 All seams and joints not required to be opened at site shall be factory welded and wherever possible they shall be double welded.

1.2.3 Each tank shall be provided with lifting lugs suitable for lifting the transformer complete with oil. A minimum of four jacking Pads in accessible position are to be provided to enable the transformer complete with oil, to be raised or lowered using hydraulic or mechanical screw jacks.

1.2.4 Tank stiffeners shall be provided for general rigidity and these shall be so designed as to prevent any retention of water.

1.2.5 The tank shall be designed to withstand.
   i) Mechanical shocks during transportation
   ii) Vacuum of 760mm of Hg.
   iii) Continuous internal pressure over normal hydrostatic pressure of oil as well as the pressure developed due to abnormal condition which may arise during service.
   iv) Earthquake forces as per Seismic zone
   v) Short Circuit forces

1.2.6 The base of each tank shall be so designed that it shall be possible to move the complete transformer unit by skidding in any direction without injury when using plates or rails.

1.2.7 The transformer tank and its accessories shall be so designed as to avoid collection of gas/air.

1.2.8 Bolted inspection opening shall be provided on the sides of the tank near the bottom to observe the position of the core.

1.2.9 Inspection opening shall be provided on the tank to facilitate inspection of Core, assembly fittings and fixtures etc.

1.2.10 Adequate space shall be provided at the bottom of the tank for collection of sediments.

1.2.11 Transformer shall have the provision for installation of the Fire Prevention and Extinguishing System offered by the tenderer.

1.2.12 Transformer shall be supplied with Nitrogen Injection Fire Prevention and Extinguishing System (NIFPES).

1.3 TANK COVER:
1.3.1 The tank cover shall be slopped to prevent retention of rain water and shall not distort when lifted. Suitable lifting arrangement shall be provided.

1.3.2 At least two adequately sized bolted inspection openings one at each end of the tank shall be provided for easy access to bushings and earth connections. The inspection covers shall not weigh more than 25 kg. and shall be provided with suitable lifting arrangements.

1.3.3 The tank covers shall be fitted with pockets at the position of maximum oil temperature at C.M.R. for bulbs of oil and winding temperature indicators. It shall be possible to remove these bulbs without lowering the oil in the tank.

1.3.4 The thermometer pocket shall be fitted with a captive screwed top to prevent the ingress of water.

1.3.5 Bushings, turrets cover of inspection openings, thermometer pockets etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.

1.3.6 All bolted connections shall be fitted with weather proof, hot oil resistant gasket in between for complete oil tightness. If gasket is compressible, metallic stops shall be provided to prevent over compression.

1.3.7 Neoprene gaskets shall be used.

1.4 AXLES AND WHEELS

1.4.1 The transformers shall be provided with flanges, bi-directional wheels and axles. These shall be so designed that under both the directions of movement they shall not deflect as to interfere with the movement of the transformer. Wheels shall be provided with suitable bearings which shall be rust corrosion resistant. Fittings/nipples for lubrication shall also be provided or the bearing shall be of permanently lubricated type.

1.4.2 All wheels should be detachable and shall be made of cast iron or steel as required.

1.4.3 Suitable locking arrangement shall be provided for the wheels to prevent accidental movement of transformer.

1.4.4 The wheels are required to swivel and they shall be arranged so that they can be turned through an angle of 90° when the tank is jacked up clear off the rails. Means shall be provided for locking the swivel movements in positions parallel to or at right angels to the longitudinal axis of the tank.

1.4.5 The wheel centre in both directions shall be 1676 mm to facilitate placement of transformer on rails spaced 1676 mm centre to centre.

1.5 CONSERVATOR TANK

1.5.1 The conservator tank shall have adequate capacity between highest and lowest visible levels to meet the requirement of expansion of the total cold oil volume, in the transformer and cooling equipment from minimum ambient temperature to 90°C.

1.5.2 Conservator shall be provided with sump and drain valve so that it can be completely drained by means of the drain valve, when mounted in service position.

1.5.3 The conservator shall be bolted into position so that it can be removed for cleaning purposes.

1.5.4 The conservator shall be fitted with magnetic oil level gauge with low level electrically insulated alarm contacts.
1.5.5 Conservator shall be provided in such a position as not to obstruct the electrical connections to the transformers.
1.6 PRESSURE RELIEF DEVICE (PRD):

1.6.1 The pressure relief valve provided shall be of sufficient size for rapid release of any pressure that may be generated within the tank and which may result in damage to the equipment. The device shall operate at a static pressure of less than the hydraulic test pressure of transformer tank. The device shall have two micro switches having contacts which shall close for actuating trip circuits in the event of operation of the pressure relief device. The pressure relief device shall be spring loaded type with detachable type diaphragm. Means shall be provided to prevent the ingress of rain water. Terminal box of PRD should confirm to degree of protection as per IP-55 of IS.

1.7 GAS AND OIL ACTUATED RELAYS

1.7.1 The transformer shall be fitted with gas and oil actuated relay as per specification hereunder.

1.7.2 Each gas and oil actuated relay shall be provided with a test cock to take a flexible pipe connection for checking the operation of the relay.

1.7.3 A double float type Buchholz relay shall be provided between the main conservator and tank. All gas evolved in the transformer shall collect in this relay. 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 device shall be provide with two electrically independent ungrounded contacts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure.

1.7.4 A machined surface shall be provided on the top of each relay to facilitate the setting of the relays and to check the mounting angle in the pipe and the cross level of the relay.

1.7.5 The design of the relay mounting arrangements, the associated pipe work and the cooling plant shall be such that mal-operation of the relays shall not take place under normal service condition.

1.7.6 The pipe work shall be so arranged that all gas arising from the transformer shall pass into the gas and oil-actuated relay. The oil circuit through the relay shall not form a delivery path in parallel with any circulating oil pipe, nor shall it be tied or connected through the pressure relief vent. Sharp bends in the pipe work shall be avoided.

1.7.7 A sudden pressure relay shall be fitted on main tank to detect a sharp rise in internal pressure. An electrically insulated trip contact shall be provided in sudden pressure relay.

1.7.8 A surge relay shall also be provided between OLTC and conservator tank to detect a sharp rise in internal pressure. An electrically insulated trip contact shall be provided in the surge relay.

1.7.9 Provision shall be made for parallel wiring of all the alarm & trip events for separate annunciation on Employer panel.

1.8 CORE

1.8.1 The core shall be constructed from high grade non-ageing, cold rolled grain oriented silicon steel laminations. Provision of core belts shall be preferred in
place of core bolts to avoid hot spots. The manufacturer who has in house cutting facility for core laminations shall be preferred.

1.8.2 The design of the magnetic circuit shall be such as to avoid static discharges, developments of short circuit paths within itself or to the earthed clamping structure and production of flux component at right angles to the plane of laminations which may cause local heating.

1.8.3 The insulation structure for core to core bolts and core to clamp plates shall be able to withstand a voltage of 2 KV rms for 1 minute.

1.8.4 Core and windings shall be capable of withstanding shocks during transport, installation, service and adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions including short circuit condition.

1.8.5 All steel sections used for supporting the core shall be thoroughly sand blasted, after cutting, drilling and welding.

1.8.6 With bell type tank construction suitable projecting guides shall be provided on core assembly to facilitate removal from the tank.

1.8.7 Every care shall be exercised in the selection, treatment and handling of core steel to ensure that as far as practicable, the laminations are flat and finally assembled core is free from distortion.

1.8.8 Oil ducts shall be provided wherever necessary to ensure adequate cooling. The winding structure and major insulation shall not obstruct the free flow of oil through such ducts.

1.8.9 Adequate lifting lugs shall be provided to enable the core and windings to be lifted.

1.8.10 The supporting frame work of the cores shall be so designed as to avoid the presence of pockets which would prevent complete emptying of the tank through the drain valve.

1.8.11 The air core reactance of HV winding of transformer shall not be less than 20%.

1.9 EARTHING TERMINALS

Two earthing pads suitable for connecting mild steel flat shall be provided at positions close to each of the two bottom corners of the tank. These grounding terminals should be suitable for bolted connections. The earthing terminals shall be capable of carrying for 4 seconds the full load voltage, short circuit current of the transformer.

1.10 WINDINGS

1.10.1 The tenderer shall ensure that windings are made in dust proof, conditioned atmosphere. The tenderer shall furnish the facilities available at his works alongwith the Bid.

1.10.2 The conductors shall be of electrolytic copper. Current density in all the windings should not be more than 2.5 Amps/mm².

1.10.3 The insulation of transformer windings and connections shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse and be non-catalytic and chemically inert in transformer oil during service.
1.10.4 Coil assembly and insulating spacers shall be so arranged as to ensure free circulation of oil and to reduce hot spot of the winding.

1.10.5 220 KV and 66 KV star connected winding shall have graded insulation as defined in IEC-60076/IS-2026. The tertiary delta connected winding wherever applicable shall be insulated for the voltage specified in clause 3.7 of section-III. In the event the tenderer recommends to adopt higher insulation level of the tertiary, the offer should give complete detailed justification and calculations related thereto.

1.10.6 The windings shall be designed to withstand impulse and power frequency test voltages as specified in IEC-60076/IS-2026 and clause 3.7 of Section-III the specification.

1.10.7 The windings shall be designed to reduce to a minimum the out of balance forces in the transformer at all voltage ratios.

1.10.8 The stacks of windings shall receive adequate shrinkage treatment before final assembly. Adjustable devices shall be provided for taking up possible shrinkages of coils in service.

1.10.9 No strip conductor shall have a width on edge exceeding six times its thickness.

1.10.10 The conductors shall be transposed at sufficient intervals in order to minimize eddy currents and equalize the distribution of currents and temperatures along the windings.

1.10.11 Core and winding shall be capable of withstanding the shock during transport, installation and service. Adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions.

1.10.12 Coil clamping rings, if provided, shall be of steel or of suitable insulating material. Axial laminated material other than bakelised paper shall not be used.

1.10.13 All threaded connections shall be provided with locking facilities. All leads from the winding to terminal board & bushings shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used where practicable.

1.10.14 Tertiary Windings shall be designed to withstand mechanical and thermal stresses due to dead short circuit on its terminals. The tertiary winding shall be suitable for connection to LT Transformer for auxiliary supply. Tertiary protection for all type of faults shall be designed by the contractor.

1.10.15 The tertiary winding of 1 No. 160 MVA Power Transformer shall be loaded for meeting auxiliary load of the sub station. The insulation level of tertiary shall be rated for 33 KV voltage level to take care of likely damage to winding due to transferred surges from primary winding.

1.11 TEMPERATURE INDICATING DEVICES

1.11.1 Oil Temperature Indicator (OTI):

The transformer shall be provided with a 150mm dial type thermometer for top oil temp, indication. The thermometer shall have adjustable, electrically independent ungrounded alarm and trip contacts, maximum
reading pointer and resetting device. The thermometer shall be mounted on body of the transformer at a height of 1200 mm above rail top level.

1.11.2 **Winding Temperature Indicator (WTI):**

In the case of two winding transformers, winding temperature indicator shall be provided on LV side only and in case of three winding transformers winding temperature indicators shall be provided separately on all the three windings. It shall comprise the following:

i) Temperature Sensing element
ii) Thermal Image coil
iii) Current Transformer
iv) 150mm dial type temperature indicating instrument mounted on the transformer with maximum reading pointer and two adjustable electrically independent ungrounded contacts, one for high winding temperature alarm and one trip besides those required for control of cooling equipment.


vi) Automatic ambient temp compensation.

In addition to the above, the following remote indication equipment shall be provided for each of the winding:

a) Single transmitter (for recording windings) temp.
b) Remote winding temp. indicator shall be mounted on OLTC panel.

1.11.3 The tripping contacts of winding temperature indicators shall be adjustable to close between 60°C and 120°C and alarm contacts to close between 50°C and 100°C and both shall re-open when the temperature has fallen by about 10°C.

1.11.4 The contacts used to control the cooling plant motors on the above devices shall be adjustable to close between 50°C and 100°C and to re-open when the temperature has fallen by 20°C.

1.11.5 All contacts shall be adjustable on a scale and shall be accessible on removal of the cover.

1.11.6 The temperature indicators shall be so designed that it shall be possible to check the operation of the contacts and associated equipment.

1.11.7 Connections shall be brought from the temperature indicators to terminals placed inside the marshalling box.

1.11.8 Cooler failure and oil flow alarm indication shall also be provided at local and remote end.

1.12 **ANTI-EARTHQUAKE CLAMPING DEVICE**

To prevent transformer movement during earthquake a clamping device should be provided for fixing the transformer to the foundation. The tenderer shall supply necessary bots for embedding in the concreting.

1.13 **INSULATING OIL**

1.13.1 The insulating oil shall conform to the requirement of IS:335, IS:1448 IS:6103, IS:6104, IS:6792, IS:6262, IS:2362 & IS:1866. No inhibitors shall be used in the oil.
1.13.2 The necessary first filling of oil along with 10% extra oil for topping up shall be supplied, in non-returnable containers suitable for outdoor storage.

1.13.3 The manufacturer shall dispatch the transformer filled in an atmosphere of dry inert nitrogen gas. In this case necessary arrangement shall be ensured to take care of pressure drop of nitrogen during transit and storage, till completion of oil filling, during erection. A gas pressure testing valve with necessary pressure gauge and adaptor valve shall be provided.

1.13.4 In case the manufacturer dispatches the transformer completely filled with oil, free from air pockets, a specific relaxation may be requested.

1.14 OIL PRESERVATION EQUIPMENT

Tenderer can offer diaphragm type oil sealing in conservator to prevent oxidation and contamination of oil due to contact with moisture/air.

1.14.1 DIAPHRAGM TYPE OIL SEALING

Each conservator shall be fitted with a dehydrating filter breather when diaphragm seal type oil preservation system is provided. It shall be so designed that:

i) Passage of air is through a dust filter and silica-gel.
ii) Silica-gel is isolated from atmosphere by an oil seal.
iii) Moisture absorption indicated by a change in colour of the tinted crystals can be easily observed from a distance.
iv) Breather is mounted not more than 1200mm above rail top level.

1.15 BUSHING INSULATIONS AND TERMINALS

1.15.1 The electrical characteristics of bushings shall be in accordance with IEC-60137, IS: 2099 and IS: 3347.

1.15.2 Bushing terminals shall be provided with terminal connectors of approved type and size for connections of external parts. Details shall be got approved before manufacture. The flexible bimetallic terminal connectors with laminated contacts at the bushings shall be designed to withstand the electrical and mechanical stresses, arising out of temperature variations and fault conditions. The terminal connectors shall conform to IS: 5561 and relevant IEC and also to clause 3.13 of Section-III of this specification.

1.15.3 No arching horns/rod gaps shall be provided on the Transformer bushings.

1.15.4 Bushings for 220 KV and 66 KV side shall be oil filled condenser type and shall preferably be of the draw lead type to facilitate removal. For 11 KV side porcelain type bushing may be used.

1.15.5 Oil Filled Condenser type bushings shall be provided with

i) Oil level gauge

ii) Oil filling plug and drain valve if not hermetically sealed.

iii) Tap for capacitance test.

1.15.6 When bushings have an under-oil end of re-entrant form, the associated pull through lead shall be fitted with a gas bubble deflector.

1.15.7 Clamps for fittings of iron and steel shall be hot dip galvanized as per IS:2633 and relevant IEC.

1.15.8 The creepage distance of the bushing shall in no case be less than 25 mm / KV, suitable for heavily polluted atmosphere.
1.15.9 Tenderer shall provide details of Bushing CT’s at the time of detailed engineering.

1.15.10 Bushing details are as under:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Bushing</th>
<th>HV</th>
<th>IV</th>
<th>LV</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>Rated Voltage (kV)</td>
<td>245</td>
<td>72.5</td>
<td>17.5</td>
</tr>
<tr>
<td>ii.</td>
<td>Rated current (Amp.)</td>
<td>800</td>
<td>3150</td>
<td>3150</td>
</tr>
<tr>
<td>iii.</td>
<td>1.2/50 micro sec. lightning impulse withstand voltage (kVp)</td>
<td>1050</td>
<td>325</td>
<td>170</td>
</tr>
<tr>
<td>iv.</td>
<td>250/2500 micro sec. Switching impulse withstand voltage (kVp.)</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>v.</td>
<td>One minute power frequency withstand voltage kV (rms.)</td>
<td>460</td>
<td>140</td>
<td>70</td>
</tr>
<tr>
<td>vi.</td>
<td>Minimum total creepage distances (mm)</td>
<td>6125</td>
<td>1813</td>
<td>438</td>
</tr>
</tbody>
</table>

1.16 PROTECTIVE DEVICES

The protective relaying of the power transformer shall be as under:-

a) Pressure relief valve for the main tank.
b) Buchholz Protection for main tank.
c) Sudden pressure relay for the main tank.
d) Surge relay for OLTC tank conservator.
e) Thermal Protection (Oil and windings with high temp.).
f) Tap changer out of step trip.

1.17 TERMINAL MARKING

The terminal marking and their physical position shall be in accordance with IEC-60076/IS: 2026.

1.18 NEUTRAL EARTHING ARRANGEMENT

1.18.1 The neutral terminals of windings shall be brought to the ground level by a copper grounding bar which shall be supported on the tank by porcelain insulators.

1.18.2 The copper bar shall be terminated at 1000 mm above rail level where a knife switch along with suitable operating arrangement shall be provided. Besides the arrangement shall exist to lock the knife switch in closed position to preclude the possibility of any inadvertent opening or its opening at the time of the fault. The transformer end of the knife switch shall have the suitable connecting arrangement with proper bolts, nuts and spring washer. The ground
end shall be suitable to accommodate the bimetallic connection for taking two nos. 65x8 mm, M.S. flat. The knife switch shall have adequate short circuit current ratings. The end of the brass/tinned copper bar shall be brought to the bottom of the tank, at a convenient point, for making bolted connection to two (2) 75x12 mm galvanized steel flats connected to Employer’s grounding mat.

1.19  ON-LOAD TAP-CHANGING MECHANISM (O.L.T.C.)
1.19.1 Each transformer shall be provided with an on-load tap changing mechanism. This shall be designed suitable for remote control operation from switch boards in the control room in addition to being capable of local manual as well as local electrical operation.

1.19.2 It shall not be possible to use the electric drive when manual gear is in use and it shall be possible to use only one electrical control at a time. Operation of the local or remote control switches shall cause one tap movement only until the control switch is returned to the off position for the next operation.

1.19.3 The local electrical control switches shall be mounted in the outdoor cubicle.

1.19.4 The equipment shall be so arranged as to ensure that when a tap change operation has been commenced it shall be completed independently of the operation of the control relays and switches. If a failure of the auxiliary supply during a tap change or any other contingency result in movement not being completed, adequate means shall be provided to safeguard the transformer and its auxiliary equipment from damage. Supervisory indication shall be provided to indicate “The change incomplete” foul.

1.19.5 Limit switches may be connected in the control circuit of the operation motor provided that a mechanical de-clutching mechanism is incorporated. Otherwise it shall be directly connected to the operating motor circuit and mechanical stop provided.

1.19.6 Thermal devices or other means shall be provided to protect the motor and control circuits. All relays switches, fuses etc. shall be mounted in the marshalling box and shall be clearly marked to indicate their purpose.

1.19.7 The control circuit shall operate at 110 V single phase to be supplied from a transformer having a ratio of 230/55-0-55 V with the centre point earthed through a removable link mounted in the marshalling box.

1.19.8 The whole of the apparatus shall be of robust design and capable of giving satisfactory service without undue maintenance under the conditions to be met in service, including frequent operation.

1.19.9 A five-digit counter shall be fitted to the tap changing mechanism to indicate the number of operations completed by the equipment.

1.19.10 A permanently legible lubrication chart shall be fitted within the driving mechanism chamber.

1.19.11 The ON-LOAD Tap Changer shall include the following :-
   a) An oil immersed tap selector and arcing switch or arc-suppressing tap selector, provided with resistor for reduction of make and break arcing voltage, overland and short circuits.
   b) Motor driven mechanism.
   c) Control and Protection devices.
   d) Local and remote tap-changer position indicator.
   e) Manual operating device.
1.19.12 The on-load tap changer shall be designed so that the contacts shall not interrupt arc within the main tank of the transformer. The tap selector and arcing switch or arc suppressing tap selector switch shall be located in one oil filled compartment. The compartment shall be provided with a means of releasing the gas produced by the arcing. It shall be designed so as to prevent the oil in the tap selector compartment from mixing with the oil in the transformer tank.

1.19.13 The oil in those compartments of the main tap-changing apparatus which do not contain contacts used for making or breaking current shall be maintained under conservator head by means of an adequate diameter pipe corresponding dia of OLTC oil surge relays connection from the highest point of the chamber connection corresponding to the dia. of OLTC oil surge relay from the highest point of the chamber to the conservator. This connection shall be controlled by a suitable valve and shall be arranged so that any gas leaving the chamber will pass into the gas and oil actuated relay.

1.19.14 The tap changer shall be capable of permitting parallel operation with other transformers for which necessary wiring and accessories, if any, shall be provided.

1.19.15 The centre of manual operating device shall be located at a height of 1000 mm from rail top so that it can be operated by a person standing at the ground level. The arrangement shall be strong and robust in construction. The transformer shall give full load output on all tap positions.

1.19.16 The control scheme for the tap changer shall be provided for independent control of the tap changers when the transformers are in independent service. In addition, provision shall be made to enable parallel operation control also at time so that the tap changer will be operated simultaneously when one unit is in parallel with another will not become out of step and this will eliminate circulating current.

Additional features like Master / Follower and visual indication during the operation of motor shall also be incorporated.

1.19.17 Necessary interlock, blocking independent control when the units are in parallel, shall be provided.

1.19.18 Under abnormal conditions such as may occur if the contactor controlling one tap changer sticks, the arrangement must be such as to switch off supply to the motor so that an out of step condition is limited to one tap difference between the units. Details of out of step protection provided for the taps should be furnished in the bid.

1.19.19 The contactor and associated gear for the tap change driving motors shall be housed in a local kiosk mounted adjacent to the transformer. The motors shall be suitable for operation on 230 V single phase or 3-phase 440 V, 50 cycle external power supply. The kiosk having space heater, shall be dust and vermin proof and suitable protected against corrosion or deterioration due to condensation, fungi etc.

1.19.20 The supplier shall furnish, in addition to the above equipment, one indoor cubicle for installation in the Employer’s control room which shall contain:
   a) Indication of the transformer ratio in use on each transformer and the number designating the tap in use by means of digital type indicators.
   b) Raise and lower push Button switch and AVR Relay.
   c) Independent/Master/Follower selector switch.
d) Remote tap position indicator with indicating lamp.

e) Repeater dial of winding temperature indicator for remote indication with a device for indicating hottest spot winding temperature in addition to a pointer to register the highest temperature reached.

f) An indication lamp showing tap change in progress.

g) Necessary audible and visual alarms.

h) Pressure relief device operation alarm.

i) Out of step relay with two spare contacts (2 NC and 2 NO).

j) The remote indoor cubicle in addition to the above indications shall also have the following trip and non-trip alarm windows facias with 5 spare windows suitable for 220V DC supply.

i) Oil Temperature alarm

ii) Winding Temperature alarm

iii) Winding temperature trip

iv) Buchholz alarm

v) Buchholz trip

vi) Sudden Pressure trip (Main tank)

vii) Surge Relay trip (OLTC Gear)

viii) Tap changer out of step alarm

ix) Low oil level alarm

x) Cooling fans working indication

xi) Oil pumps on and off indication

xii) Failure of group of fans alarm

xiii) Failure of group of oil pumps alarm

xiv) Failure of supply

xv) Oil flow alarm

Each relay for tripping function shall have two normally open and two normally closed contacts for connection.

k) The OLTC shall be provided on the conservator side of the Power Transformer and not in front of H.V. Bushings.

l) OLTC shall be suitable for bi-directional power flow.

1.20 COOLING EQUIPMENT

1.20.1 Cooling fans for each radiator bank shall be housed in fan box to prevent ingress of rain water. Each fan shall be suitably protected by galvanized wire mesh guard. It shall be possible to remove the cooling fan with motors without disturbing and dismantling the cooler structural frame work.

1.20.2 Where OFAF cooling is applicable, two numbers of centrifugal oil pumps shall be used. Measures shall be taken to prevent mal-operation of Buchholz relay or sudden pressure relay when all oil pumps are simultaneously put into service. The pumps shall be so designed that on failure of power supply to the pump motor, the pump impeller will not limit the natural circulation of oil.

1.20.3 Cooling fans and oil pump motors shall be of squirrel cage, totally enclosed whether proof type suitable for operation on 400 volts, three phase, 50 Hz power supply. All motors having ball and roller bearings and grease lubricators shall be fitted with hexagonal nipples conforming to relevant Indian Standard.

1.20.4 An oil flow indicator with alarm contacts shall be provided for the confirmation of the oil pump operating in a normal state. An indication shall be provided on the control panel to indicate that the pump is running.
1.20.5 The coolers and their accessories shall be hot dip galvanized or corrosive resistant painted.

1.20.6 The supporting arrangement for the cooler units or for radiator banks shall be in such a manner that the stresses if developed, shall not be transferred to the flanges of the butterfly valves.

1.20.7 The shut off valves shall be provided on the tank at each point of connection of cooler units radiators to the transformer tank. Removable blanking plates shall be provided to permit blanking off the oil connection to cooler radiators.

1.20.8 All valves shall be of gun metal or cast steel or may have cast iron bodies with gun metal fittings. They shall be of full way type with internal screw and shall be opened by turning counter clock-wise when facing the hand wheel.

1.20.9 Means shall be provided for pad locking of valves in the open and closed position.

1.20.10 Every valve shall be provided with indicator to show clearly the position of the valve whether open or closed.

1.20.11 All valves shall be provided with flanges having machined faces.

1.20.12 The drilling of valve flanges shall comply with the requirements of IS:3639.

1.21 CONTROL OF COOLER OPERATION

1.21.1 Each motor or group of motors shall be provided with an electrically operated contactor and with control gear of suitable design both for starting and stopping the motor manually and also automatically from the contacts on the winding temperature indicating device as specified. Additional terminal for remote manual electrical control of motors shall be provided. Overload and single phasing protection shall be provided. HRC fuses shall be provided for short circuit protection. This equipment shall be accommodated in the marshalling box. The power supply shall be adequately and properly fused.

1.21.2 Where small motors are connected in groups, the group protection shall be arranged so that it operates satisfactorily in the event of a fault occurring on a single motor.

1.21.3 Where fans and oil pumps are provided, the connection shall be arranged as to allow the motors or groups of motors to be started up and shutdown either collectively or individually.

1.21.4 All motor contactors and their associated apparatus shall be capable of holding in and operating satisfactorily and without overheating for a period of ten minutes if the supply voltage falls for that period, to 75% of normal value and at normal frequency. The motor contactors and associated apparatus shall be capable of normal operation with a supply voltage of 85% of the normal value and at normal frequency.

1.21.5 All contacts and other parts which may require renewal, adjustment or inspection shall be readily accessible.

1.21.6 The control arrangements are to be so designed as to prevent the simultaneous starting of motors of total rating of more than 20 HP where such an eventually may arise, two step operation shall be preferred.

1.21.7 Alarm indication for failure of group of fans and oil pump shall be provided.

1.21.8 Alarm indication shall be provided to indicate failure of power supply.
1.21.9 Provision in the cooler control circuit may be made such that tripping of transformer breaker on Differential or Sudden Pressure should lead to supply disconnection to motor of the cooler pump.

1.22 MARSHALLING BOX
1.22.1 A sheet steel, vermin, dust proof, galvanized, well ventilated and weather-proof marshalling box of a suitable construction shall be provided for the transformer ancillary apparatus. The box shall have domed or sloping roofs and the interior and exterior painting shall be in accordance with clause-1.25. Sheet thickness of the box shall not be less than 3.15mm and it shall be provided with lockable doors.

1.22.2 The marshalling box shall accommodate the following:
   a) Control and protection equipment for the local electrical control of tap changer.
   b) Control and protection equipment for the cooling plant.
   c) Terminal blocks and gland plates with electroplated brass glands for incoming and outgoing cables.

1.22.3 All the above equipments except(c) shall be mounted on panels and back of panel wiring shall be used for interconnection.

1.22.4 The temp. indicators shall be so mounted on the body of the transformer at a height of 1200 mm above rail top level.

1.22.5 Terminal block shall be adequate and suitable to adopt at least 4mm sq. control wires and loop connections. One piece moulded from non inflammable plastic material only with insulation barriers, stud type terminals, washers, nuts, lock nuts and identification strips. Separate studs shall be provided for incoming and outgoing wires. Making on the terminal strip shall correspond to the wire numbers on the wiring diagram.

   Wire termination shall be made with solderless crimping type tinned copper, lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire.

   Supplier shall indicate the no. and size of control cables terminating at the marshalling box.

1.22.6 To prevent internal condensation an approved type of metal clad space heater shall be provided, controlled by a suitable switch. Cubicle lighting with door switch and ventilation louvers shall be provided. HRC cartridge fuse protection shall be provided for space heater and light. Supply shall be 230 V single phase 50 Hz AC.

1.22.7 All incoming cables shall enter the cubical from the bottom and the gland plate shall be not less than 450mm from the base of box. The gland plate and associated compartment shall be sealed in suitable manner to prevent the ingress of moisture from the cable trench. The marshalling box front and back shall be flushed with the ground level.

1.22.8 Drilled gland plate with proper blanking plates shall be provided for accommodating glands for incoming and outgoing cables. Sizes and number of glands to be provided shall correspond to the no. the control cables. Also the gland shall be suitable for earthing of armour.
1.23 CONTROL CONNECTIONS AND INSTRUMENT WIRING
TERMINAL BOARD AND FUSES:

1.23.1 All wiring connections, boards, fuses and links shall be suitable for tropical atmosphere. Any wiring liable to be in contact with oil shall have oil resisting insulation and the bared ends of standard wire shall be sweated together to prevent creepage of oil along the wire.

1.23.2 There shall be no possibility of oil entering connection boxes used for cables or wiring.

1.23.3 Panel connections shall be neatly and squarely fixed to the panel. All instruments and panels wiring shall be run in PVC cleats of the limited compression or in ‘C’ type channels. All wiring to a panel shall be taken from suitable terminal boards.

1.23.4 Where conduits are used, the runs shall be laid with suitable falls, and the lowest parts 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.

1.23.5 Danger plates wherever necessary shall be provided.

1.23.6 All box wiring shall be in accordance with the relevant IS. All wiring shall be of high grade PVC or polythene insulated stranded copper of 1100V grade and size not less than 2.5 sq.mm. The cables shall be suitable for tropical climate and shall be vermin and fire proof.

1.23.7 All wires shall be suitably terminated with ferruled numbers in accordance with the schematic and wiring diagram for ease of identification and tracing of faults.

1.23.8 All those paints of interconnection between the wiring carried out on control equipments, 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.

1.23.9 The same ferrule number shall not be used on wires in different circuits on the same panel.

1.23.10 Ferrules shall be of insulated 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 damp or oil.

1.23.11 Standard wires shall be terminated with tinned Ross Countney terminals, claw washers or crimped tubular lugs. Separate washers shall be used for each wire. The size of the washers shall be suitable to the size of the wire terminated. Wiring shall in general be accommodated on the sides of the box and the wires for each circuit shall be separately grouped and name plates fixed for each type of circuits.

1.23.12 Wires shall not be jointed or tied between terminal points.

1.23.13 Wherever practicable, 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.

1.23.14 Where apparatus is mounted on panels all metal cases shall be separately earthed by means of copper wire or strip having a cross-section of not less than 2 sq.mm where strip is used, the joints shall be suitably ferruled and crimped.
1.23.15 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 service. All diagrams shall show which view is employed.

1.23.16 Multicore cable tails shall be so bound that each wire may be traced without difficulty to its location.

1.23.17 The screens or screen pairs of multi-core cables shall be earthed at one end of the cable only. The position of earthing connections shall be shown clearly on the diagrams.

1.23.18 All terminal boards shall be mounted obliquely towards the rear door to give easy access to terminators and to enable ferrules numbers to be read without difficulty.

1.23.19 Terminal boards rows should be spaced not less than 100mm apart to permit convenient access to wires and terminations.

1.23.20 Terminal boards shall be so placed with respect to the cable gland (at a min. distance of 200 mm) as to permit satisfactory arrangement of multicore cable tails.

1.23.21 Terminal boards shall have pairs 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.

1.23.22 No live meal shall be exposed at the back of the terminal boards.

1.23.23 All fuses shall be of the cartridge type.

1.23.24 Fuses and links shall be labeled.

1.24 CLEANING AND PAINTING

1.24.1 Before painting or filling with oil or compound all un-galvanised parts shall be completely cleaned and freed from rust, scale and grease by pickling, degreasing process and all external surface cavities on castings shall be filled by metal deposition.

1.24.2 The interior of all transformer tanks and other oil filled chambers and internal structural steel works shall be cleaned of all scale and rust by shot blasting or other approved method. These surfaces shall be spray painted with hot oil resisting varnish or paint. Unexposed welds need not be painted.

1.24.3 Except for nuts, bolts and washers, which may have to be removed for maintenance purposes, all external surfaces shall receive a minimum of three coats of spray paint.

1.24.4 The primary coat shall be applied immediately after cleaning. The second coat shall be of an oil and weather resisting nature and preferably of a shade or colour easily distinguishable from the primary and final coats and shall be applied after the primary coat has been touched up where necessary. The final coat shall be of a glossy oil and whether resisting non-fading paint of shade No. 631 of IS:5. Primer paint shall be ready make zinc chrome as per IS:104; intermediate and final coats of paint shall be as per IS:2932.

1.24.5 Nuts, bolts and washers which may have to be removed for maintenance purposes shall receive a minimum of one coat of paint after erection.

1.24.6 All interior surfaces of mechanism chambers and kiosks except those which have receive anticorrosion – treatment shall receive three coats of paint.
applied to the thoroughly cleaned metal surface. The final coat shall be of an
approved light coloured anti-condensation mixture.

1.24.7 Any damage to paint work incurred during transport and erection shall be
made good by the supplier by thoroughly cleaning the damaged portion and
applying the full number of coats of paint that had been applied before the
damage was caused.

1.24.8 One coat of additional paint shall be given at site to the purchase. Supplier will
also supply the requisite quantity of paint.

1.24.9 Cubical and marshalling kiosk sheets shall be phosphated before application of
enamel paint.

1.25 BOLTS AND NUTS

1.25.1 Steel bolts and nuts exposed to atmosphere shall have suitable finishers like
cadmium plated or zinc plated for diameters above 6mm.

1.25.2 All nuts/bolts and pins shall be locked in position with the exception of those
external to the transformer.

1.25.3 On outdoor equipments al bolts, nuts and washers in contact with non-ferrous
parts, which a carry curt shall be phosphor-bronze, where transfer of current is
through the bolts.

1.25.4 If bolts and nuts are placed so that they are inaccessible by means of ordinary
spanners, suitable special spanners shall be provided by the supplier.

1.26 FITTINGS

The fittings shall be provided with each transformer covered in the
specification.

1.27 PACKING

The packing shall be in accordance with the tenderer’s standard practice but he
shall give full particulars of packing for the approval of the Employer. All
parts shall be adequately marked to facilitate field erection. Boxes and crates
shall be marked with the contract number and shall have a packing list
enclosed showing the parts contained therein. The same packing list shall also
included in the boxes and crates duly signed signed by the bidder/ authorized
person.

1.28 LABELLING

The transformer shall be labeled with the name of the substation where
proposed to be installed. The label plate shall be fixed adjoining the name and
plate and shall be of similar design so as to match with the name plate. The
transformer should only be dispatched with the name plate and the labeling
plate indicating the name of the sub station thereon.

1.29 TRANSPORTATION

1.29.1 Transportation of power transformer shall be done on Hydraulic trailer. It is
mandatory condition which the supplier is bound to follow.

1.29.2 Dragging of Transformers at site, after unloading, shall be done on rollers and
not on rails.
## SECTION – II : INSPECTION AND TESTING

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2.0 INSPECTION AND TESTING
The Contractor shall carry out a comprehensive inspection and testing programme during manufacture of the equipment. An indication of inspection envisaged by the Employer is given under Clause 2.1. This is however not intended to form a comprehensive programme as it is Contractor’s responsibility to draw up and carry out such a programme in the form of detailed quality plan duly approved by Employer for necessary implementation.

2.1 Inspection
2.1.1 Tank and Conservator
2.1.1.1 Certification of chemical analysis and material tests of plates.
2.1.1.2 Check for fitness.
2.1.1.3 Electrical interconnection of top and bottom bybraided tinned copper flexible.
2.1.1.4 Welder’s qualification and weld procedure.
2.1.1.5 Testing of electrodes for quality of base materials and coatings.
2.1.1.6 Inspection of major weld preparation.
2.1.1.7 Crack detection of major strength weld seams by dye penetration test.
2.1.1.8 Measurement of film thickness of:
   i). Oil insoluble varnish.
   ii). Zinc chromate paint.
   iii). Finished coat.
2.1.1.9 Check correct dimensions between wheels; demonstrate fuming of wheels through 90°
   C and further dimensional check.
2.1.1.10 Check for physical properties of materials for lifting lugs, jacking pads, etc. All
   load bearing welds including lifting lug welds shall be subjected to NDT.
2.1.1.11 Leakage test of the conservator.
2.1.1.12 Certification of all test results.

2.1.2 Core
2.1.2.1 Sample testing of core materials for checking specific loss, bend properties,
magnetization characteristics and thickness.
2.1.2.2 Check on the quality of varnish if used on the stampings:
   i). Measurement of thickness and hardness of varnish on stampings.
   ii). Solvent resistance test to check that varnish does not react in hot oil.
   iii). Check over all quality of varnish by sampling to ensure uniform shining
        colour, no bare spots, no over burnt varnish layer and no bubbles on varnished
        surface.
2.1.2.3 Check on the amount of burrs.
2.1.2.4 Bow check on stampings.
2.1.2.5 Check for the overlapping of stampings. Corners of the sheet are to be part.
2.1.2.6 Visual and dimensional check during assembly stage.
2.1.2.7 Check for interlaminated insulation between core sectors before and after pressing.
2.1.2.8 Check on completed core for measurement of iron loss and check for any hot spot
   by exciting the core so as to induce the designed value of flux density in the core.
2.1.2.9 Visual and dimensional checks for straightness and roundness of core, thickness of
   limbs and suitability of clamps.
2.1.2.10 High voltage test (2kV for one minute) between core and clamps.
2.1.2.11 Certification of all test results.
2.1.3 **Insulation Material**
2.1.3.1 Sample check for physical properties of materials.
2.1.3.2 Check for dielectric strength.
2.1.3.3 Visual and dimensional checks.
2.1.3.4 Check for the reaction of hot oil on insulating materials.
2.1.3.5 Dimension stability test at high temperature for insulating material.
2.1.3.6 Tracking resistance test on insulating material
2.1.3.7 Certification of all test results.

2.1.4 **Winding**
2.1.4.1 Sample check on winding conductor for mechanical properties and electrical conductivity.
2.1.4.2 Visual and dimensional checks on conductor for scratches, dent marks etc.
2.1.4.3 Sample check on insulating paper for pH value, bursting strength and electric strength.
2.1.4.4 Check for the reaction of hot oil on insulating paper.
2.1.4.5 Check for the bonding of the insulating paper with conductor.
2.1.4.6 Check and ensure that physical condition of all materials taken for windings is satisfactory and free of dust.
2.1.4.7 Check for absence of short circuit between parallel strands.
2.1.4.8 Check for brazed joints wherever applicable.
2.1.4.9 Measurement of voltage ratio to be carried out when core/ yoke is completely restacked and all connections are ready.
2.1.4.10 Conductor enamel test for checking of cracks, leakage and pin holes.
2.1.4.11 Conductor flexibility test.
2.1.4.12 Heat shrink test for enameled wire.
2.1.4.13 Certification of all test results.

2.1.5 **Checks Before Drying Process**
2.1.5.1 Check condition of insulation on the conductor and between the windings.
2.1.5.2 Check insulation distance between high voltage connections, cables and earth and other live parts.
2.1.5.3 Check insulating distances between low voltage connections and earth and other parts.
2.1.5.4 Insulation of core shall be tested at 2 kV/ minute between core to bolts and core to clamp plates.
2.1.5.5 Check for proper cleanliness and absence of dust etc.
2.1.5.6 Certification of all test results.

2.1.6 **Checks During Drying Process**
2.1.6.1 Measurement and recording of temperature, vacuum and drying time during vacuum treatment.
2.1.6.2 Check for completeness of drying by periodic monitoring of IR and Tan delta.
2.1.6.3 Certification of all test results.

2.1.7 **Assembled Transformer**
2.1.7.1 Check completed transformer against approved outline drawings, provision for all fittings, finish level etc.
2.1.7.2 Test to check effective shielding of the tank.
2.1.7.3 Jacking test with oil on all the assembled transformers.
2.1.7.4 Dye penetration test shall be carried out after the jacking test.

2.1.8 Bought Out Items
2.1.8.1 The makes of all major bought out items shall be subject to Employer’s approval.
2.1.8.2 The Contractor shall also prepare a comprehensive inspection and testing programme for all bought out/ sub-contracted items and shall submit the same to the Employer for approval. Such programme shall include the following components:
   a) Buchholz Relay.
   b) Axles and wheels.
   c) Winding temperature indicators for local and remote mounting.
   d) Oil temperature indicators.
   e) Bushings.
   f) Bushing current transformers.
   g) Cooler control cabinet.
   h) Cooling equipment.
   i) Oil pumps.
   j) Fans/ Air Blowers
   k) Tap change gear.
   l) Terminal connectors.
The above list is not exhaustive and the Contractor shall also include other bought out items in his programme.

2.2 Factory Tests.
2.2.1 Routine Tests
2.2.1.1 All standard routine tests in accordance with IS: 2026 with dielectric tests corresponding to Method 2 shall be carried out on each transformer. Operation and dielectric testing of OLTC shall also be carried out as per IS: 2026.
2.2.1.2 The Routine test should be done in the following sequence of testing:-
   1. Transformer turn ratio test.
   2. Magnetising current with single phase A.C. supply
   4. Short circuit test at 400V, 3 phase A.C. supply
   5. D.C. resistance Test.
   6. I.R. Value in Mega Ohm by Megger.

2.2.1.3 Following additional routine tests shall also be carried out on each transformer:
   1. Magnetic Circuit Test
      After assembly each core shall be tested for 1 minute at 2000 Volts between core and core belts.
   2. Oil leakage test on transformer tank as per Clause 2.2.6.1 below.
   3. Magnetic balance test
   4. Measurement of no-load current with 415V, 50Hz ac supply on LV side.
   5. Frequency response analysis (FRA).
   6. High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.
2.2.2 Type Tests

Following type test shall be conducted on one Transformer of each rating:

2.2.2.1 (1) Temp. Rise Test as per IS:2026 (Part-II)
(2) Measurement of capacitance & tan delta of bushing and winding. The value of tan delta should not exceed 0.5.

Gas chromatographic analysis on oil shall also be conducted before and after this test and the values shall be recorded in the test report. This sampling shall be in accordance with IEC 567. For the evaluation of the gas analysis in temperature rise test the procedure shall be as per IS:9434 (based on IEC:567) and results will be interpreted as per IS:10593 (based on ICE-599).

The temperature rise test shall be conducted at a tap for the worst combination of loading on the three windings of the transformer. The Contractor before carrying out such test shall submit detailed calculation showing alternatives possible, on various taps and for the three types of ratings of the transformer and shall recommend the combination that results in highest temperature rise for the test.

2.2.2.2 Tank vacuum Test as per Cl. No. 2.6.2.2(i) below.
2.2.2.3 Tank pressure Test as per Cl. No. 2.6.2.2(ii) below.
2.2.2.4 Measurement of capacitance and tan delta to determine capacitance between winding and earth. The value of Tan Delta should not exceed 0.5.
2.2.2.5 Lightning Impulse withstand test in all phases as per IS:2026 (As type test, only for 220kV class & below).

2.2.3 Additional type tests

Following additional type tests other than type and routine tests shall also be carried out on one unit of each type:

2.2.3.1 Measurement of zero Seq. reactance (As per IS:2026, for 3-phase transformer only).
2.2.3.2 Measurement of acoustic noise level.
2.2.3.3 Measurement of power taken by fans and oil pumps.
2.2.3.4 Measurement of harmonic level in no load current.
2.2.3.5 Measurement of transferred surge on LV (tertiary) winding due to HV lightning impulse and IV lightning impulse.

2.2.4 Routine tests on bushings

The following tests shall be conducted on bushings

2.2.4.1 Test for leakage on internal fillings.
2.2.4.2 Measurement of creepage distance, dielectric dissipation factor and capacitance.
2.2.4.3 Dry power frequency test on terminal and tapping.
2.2.4.4 Partial discharge test followed by dielectric dissipation factor and capacitance measurement.

2.2.5 Type Tests on fittings:

All the following fittings shall conform to type tests and the type test reports shall be furnished by the contractor along with the drawings of equipment/ fittings. The list of fittings and the type test requirement is:

1. Bushing (Type Test as per IS:2099/ IEC:137)
2. Buchholz relay (Type Test as per IS:3637 and IP-55 Test on terminal box)
3. OLTC (Temperature Rise of contact, Short circuit current test, Mechanical test and Dielectric Test as per IEC:214 and IP-55 test on driving mechanism box)
4. Cooler control Cabinet (IP-55 test)
5. Pressure Relief device Test
   The pressure Relief Device of each size shall be subjected to increase in oil pressure. It shall operate before reaching the test pressure specified in transformer tank pressure test at Cl. No. 2.2.6.2 (ii) below. The operating pressure shall be recorded. The device shall seal off after excess pressure has been released.
   The terminal box/ boxes of PRD should conform to degree of protection as per IP-55 of IS: 13947.
6. Magnetic Oil Level gauge & Terminal Box for IP-55 degree of protection.
7. Air Cell (Flexible air separator)- Oil side coating, Air side under Coating, Air side outer coating and coated fabric as per IS:3400 /BS:903/ IS:7016.
8. OTI & WTI – Switch setting & operation, Switch differential, Switch rating.
9. Oil pump – Vacuum Test at 250 torr maximum, oil pressure test at 1 kg/cm² for 24 hrs. Temperature rise test by resistance method. IP-55 degree of protection for terminal box.
10. Cooling fan and motor assembly- Free air delivery, Temperature rise, sound level, running at reduced voltage, IP-55 degree of protection for terminal box.

2.2.6 Tank Test
2.2.6.1 Routine Tests
   Oil Leakage Test
   All tanks and oil filled compartments shall be tested for oil tightness by being completely filled with air or oil of a 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/Sq.m ( 5 psi) measured at the base of the tank. The pressure shall be maintained for a period of not less than 12 hours for oil and one hour for air during which time on leak shall occur.
2.2.6.2 Type Tests
   (i) Vacuum Test
   One transformer tank of each size shall be subjected to the specified vacuum. The tank designed for full vacuum shall be tested at an internal pressure of 3.33 KN/Sq.m absolute (25 torr) for one hour. The permanent deflection of flat plate after the vacuum has been released shall not exceed the values specified below:

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<th>Horizontal Length of flat plate (in mm)</th>
<th>Permanent deflection (in mm)</th>
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<tr>
<td>Upto and including 75 C</td>
<td>5.0</td>
</tr>
<tr>
<td>751 to 1250</td>
<td>6.5</td>
</tr>
<tr>
<td>Size</td>
<td>Pressure (KN/m²)</td>
</tr>
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<td>-----------------</td>
<td>------------------</td>
</tr>
<tr>
<td>1251 to 1750</td>
<td>8.0</td>
</tr>
<tr>
<td>1751 to 2000</td>
<td>9.5</td>
</tr>
<tr>
<td>2001 to 2250</td>
<td>11.0</td>
</tr>
<tr>
<td>2251 to 2500</td>
<td>12.5</td>
</tr>
<tr>
<td>2501 to 3000</td>
<td>16.0</td>
</tr>
<tr>
<td>Above 3000</td>
<td>19.0</td>
</tr>
</tbody>
</table>

(ii) Pressure Test
One transformer tank of each size, its radiator, conservator vessel and other fittings together or separately 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, the permanent deflection of flat plates after the excess pressure has been released shall not exceed the figure specified above for vacuum test.

2.2.7 Pre-Shipment Checks at Manufacturer’s Works
2.2.7.1 Check for interchangeability of components of similar transformers for mounting dimensions.
2.2.7.2 Check for proper packing and preservation of accessories like radiators, busings, dehydrating breather, rollers, buchholz relay, fans, control cubicle, connecting pipes, conservator etc.
2.2.7.3 Check for proper provision for bracing to arrest the movement of core and winding assembly inside the tank.
2.2.7.4 Gas tightness test to confirm tightness.
2.2.7.5 Derivation of leakage rate and ensure the adequate reserve gas capacity.

2.3 Inspection and Testing at Site
The Contractor shall carry out a detailed inspection and testing programme for field activities covering areas right from the receipt of material stage upto commissioning stage. An indicative programme of inspection as envisaged by the Employer is given below. However, it is contractor’s responsibility to draw up and carry out such a programme duly approved by the Employer. Testing of oil sample at site shall be carried out for BDV, Moisture content, Tan Delta at 90 deg C, Resistivity at 90 deg C and interfacial tension.

2.3.1 Receipt and Storage Checks
2.3.1.1 Check and record condition of each package, visible parts of the transformer etc. for any damage.
2.3.1.2 Check and record the gas pressure in the transformer tank as well as in the gas cylinder.
2.3.1.3 Visual check for wedging of core and coils before filling up with oil and also check conditions of core and winding in general.
2.3.1.4 Check and record reading of impact recorder at receipt and verify the allowable limits as per manufacturer’s recommendations.
2.3.2 Installation Checks

2.3.2.1 Inspection and performance testing of accessories like tap changers, cooling fans, oil pumps etc.

2.3.2.2 (i) Check the direction of rotation of fans and pumps.
(ii) Check the bearing lubrication.

2.3.2.3 Check whole assembly for tightness, general appearance etc.

2.3.2.4 Oil leakage test

2.3.2.5 Test on Oil Sample.

2.3.2.6 Capacitance and tan delta measurement of busing before fixing/ connecting to the winding, contractor shall furnish these values for site reference.

2.3.2.7 Leakage test on bushing before erection.

2.3.2.8 Measure and record the dew point of nitrogen in the main tank before assembly.

2.3.3 Commissioning Checks

2.3.3.1 Check the colour of silica gel in silica gel breather.

2.3.3.2 Check the oil level in the breather housing, conservator tanks, cooling system, condenser bushing etc.

2.3.3.3 Check the bushing for conformity of connection to the lines etc.

2.3.3.4 Check for correct operation of all protection devices and alarms:
(i) Buchholz relay.
(ii) Excessive winding temperature.
(iii) Excessive oil temperature.
(iv) Low oil flow.
(v) Low oil level indication.
(vi) Fan and pump failure protection.

2.3.3.5 Check for the adequate protection on the electric circuit supplying the accessories.

2.3.3.6 Check resistance of all windings on all steps of the tap changer. Insulation resistance measurement for the following:
(i) Control Wiring
(ii) Cooling system motor and control
(iii) Main windings
(iv) Tap changer motor and control.

2.3.3.7 Check for cleanliness of the transformer and the surroundings.

2.3.3.8 Continuously observe the transformer operation at no load for 24 hours.

2.3.3.9 Gradually put the transformer on load, check and measure increase in temperature in relation to the load and check the operation with respect to temperature rise and noise level etc.

2.3.3.10 Phase out and vector group test.

2.3.3.11 Ratio test on all taps.

2.3.3.12 Magnetizing current test.

2.3.3.13 Capacitance and Tan delta measurement of winding and bushing after assembly of transformer. It will provide a base data which would act as guideline for maintenance staff for subsequent condition monitoring of the transformer.

2.3.3.14 DGA of oil just before commissioning and after 24 hours energisation at site.

2.3.3.15 Frequency response analysis (FRA).

2.3.3.16 Contractor shall prepare a comprehensive commissioning report including all commissioning test results and forward to Employer for future record.
### SECTION – III : ELECTRICAL CHARACTERISTICS AND PERFORMANCE REQUIREMENTS

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SECTION – III : ELECTRICAL CHARACTERISTICS AND PERFORMANCE REQUIREMENTS

3.0 TYPE & RATING
The power transformer shall be of core or shell type construction oil immersed, ONAN/ONAF/OFAF cooled, 3 phase unit suitable for outdoor service as step up/step down transformer. The rating and electrical characteristics shall be as follows:-

SYSTEM PARAMETERS

<table>
<thead>
<tr>
<th>Nominal Voltage</th>
<th>220 KV</th>
<th>66 KV</th>
</tr>
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<tbody>
<tr>
<td>i) Rated Voltage of Equipment (KV)</td>
<td>245</td>
<td>72.5</td>
</tr>
<tr>
<td>ii) Rated impulse voltage withstand level (peak) (KV)</td>
<td>1050</td>
<td>325</td>
</tr>
<tr>
<td>iii) Rated one-minute power frequency Withstand voltage (r.m.s.) (KV)</td>
<td>460</td>
<td>140</td>
</tr>
<tr>
<td>iv) Rated short time current rating for 3 sec. (r.m.s.) (KA)</td>
<td>40</td>
<td>31.5</td>
</tr>
</tbody>
</table>

3.1 NORMAL CONTINUOUS RATING IN M.V.A.

a) H.V. Winding 160 MVA limited to summation of (b) and (c)
b) L.V. Winding 160
c) Tertiary Winding 160

d) In case of star/star connected transformer where a specified the stabilizing winding (tertiary winding) shall be capable of carrying continuously the capacitive load to 100% rating of tertiary as specified. The stabilizing winding shall be designed with particular attention to the suppression of harmonic voltage, especially the third and fifth, so as to eliminate wave-for distortion and possibility of high frequency disturbances, including switching surges, inductive effects or of circulating currents between the neutral points at different transforming stations reaching such a magnitude as to cause interference with communication circuits. The percentage of third and fifth harmonic shall be specified.

The stabilizing winding shall be designed for 170 KV peak B.I.L. Also refer clause 1.10.5.

Windings shall be capable to withstand short circuit currents resulting from different types of system faults that can arise in service associated with relevant system earthing conditions.
3.2 **RATED VOLTAGE**
   a) H.V. Winding  220 KV  
   b) L.V. Winding  66 KV  
   c) Tertiary winding  11 KV  

3.3 **CONNECTIONS**
   a) H.V. Winding  Star neutral solidly earthed  
   b) L.V. Winding  Star neutral solidly earthed  
   c) Tertiary Winding  Delta  

3.4 **VECTOR GROUP**  YNyn0d11  

3.5 **TYPE OF COOLING AND RATNG**
   a) ONAN  60%  
   b) ONAF  80%  
   c) OFAF  100%  

3.6 **IMPEDEANCE VOLTAGE AT RATED CURRENT FOR THE PRINCIPAL TAPINGS**
   a) HV to LV  16 %  
   b) HV to Tertiary  24 %  
   c) LV to Tertiary  12 %  

   The value of impedance on other taps shall be indicated subject to the approval of the Employer at the time of order.  

3.7 **INSULATION LEVEL :**  

<table>
<thead>
<tr>
<th>Nominal Voltage for equipment (KV rms.)</th>
<th>Highest system Voltage for equipment (KV rms)</th>
<th>Lightning impulse withstand voltage (KV peak)</th>
<th>Induced over voltage withstand voltage (KV rms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>12</td>
<td>170*</td>
<td>70</td>
</tr>
<tr>
<td>66</td>
<td>72.5</td>
<td>325</td>
<td>140</td>
</tr>
<tr>
<td>220</td>
<td>245</td>
<td>1050</td>
<td>460</td>
</tr>
</tbody>
</table>

* Also refer clause 1.10.5  

The bay width of the 220 KV yard is 16.65 metres and as such the bidder may specifically note that the length of the transformer along with the bay width shall not be more than 10 Metres. The electrical clearance should be suitable for erecting transformers in two adjacent bays. If adjacent transformers are
separated by a distance more than minimum clearance required but less than 35 meters, fire protection wall will be provided between them. The barrier wall of brick or reinforced cement concrete shall be provided for separation of transformer wherever adequate space is not available. The barrier shall extend at least 300 mm above the transformer bushing and pressure relief vent and length wise 600 mm beyond the transformer including any radiators and tap changer enclosure.

3.8 Service:

a) Rated Frequency  50 Hz
b) Number of phases  3 (three)

3.9 On load tap-changer:
The on load tap-changer shall be in the steps of 1.1/4% on HV winding for HV variation from + 5% to -15% in 16 equal steps. Tap No. 5 shall be the Principal Tap.

3.10 CLEARANCES:
The clearances in air between live conductive parts and between live conductive parts to earthed structure shall be as follows:-

<table>
<thead>
<tr>
<th>Nominal system Voltage kV rms</th>
<th>Test Impulse Voltage kV peak</th>
<th>Clearances (mm)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Phase to phase</td>
<td>Phase to earth</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>75</td>
<td>280</td>
<td>140</td>
</tr>
<tr>
<td>66</td>
<td>325</td>
<td>925</td>
<td>630</td>
</tr>
<tr>
<td>220</td>
<td>1050</td>
<td>2400</td>
<td>2400</td>
</tr>
</tbody>
</table>

3.11 Temperature Rises:-
With reference to ambient temperatures adopted for purpose of this specification, the temperature rise shall be as under :-

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Part</th>
<th>External Cooling Winding (Air)</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Winding (temp.) rise by resistance</td>
<td>(i) 55°C when the oil circulation is natural or forced non-directed. (ii) 60°C when the oil circulation is forced directed.</td>
</tr>
<tr>
<td>ii)</td>
<td>Top oil (Temp. rise)</td>
<td>50°C (when the transformer is equipped with conservator)</td>
</tr>
</tbody>
</table>
3.12 PARALLEL OPERATION:
The power transformers with O.L.T.C. shall be suitable for parallel operation.

3.13 Bushing
Each bushing shall be capable to carry at least 200% current at C.M.R. and to withstand short circuit current of not less then ten times of the nominal current of three seconds.

11 KV Terminals: Oil communicating type Porcelain, bushing on top of transfer, tank. Arrangement of terminating two Nos. single core 1000 mm² Aluminium cable per phase by suitably extending the connection, Extension pieces shall be properly insulated by heat shrink sleeves. Connections between the bushing terminals and extension pieces shall be flexible to restrict transmission of vibrations. Supporting frame, steel structure etc. for mounting 8 Nos. 11 KV, 1000 mm² Aluminium cable (Two for each phase) and their fixing and mounting arrangements, clamps and accessories shall form an integral part of supply. Expansion joints shall be provided between cable and terminals and bushing terminals.

66 KV Terminals 72.5 KV condenser bushings complete with terminal connector suitable for twin ACSR ‘BERSIMIS’ conductor.

220 KV Terminals 245 KV condenser bushings complete with terminal connector suitable for twin ACSR ‘Bersimis’ conductor. Creepage distance as per IS : 2090 and IEC-71 suitable for heavily polluted atmosphere.

3.14 FLUX DENSITY
i) The maximum designed continuous flux density in any part of the cored and yoke at normal voltage and frequency shall not exceed 1.6 TESLA.

ii) The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall be such that the flux density on any tap position with plus 10% voltage variation from voltage corresponding to the tap shall not exceed 1.9 TESLA

3.15 RADIO INFLUENCE AND NOISE LEVEL:

i) The transformer shall be designed with particular attention to the suppression of maximum harmonic voltage, especially the third and fifth, so as to minimize interference with communication circuit.

ii) The noise-level when energized at normal voltage and frequency with fans and pumps running shall not be more than 0.5 db above the NEMA Standard Publication TR-1.
CONTINUOUS MAXIMUM RATING & OVERLOAD

a) Transformer specified for mixed cooling shall be capable of operating under the natural cooled condition up to the specified load. The forced cooling equipment shall come into operation by contacts of winding temperature indicator and the transformer shall operate as a forced cooled unit.

b) Total cooling system of transformer with oil forced and air forced (OFAF) cooling shall be so designed that during total failure of power supply to cooling fans and oil pumps the transformer shall be able to operate at full load for at least ten minutes without the calculated winding hot spot temperature exceeding $150^\circ$C. Also stopping of one or two cooling fans should not have any effect on the cooling system. For transformer with oil natural and air forced (ONAF) cooling a similar cooling system should be designed in case of a total loss of power supply to cooling fans.

c) The transformers shall be capable of being loaded in accordance with IS:6600. There shall be no limitations imposed by bushings, tap changer etc. Please refer clause 3.13.

d) The transformer shall be capable of being operated without danger on any tapping at the rated KVA, with voltage variation of $\pm 10\%$ corresponding to the voltage of the tapping.

e) The transformers and all its accessories shall be designed to withstand without injury, the thermal and mechanical effects of any external short circuit to earth and of short circuits at the terminals of any winding for a period of 3 secs. The short circuit level of the HV & IV system to which the subject transformers will be connected is 40KA for 220KV system and 31.5KA for 66KV system. The calculation in support of short circuit withstand capacity of Transformer is to be submitted by the tender or the Transformer will be subjected to short circuit test, if desired by DTL.

FITTINGS AND ACCESSORIES

The fittings and accessories as per annexure ‘A’ shall be provided with each transformer covered in this specification.

GUARANTEE, EVALUATION OF LOSSES & PENALTIES :

The no-load losses, load-losses shall be stated in the offer:

3.18.1 The Indian Standards specification IS:2126 allow certain tolerances for acceptance of the transformer no load and load losses. The bidders are to indicate whether the figures given for guaranteed losses in schedule of guaranteed technical particulars are with or without such tolerances. If tolerances are applicable, the limits for the same should be indicated. In the absence of any information to this effect, the figures for no load and load losses (including auxiliary losses) will be increased by 10% as provided in IEC-60076 & IS:2026). Any changes in the figures assigned for transformer losses will not be permitted after opening of the bids and bid evaluation will be carried out on the basis of information made available at the time of bid opening.
3.18.2 The no load loss in kilo-watts at rated voltage and rated frequency and the total losses in kilo-watts at rated output, rated voltage and rated frequency shall be guaranteed under penalty. For the purpose of penalty computations, the test figures of these losses shall be compared with the corresponding guaranteed figures.

3.18.3 The penalties shall be separately evaluated from the excess of the test figures of the no-load loss in kilo-watts, over the corresponding guaranteed value and the excess of the difference between the test values of the total losses and the no-load loss in kilowatts, over the difference of the corresponding guaranteed values. No tolerance shall be permitted over the test figures of the losses.

3.18.4 The penalties shall be calculated at the rate of Rs.171300/- per kilo-watt for the excess of no-load loss, the rate of Rs.69900/- per kilo watt for the excess of difference in the total and the no-load losses and the rate of Rs.68500/- per KW for cooler Loss. For fraction of kilo-watt, the penalties shall be applied pro-rata.

3.18.5 For the purpose of comparison of tenders, the quoted prices shall be equalized for the transformer losses at the following rates:
   i) No load losses: @ Rs.171300/- per KW
   ii) Load losses: @ Rs.69900/- per KW
   iv) Cooler Loss (KW):@ Rs.68500/- per KW

3.18.6 The bidder should note that values assigned for the capitalization of losses are based on the present worth and therefore capitalization of investment will not be made separately.

3.19 GUARANTEE, EVALUATION OF AUXILIARY POWER CONSUMPTION AND PENALITIES:

3.19.1 The power consumed at full load by the fans, oil pumps and any other auxiliary apparatus shall be stated in the offer which shall be guaranteed. Tolerance, if any on this figure shall also be indicated failing which a tolerance of 10% shall be assumed. For the purpose of evaluation of tenders and imposition of penalty the guaranteed figure after taking in account the maximum tolerance if any, shall be assumed.

3.19.2 For the purpose of evaluation of tenders, the power consumption of the auxiliaries shall be considered for 20% of the capacity and shall be capitalized to arrive at the final evaluated price for comparison. For the purpose of evaluation, the rates as given in para 3.18.4 above shall be taken.

3.20 SPARE PARTS & MAINTENANCE EQUIPMENT:
In making a bid for the equipment, the Bidder may offer recommended spare parts and a list of optional accessories, the rates of which will be valid for two years from the date of successful commissioning of sub station.

3.21 REJECTION
The Employer may reject any transformer if during tests or service any of the following conditions arise: -
a) No load loss exceeds the guaranteed value by 15% or more.
b) Load loss exceeds the guaranteed value by 15% or more.
c) Total losses exceed the guaranteed value by 10% or more.
d) Impedance value exceeds the guaranteed value by ± 10% or more.
e) Transformer fails on impulse test.
f) Transformer fails on power frequency voltage withstand test.
g) Transformer is provided to have been manufactured not in accordance with the specification.

3.22 **STANDARD**
The transformer shall generally conform to the I.E.C./I.S. specification and CBIP recommendations except for certain technical variations as per specification.

3.23 Transformer shall be provided with gas collecting device.
### SECTION – IV : SPECIFICATIONS FOR MICRO GAS ANALYSER

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SECTION – IV : SPECIFICATIONS FOR MICRO GAS ANALYSER

4.0 Other Testing Equipment
4.1 Micro gas analyzer shall be suitable for analysing gases evolved from transformer oil as well as that collected from Buchholz relay.
4.2 The equipment shall be suitable for rapid on-sight measurements.
4.3 The analyzer shall be supplied complete with all accessories required for normal operation.
4.4 The analyzer shall be a precision instrument and gas detector tubes (colour change tubes) shall be incorporated in it in such a manner that the instrument shall:
   a) enable a proper gas-tight connection to be made to the equipment being tested;
   b) allow all such connections to be flushed with the gas to be tested using the minimum volume of that gas:
   c) provide a scheme for rapidly directing the gas through a range of colour change detector tubes without making and breaking the temporary rubber tune joints;
   d) provide a system to measure the gas flowing through each detector tube to ensure the absence of leaks and to provide a means for subdividing small volumes of gas to obtain more precise analyses.
4.5 The equipment shall be supplied with a 2 litre calibrated polythene sample bottle to drain out the gas from Buchholz relay.
4.6 The equipment shall be suitable for operating in tropical conditions with maximum ambient temperature of 50°C and 100 percent humidity.

5.0 Oil Sampling bottles
5.1 Oil sampling bottles suitable for collecting samples from transformer for DGA shall be provided. They shall be made of stainless steel having a capacity of one liter.
5.2 Oil sampling bottles shall be capable of being sealed gas-tight and shall be flitted with cocks on both ends.
5.3 The design of bottle & seal shall be such that loss of hydrogen shall not exceed 5% per week.
5.4 An impermeable oil-proof, transparent plastic or rubber tube of about 5mm diameter, and of sufficient length shall also be provided with each bottle along with suitable connectors to fit the tube on to the oil sampling valve of the equipment and the oil collecting bottles respectively.
FITTINGS AND ACCESSORIES

The transformer shall be complete with following fittings and accessories:-

i) Set of bushing – with adjustable rod gap and terminal connectors for primary winding.

ii) Set of bushing with adjustable rod gap and terminal connectors for secondary winding.

iii) Set of bushings with adjustable rod gaps and terminal connectors for tertiary winding.

iv) Neutral bushings with connectors and earth bars.

v) Conservator with oil filling hole, cap and drain valve.

vi) Magnetic type oil gauge with low oil level alarm.

vii) Prismatic oil level gauge.

viii) Oil preservation equipment with necessary arrangements to connect preservation equipment.

ix) Dry inert Nitrogen Gas sealing arrangements

x) Thermosiphen filters.

xi) a) Buchholz relay with testing sampling cocks, alarm and trip contacts and one isolating valve on conservator side – size 80 mm.

b) Oil surge relay for OLTC conservator tanks with isolating valve and trip contacts.

c) Sudden pressure relay.

xii) Pressure relief device.

xiii) Pocket on tank cover for thermometer

xiv) Oil temperature indicator with maximum pointer and two sets of contacts.

xv) Winding temperature indicators with maximum pointer with 4 sets of contacts (for ONAN/ONAF/OFAF)

xvi) Repeater dials of winding temperature, oil temperature for remote indication.

xvii) **VALVES**

a) Oil shut off valves between cooler and main tank as specified.

b) Drain valve – size 100 mm.

c) 2 Nos. filter valves on diagonally opposite corners – size 50 mm

d) 2 Nos. sampling valves at top and bottom of main tank.

xviii) Earthing terminals (2 Nos.)

xix) Rating and diagram plates

xx) Valve Schedule Plate

xxi) Jacking pads

xxii) Lifting bollards

xxiii) Haulage lugs

xxiv) Cover Lifting lugs

xxv) Bi-directional flanged rollers with locking and bolting device arranged for rail gauge as specified.

xxvi) Marshalling box (Weather proof) for housing control equipment and terminal connections.

xxvii) Air release devices
xxxii) Insulating oil with 10% extra oil (In non returnable M.S. drum)
   The fittings and accessories listed above are only indicative and any other fittings and
   accessories which generally are required for satisfactory operation of the transformer
   are deemed to be included, unless specifically excluded.

xxxiii) Oil Storage Tank and Oil Sampling Bottle
   Specification of above is attached in Annexure-B
ANNEXURE-B

1.0 OIL STORAGE TANK

1.1 General
This specification covers supply of oil storage tank of 15 cubic meter capacity along with complete accessories.

1.2 Standard
The oil storage tank shall be designed and fabricated as per relevant Indian Standards e.g. IS:803 or other internationally acceptable standards.

1.3 Specifications
Transformer oil storage tanks shall be towable & rested on pneumatic tyres of adequate quantity & size. The tank shall be to cylindrical shape & mounted horizontally and made of mild steel plate of adequate thickness. Size of the storage tank shall be as follows:

Diameter : 2.5 meter and Capacity : 15 cubic metre

The tank shall be designed for storage of oil at a temperature of 100ºC.

1.4 The Bidder may further note that maximum height of any part of the complete assembly of the storage tank shall not exceed 4.0 metres above road top.

1.5 The tank shall have adequate number of jacking pad so that it can be kept on jack while completely filled with oil. The tank shall be provided with suitable saddles so that tank can be rested on ground after removing the pneumatic tyres.

1.6 The tank shall also fitted with manhole, outside & inside access ladder, silicagel breather assembly, inlet & outlet valve, oil sampling valve with suitable adopter, oil drainage valve, air vent etc. Pulling hook on both ends of the tank shall be provided so that the tank can be pulled from either end while completely filled with oil. Bidder shall indicate the engine capacity in horse power to pull one tank completely fitted with oil. Oil level indicator shall be provided with calibration in terms of litre so that at any time operator can have an idea of oil in the tank. Suitable arrangement shall also be provided to prevent overflow in the tank. Four nos. suitable rubber hoses with couplers and unions each not less than 10 metre long shall also be provided.

1.7 The internal & external surfaces to be painted shall be shot or sand blasted to remove all rust and scale of foreign adhering matter or grease. All steel surfaces in contact with insulating oil shall have painted with two coats of heat & oil resistant anti-corrosive paint.

All steel surfaces exposed to weather shall be given a primary coat of zinc chromate, second coat of oil & weather resistant paint of a colour distinct from primary and final two coats of glossy oil & weather resistant light grey paint in accordance with shade no. 631 of IS:5. All paints shall be carefully selected to withstand heat & extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. The minimum thickness of outside painting of tank shall be 20 microns per coat the total thickness shall be within 70 to 100 microns.

1.8 The tank shall contain a self mounted centrifugal oil pump with inlet and outlet valves, with couplers -suitable for flexible rubber hoses and necessary switchgear for its control. There shall be no rigid connection to the pump. The pump shall be electric
motor driven, and shall have a discharge of not less than 6.0 kl/hr. with a discharge head of 8.0m. The pump motor and the control cabinet shall be enclosed in a cubical with IP-55 enclosure.

2.0 **OIL SAMPLING BOTTLE**

2.1 Oil sampling bottles shall be suitable for collecting oil samples from transformers and shunt reactors, for Dissolved Gas Analysis. Bottles shall be robust enough, so that no damage occurs during frequent transportation of samples from site to laboratory.

2.2 Oil Sampling bottles shall be made of stainless steel having a capacity of 1 litre.

2.3 Oil Sampling bottles shall be capable of being sealed gas-tight and shall be fitted with cocks on both ends.

2.4 The design of bottle & seal shall be such that loss of hydrogen shall not exceed 5% per week.

2.5 An impermeable oil-proof, transparent plastic or rubber tube of about 5 mm diameter, and of sufficient length shall also be provided with each bottle along with suitable connectors to fit the tube on to the oil sampling valve of the equipment and the oil collecting bottles respectively.
SECTION : 6

FIRE PROTECTION SYSTEM

1.0 INTENT OF SPECIFICATION
This section covers the design and performance requirements of the following types of fire protection systems:

a) Nitrogen Injection Fire Prevention cum Extinguishing System
b) Portable Fire Extinguishers

1.1 It is not the intent to completely specify all details of design and construction. Nevertheless, the system design and equipment shall conform in all respects to high standard of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Owner. The system design shall also conform to TAC/ NFPA norms.

1.2 The scope of work includes complete installation of fire protection system wherever it is required.

1.3 The equipment offered shall comply with the relevant IEC. The equipment conforming to any other approved international standards shall meet the requirement called for the latest revision of relevant Indian Standard or shall be superior.

1.4 Ambient temperature for design of all equipment shall be considered as 50°C.

1.5 The successful bidder shall prepare detailed layout and piping drawing and also other drawing such as road, drainage, cable trench, switch yard layout, etc. as furnished by the Employer during detailed engineering.

2.0 NITROGEN INJECTION FIRE PREVENTION CUM EXTINGUISHING SYSTEM

2.1 General:
Provision of inbuilt Complete Nitrogen Injection Fire Prevention cum Extinguishing System

Nitrogen Injection System for the Protection of Transformers against fire due to an arc, during internal faults and external fires is required to be provided with the 100MVA and 160 MVA Transformers for preventing tank explosion.

2.2 The system should comprise the following:

i). Fire Extinguishing Cubicle with base frame and containing, oil drain assembly, nitrogen cylinder, electric mechanical control unit for oil drain and nitrogen release detections necessary for monitoring system flanges on top panel for connecting pipe connections from transformer, panel lighting etc.

ii). Control Box for monitoring system operation, automatic control and remote operation, with alarms, indication light switches, push buttons, audio signal, suitable for tripping and signaling on 220 V DC supply.

iii). Pre-stressed non-return valve (PNRV) working on transformer oil flow rate, with proximity switch for remote alarm indication and with visual position indicator.

iv). Required number of fire detectors rated for 141°C for heat sensing, each fitted with two number cable glands.

v). Signal box for terminating cable connections from PNRV and fire detectors.

vi). Pressure relief valve with limit switch.
The following arrangements are required to be made on the transformer Tank at the time of fabrication of the tank:

- **i).** Oil drain opening with pipe, flange and manual gate valve at about 120mm below the top cover. Pipe size DN125 for 100 MVA and 160MVA.
- **ii).** Nitrogen Injection openings with pipe size DN 25 with flange and manual gate valve on tank sides at about 100-200 mm from the bottom plate.
- **iii).** Flanges having 4 Nos. 18 dia. holes with pcd as 155mm and dummy pipe on the conservator pipe between buchholz relay and conservator tank manual gate valve, for fixing PNRV.
- **iv).** Supply and welding of fire detector brackets on top cover.
- **v).** Supply and welding of the brackets for fixing signal box at a suitable location on top cover or tank size wall.

The following jobs shall also be within the scope of the Contractor/Sub-Contractor:

- **i).** Civil work including oil pit and fire wall.
- **ii).** Material handling facility for placing F.E. cubicle on plinth.
- **iii).** Required electric signals connections to control box except fire detectors and PNRV.

However all cabling, piping and any other material required shall be supplied by the manufacturer. Installation and Pre-commissioning tests shall also be in the scope of Contractor/Sub-Contractor.

### ACTIVATION OF NIFPES:

**2.5.1** Mal-functioning of fire prevention / extinguishing systems is their major shortcoming which leads to interruption in power supply. The Contractor/Sub-Contractor shall ensure that the chances of malfunctioning of NIFPES are practically nil. To achieve this objective, the Contractor/Sub-Contractor shall work out his scheme of activating signals which, while preventing mal-operation, should not be to rigorous to make the operation of NIFPES impracticable in case of actual need. Transformer isolation shall be the mandatory pre-requisite for activation of the system in Automatic mode or Remote mode in the control room. In addition, at least following electrical-signals shall be provided in series for activating NIFPES.

**2.5.2** **Auto Mode**

- **a) For Prevention of Fire**
  - i) Differential Relay Operation
  - ii) Buchholz Relay parallel with Pressure Relief Valve or RPRR.
    - (Rapid Pressure Release Relay)
  - iii) Tripping of all concerned breakers is a pre-requisite for initiation of system activation.

- **b) For Extinguishing Fire**
  - i) Fire Detector
  - ii) Buchholz Relay paralleled with Pressure Relief Valve or RPRR.
  - iii) Tripping of all connected breakers is a pre-requisite for initiation of system activation.
2.5.3 Manual Mode (Local/Remote) : Tripping of all connected breakers is a pre-requisite for initiation of system activation.

2.5.4 Manual Mode (Mechanical) : Tripping of all connected breakers is a pre-requisite for initiation of system activation.

2.6 General Description of NIFPES

2.6.1 Schematic of the System

NIFPES should be a stand alone dedicated system for oil filled. It should have a fire extinguishing (FE) cubicle placed on a plinth at a distance of 6-10 mtrs. from the transformer. The F.E. cubicle may be connected to the transformer oil tank (near its top) and to the oil pit from its bottom through oil pipes with gate valves. The F.E. cubicle should house a pressurized nitrogen cylinder connected to the transformer oil tank (near its bottom). Cable connections are to be provided from signal box placed on the transformer to the control box in the control room and from control box to F.E. cubicle. Fire detectors placed at the top of transformer are to be connected in parallel to the signal box. The signal box may be connected to a pre-stressed non-return valve fitted between the conservator tank and Buchholz relay. Control box is also to be connected to relay panel is control room for system activation signals.

2.6.2 Operation

On receipt of all activating signals, drain of pre-determined quantity of oil commences thus removing high temp. top oil layer. Simultaneously nitrogen is injected under high pressure at a pre-fixed rate, string the oil thus bringing the temperature of top oil layer down. Nitrogen occupies the space created by oil drained out and acts as an insulating layer between the tank oil & fire on top cover. Pre-stressed non return valve blocks oil flow form conservator tank, thus isolating it & preventing aggravation of fire.

2.6.3 System Components

Broadly, NIFPES shall consist of the following components. It is emphasized that all components irrespective of their exclusion in the details given below, necessary for fast reliable & effective working of NIFPES shall be considered within the scope of supply.

2.6.4 Fire Extinguishing Cubicle

It shall be made of 3mm thick steel sheet, painted dark red from inside & outside with hinged split doors fitted with high quality tamper proof lock. It shall be complete with the base frame and the following :-

- Nitrogen gas cylinder with regulator and falling pressure electrical contact manometer
- Oil drain pipe with mechanical quick drain valve.
- Electro mechanical control equipment for oil drain and pre-determined regulated nitrogen release.
- Pressure monitoring switch for back-up protection for nitrogen release.
- Limit switches for monitoring of the system.
- Flanges on top panel for connecting oil drain and nitrogen injection pipes for transformer.
- Panel lighting (CFL Type)
- Oil drain pipe extension of suitable sizes for connecting pipes to oil pit.

2.7 Control Box

Control Box for monitoring system operation, automatic control and remote operation, with following alarms indication, light switches, push buttons, audio signal, line fault detection suitable for tripping and signaling on 220V DC supply:

- System on*
- PNRV open*
- Oil drain valve closed*
Gas inlet valve closed*
PNRV closed^
Fire Detector Trip^
Buchholz Relay Trip^
Oil drain valve open^
Extinction in pressure^
Cylinder pressure low^
Differential relay trip^
PRV/RPRR trip^
Transformer trip^
System out of service
Line fault free detector
Line fault differential relay
Line fault buchholz relay
Line fault PRV
Line fault transformer trip
Line fault PNRV
Auto/Manual/Off^
Extinction release on
Extinction release off
Lamp test
Visual / Audio Alarm
Visual / Audio alarm for DC supply fail

The signals marked (*) shall be in the topmost row of control box panel. The signals marked (^) shall follow next.

2.8 Pre-stressed Non Return Valve (PNRV)
PNRV is to be fitted in the conservator pipe line between conservator & Buccholz replay. It shall have the proximity switch for remote alarm, indication and with visual position indicator. The PNRV should be of the best quality because malfunction of PNRV shall be of serious consequence as its closing leads to stoppage of breathing of transformer.

2.9 Fire Detectors
The system shall be complete with adequate number of fire detectors fitted on the top of oil tank, OLTC/Off ckt. Tap changer rated for 141°C for heat sensing each fitted with two no. cable glands (water proof/weather proof).

2.10 Signal Box
It shall be fitted on the transformer for terminating cable connections from PNRV & fire detectors and for further connection to the control box.

2.11 Cables
Fire survival cables, able to withstand 750°C, 4 core x 1.5mm sq. for connection of fire detectors in parallel shall be used.

Fire retardant low smoke (FRLS) cable 12 core x 1.5mm sq. for connection between transformer signal box/marshalling box to control box and control box to fire extinguishing cubicle shall be used.

Fire retardant low smoke (FRLS) cable 4 core x 1.5mm sq. for connection between control box to DC supply source and fire extinguishing cubicle to AC supply source, signal box marshalling box to pre-stressed non return valve connection on transformer shall be used.
2.12 Pipes
Pipes, complete with connections, flanges, bends, tees etc. shall be supplied alongwith the system.

2.13 Other items
a) Oil drain and nitrogen injection openings with gate valves on transformer tank at suitable locations
b) Flanges with dummy piece in conservator pipe between Buchholz relay and conservator tank for fixing PNRV.
c) Fire detector brackets on transformer top cover.
d) Spare potential free contacts for system activating signals i.e. differential relay, buchholz relay, pressure relief valve, transformer isolation (master trip relay).
e) Pipe connections between transformer to fire extinguishing cubicle and fire extinguishing cubicle to oil pit.
f) Cabling on transformer top cover for fire detectors to be connected in parallel and inter cabling between signal box to control box and control box to fire extinguishing cubicle
g) Mild steel oil tank with moisture proof coating with capacity as minimum 20% of total oil quantity of transformer, with water tight cover, to be place in the oil pit. This tank shall be provided with the manhole, air vent pipe through silica gel breather, drain valve and a spare gate valve at the top.
h) Gate valves on oil drain pipe & nitrogen injection pipe should be able to withstand full vacuum. A non-return valve shall also be fitted on nitrogen injection pipe between transformers & gate valve.
i) Pressure relief valve, wherever not fitted on the existing transformer, shall also be in the scope of supply of Contractor/Sub-Contractor, alongwith its installation.
j) The F.E. cubicle shall be painted with post office red colour (Shade 538 of IS-5). All the exposed parts i.e. pipes, supports, signal box etc. shall be painted with enameled paint.

2.14 Mandatory Spares
The spares for Fire Fighting System are mentioned in relevant bid price schedules (Vol.-III).

2.15 Modification on the transformer
No modification on the transformer shall be allowed which affects its performance (i.e. efficiency, losses, heat dissipation ability etc.), safety, life etc. or its any other useful parameter. This requirement shall be of paramount importance and shall form the essence of the contract.
However, in any case, performance of transformer should not be affected in any manner by having NIFPES system and the Contractor/Sub-Contractor shall give an undertaking to this effect. All pipes should be washed/rinsed with transformer oil. If any damage is done to the transformer and/or any connected equipment during installation & commissioning full recovery therefore shall be effected from the Contractor/Sub-Contractor, of NIFPES system.
It shall be solely the responsibility of Contractor/Sub-Contractor to install, carry out pre-commissioning tests & commissioning NIFPES at site indicated in the Specification, to the entire satisfaction of the Employer and/or his representative.

2.16 Interlocks
It shall be ensured that once the NIFPES gets activated manually or in auto mode, all the connected breakers shall not close until the system is actually put in OFF mode. Also PNRV shall get closed only if all the connected breakers are open.
2.17 Scope of work

**Bidder to substations.**

The bidder may visit the substations in order to prepare a realistic bid especially w.r.t.

a) The probable location of various components of NIFPES in consultation with DTL. The location of oil pit shall be such that the same could be used for other transformer of the substation to be covered under NIFPES. The possibility of common oil pit for the transformer at substation to be covered with NIFPES.

b) Required lengths of various pipes & cables.

c) The design of NIFPES to ensure that it does not interfere with general maintenance/other activities carried on the transformer & in the substation and provision of NIFPES on remaining transformers at the substation.

2.18 Technical Particulars

2.18.1 Fire Extinction period

<table>
<thead>
<tr>
<th></th>
<th>Maximum 30 seconds</th>
<th>Maximum 3 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>On commencement of Nitrogen Injection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>From the moment of system activation to complete cooling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire detectors heat sensing temperature</td>
<td>141°C</td>
<td></td>
</tr>
<tr>
<td>Heat sensing area</td>
<td>800mm radius</td>
<td></td>
</tr>
<tr>
<td>Pre-stressed non return valve setting for Operation</td>
<td>minimum 60 ltr. Per minute</td>
<td></td>
</tr>
<tr>
<td>Capacity of Nitrogen cylinder</td>
<td>Minimum 68 litre water capacity And shall hold minimum 10 cubic Meter gas to 150 bar pressure.</td>
<td></td>
</tr>
<tr>
<td>Power Source:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Box</td>
<td>220V DC</td>
<td></td>
</tr>
<tr>
<td>Fire extinguishing cubicle for lighting</td>
<td>230V AC</td>
<td></td>
</tr>
</tbody>
</table>

Guaranteed technical particulars as per Section GTP shall be submitted alongwith the bid. The bidder shall clearly specifies the following in the bid:-

a) The maintenance and testing schedule for NIFPES.

b) All the steps required to be undertaken for restarting the transformer and connected equipment after operation and mal-operation (if any) of the NIFPES.

c) The process of venting nitrogen in case nitrogen pressure in the cylinder exceeds the stipulated maximum value.

2.19 Previous Experience for qualifying Bidder

The Bidder shall have a minimum experience of five years in the design, manufacturing, erection, testing and commissioning of nitrogen injection fire protection, system on power transformers of similar or higher rating. At least 6 sets of the system shall be in successful operation on power transformers on similar & higher ratings with at least three different organisations for a minimum period of the 2 years. The Bidder shall furnish the details of nitrogen injection fire prevention and extinguishing systems supplied by them so far giving order reference, name and address of the customer, indicating the dates of commissioning as well as performance certificate from customers, of successful and satisfactory operation for minimum two years.

2.20 CODES AND STANDARDS

The design and installation of complete fire protection system shall comply with the latest applicable Indian standards wherever Indian standards are not available relevant British / I.E.C. / codes shall be followed. The following standards / codes shall be followed in particular.

a) Approval certificate should be obtained from Loss Prevention Association (LPA).
b) National Fire Codes 1993 of National Fire Protection Association (NFPA) USA. The entire fire protection system shall be designed, erected and commissioned in accordance with the regulation of Tariff. Advisory Committee (TAC). In the absence of TAC regulations NFPA regulation shall be adhered to.

### 2.21 TESTS

#### Type Tests

Type test reports including that for detectors along with declared response time as per TAC’s letter shall be submitted along with the tender. Certificates of the test on the system carried out by national/international testing bodies & TAC’s approval, if any, shall also be submitted with the bid.

#### Factory Test

Tests will be carried out on individual equipment of the system, as applicable and the total system in the Contractor/Sub-Contractor’s workshop in presence of Employer’s representative.

#### Performance Test

Performance test of the complete system shall be carried out after complete erection at site by the Contractor/Sub-Contractor’s representative. These tests shall include simulation and verification of the response of the complete system without injection of the nitrogen gas.

#### Drawings and Manuals

Detailed layout drawing along with the equipment drawing & control ckt. Drawing shall be given by the bidder along with complete bill of materials. After awarding of contract, detailed dimensional drawing of the system complete bill of materials including location and size of plinth for cubicle and oil pit shall be submitted for Employer’s approval as per GCC.

### 2.22 DOCUMENTATION

All drawings shall conform to Internationals standards organization (ISO). All dimensions and data shall be in system International Units.

Bidder shall furnish four sets of following drawings alongwith the offer.

a) A detail write up on operation of the offered protection system also describing it’s effectiveness for quenching fire in an oil filled power transformer.

b) General outline drawing of the complete system with technical parameters.

c) Drawing showing clearances from ground and other live points of transformers and system.

d) The drawings showing the details of detectors to be provided on transformers.

e) Drawing indicating the details of fire alarm control panel.

f) Mounting details/Installation and commissioning instruction of system equipment.

h) The manufacturing of the equipments shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Employer. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor/Sub-Contractor’s risk.

i) Approval of drawings / works by Employer shall not relieve the Contractor/Sub-Contractor of any of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirements of the latest revision of applicable standards, rule and codes of practices and effective performance of the system. The Employer shall have the power to reject any work or material which in his judgment is not in accordance therewith.
3.0 PORTABLE FIRE EXTINGUISHERS

3.1 Intent of Specification
This specification lays down the requirement regarding fire extinguishers of following types:

*Portable fire extinguishers.*
  a) Dry chemical powder type
  b) Carbon Dioxide type

3.2 All the extinguishers offered by the Bidder shall be of reputed make and should have been approved by Tariff Advisory Committee of India or any other international authorities like FOC - London/NFPA-USA. Certificates to this effect shall be furnished by the Bidder. All extinguishers shall be ISI marked.

3.3 Adequate number of smoke detector and Portable Fire Extinguishers of Dry Chemical Powder and Carbon dioxide shall be provided in suitable location in control room building, GIS Hall and DG set room. These extinguishers will be used during the early phases of fire to prevent its spread and costly damage.

3.4 Design and Construction
3.4.1 All the portable extinguishers shall be of freestanding type and shall be capable of discharging freely and completely in upright position.
3.4.2 Each extinguisher shall have the instructions for operating the extinguishers on its body itself.
3.4.3 All extinguishers shall be supplied with initial charge and accessories as required.
3.4.4 Portable type extinguishers shall be provided with suitable clamps for mounting on walls or columns.
3.4.5 All extinguishers shall be painted with durable enamel paint of fire red colour conforming to relevant Indian Standards.
3.4.7 Dry chemical powder type extinguisher shall conform to IS: 2171.
3.4.8 Carbon Dioxide type extinguisher shall conform to IS: 2878.

3.5 Tests and Inspection
3.5.1 Particulars of shop tests and procedure shall be submitted to the Employer before hand for his approval.
3.5.2 A performance demonstration test at site of five (5) percent or one (1) number whichever is higher, of the extinguishers shall be carried out by the Contractor. All consumable and replaceable items require for this test would be supplied by the Contractor without any extra cost to Employer.
3.5.3 Performance testing of extinguisher shall be in line of applicable Indian Standards. In case where no Indian Standard is applicable for a particular type of extinguisher, the method of testing shall be mutually discussed and agreed to before placement of order for the extinguishers.

3.6 Performance Guarantee
The contractor shall guarantee all equipment supplied by him against any defect due to faulty design, material and workmanship. The equipment shall be guaranteed to operate satisfactorily at the rated conditions at site.

3.7 Painting
Each fire extinguisher shall be painted with durable enamel paint of fire red colour conforming to relevant Indian Standards
Specification of UG Tank

A. OIL Container:-

1. Capacity of tank shall be of 20% excluding free board as per requirement of the total oil capacity of the largest transformer in Sub Station.
2. Tank shall be of cylindrical shape and made of minimum 5 mm thick MS sheet.
3. Cylinder shall be placed with horizontal axis below ground level with adequate supporting frame of angles and channels at bottom and clamp on sides. The bottom frame shall be fixed firmly with bolts grouted in ground with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate).
4. Tank shall have
   (i) 700 mm dia air tight manhole cover with gasket.
   (ii) Drainage/suction valve.
   (iii) Lifting hooks of suitable strength.
   (iv) Air vent pipe with through silica gel breather.
   (v) One no. drain/suction pipe DN 50 NB on topmost circular surface of tank.
   (vi) One no. drain pipe DN 150 NB on vertical flat surface of tank and
   (vii) All other accessories for functional requirement of tank.
5. Outside surface of tank shall be painted with black anti corrosive bitumastic paint (two or more coats on new work) and also oil resistive paint as per requirement.

B. Chamber for OIL tank below GL :-

1. Chamber shall be of rectangular in size having minimum 50 CM clearance on sides and top of the MS tank.
2. Bottom slab of the tank shall be of minimum 125 mm thick RCC 1:1.5:3 (1 cement :1.5 coarse sand: 3 grade stone aggregate of 20 mm of nominal size) having reinforcement 12mm dia @ 175 center to center both ways (TMT bars confirming to relevant IS codes).
3. Cement shall confirm to OPC 43 grade.
4. Water proofing compound @ 1 kg./bag cement as per CPWD specifications shall be mixed with the cement in RCC and plaster work.
5. Side walls of the chamber shall be brick masonry in cement mortar (1 cement: 4 Coarse sand) with bricks confirming to class designation 75 thickness of wall shall be given below.
   a) From GL to 500 mm below GL - 230 mm
   b) From 500 mm below GL to 1250 mm below GL - 345 mm.
   c) From 1250 mm below GL to 2000 mm below GL - 460mm
6. Complete inside face and outer surface up to 300 mm below of GL of wall shall be plastered with 15mm thick cement mortar 1:4 (1 Cement:4 fine sand) having neat cement punning on top of the plaster.
7. Top of brick wall shall have 100 mm thick coping in cement concrete 1:2:4 (1 cement:2 Coarse sand : 4 graded stone aggregate 20 mm nominal size).
8. Space between wall and MS tank including bottom gasp and top of tank shall be filled with dry Jamuna sand after fixing of tank in chamber and on top of Jamuna sand gap shall be plugged with cement concrete 1:2:4 (1 cement :2 Coarse sand : 4 graded stone aggregate) having minimum 125mm thickness.
9. All material and items shall confirm to CPWD specifications.
10. For 700mm dia. Of manhole of tank, round MS sheet of 700mm dia., 5mm thick and length as per requirement to be provided as attachment with tank.
SECTION : 7

LT SWITCHGEAR

1.1 CONSTRUCTIONAL DETAILS OF SWITCHBOARD AND DISTRIBUTION BOARDS

1.1.1 All boards shall be of metal enclosed, indoor floor mounted, compartmentalized construction and freestanding type.

1.1.2 All board frames, shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary.

1.1.3 All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.

1.1.4 The complete structures shall be rigid, self-supporting free form flaws, twists and bends. All cut-outs be true in shape and devoid of sharp edges.

1.1.5 All boards shall be of dust and vermin proof construction and shall be provided with a degree of protection of IP:42 as per IS 2147. However, the busbar chambers having a degree of protection of IP:42, in accordance with IS:2147, are also acceptable where continuous busbar rating exceeds 1000 Amp. Provision shall be made in all compartments for providing IP:42 degree of protection, when Circuit breaker or module trolley, has been removed. All cut-outs shall be provided with neoprene/Synthetic rubber gaskets.

1.1.6 Provision of louvers on boards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating exceeds 1000 Amps.

1.1.7 All boards shall be uniform height not exceeding 2450 mm.

1.1.8 Boards shall be easily extendible on both sides, by the addition of the vertical sections after removing the end covers.

1.1.9 Boards shall be supplied with base frames made of structural steel sections, alongwith all necessary mounting hardware required for welding the base frames to the insert plates.

1.1.10 All boards shall be divided into distinct vertical sections, each comprising of:

i) A completely enclosed busbar compartment for running horizontal and vertical busbars. Busbar chamber shall be completely enclosed with metallic portions. Bolted covers shall be provided for access to horizontal and Vertical bus bars and all joints for repair maintenance, which shall be feasible without disturbing feeder compartment.

ii) Completely enclosed switchgear compartment(s) one for each circuit for housing circuit breaker or MCCB or motor starter.

iii) A compartment or alley for power and control cables. Cable alley door shall preferably be hinged. Cable alley shall have no exposed live parts, and shall have no communication with busbar chamber. It shall be of atleast 350mm width.

iv) A compartment for relays and other control devices associated with a circuit breaker.
1.1.11 Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. Each shipping section shall have full metal sheets at both ends for transport and storage.

1.1.12 All equipments associated with a single circuit except MCB circuits shall be housed in a separate compartment of the vertical section. The Compartment shall be sheet steel enclosed on all sides with the withdrawal units in position or removed. The front of the compartment shall be provided with the hinged single leaf door, with locking facilities.

In case of circuits controlled by MCBs, group of MCB feeders can be offered in common compartment. In such case number of MCB feeder to be used in a common compartment shall not exceed 4 (four) and front of MCB compartment, shall have a viewing port of toughen glass sheet for viewing and sheet steel door of module shall be lockable with star knob/panel key.

1.1.13 After isolation of power and control circuit connections it shall be possible to safely carry out maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.

1.1.14 The minimum clearance in air between phases and between phase and earth for the entire run of horizontal and vertical busbars, shall be 25mm. For all other components, the clearance between “two live parts”, “A live part and an earthed part” and isolating distance shall be at least ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal run of busbar minimum clearance of 25mm should be maintained even if they are sleeved.

1.1.15 The temperature rise of horizontal & vertical busbars when carrying rated current along its full run shall in no case exceed 55°C, with silver plated joints and 40°C with all other type of joints over an outside ambient temperature of 50°C.

1.1.16 All single front boards shall be provided with removable bolted covers at the rear. The covers shall be provided with danger labels.

1.1.17 All identical circuit breakers and module chasis of same test size shall be fully interchangeable without having to carry out modifications.

1.1.18 All Circuit breaker boards shall be of Single Front type, with fully drawout circuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between SERVICE, TEST and ISOLATED positions and for withdrawal from the Switchboard. Testing of the breaker shall be possible in the TEST position.

1.1.19 Wherever two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.

1.1.20 All disconnecting contacts for power circuits shall be of robust design and fully self aligning. Fixed and moving contacts of the power drawout contact system shall be silver plated. Both fixed and moving contacts shall be replacement.

1.1.21 All AC & DC boards shall be of single Front type.

1.1.22 All module shall be fixed type except air circuit breaker module, which shall be drawout type.

1.1.23 The connections from busbars to the main switch shall be fully insulated/shrouded, and securely bolted. The partition between the feeder compartment and cable alley may be
non-metallic and shall be such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination.

1.1.24 All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to Owner’s approval. Bidder shall submit dimensional drawings showing complete internal details of Busbars and module components for each type and rating for approval.

1.1.25 The tentative power and control cable entries shall be from bottom. However, Owner reserves the right to alter the cable entries, if required, during detailed engineering, without any additional commercial implications.

1.1.26 Adaptor panels and dummy panels required to meet the various busbar arrangements and layouts required shall be included in Bidder’s scope of work.

1.1.27 All sheet work shall be pre-treated, in tanks, in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall ‘Class-C’ as specified in IS:6005. The phosphated surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating after primer application, two coats of finishing synthetic enamel paint on panels shall be applied, Electrostatic painting shall also be acceptable.

1.1.28 Finishing paint on panels shall be shade 692 (Smoke grey) of IS:5 unless required otherwise by the OWNER. The inside shall be properly stoved. The paint thickness shall be coated by peelable compound by spraying method to protect the finished surfaces from scratches grease dirt and oily spots during testing, transportation, handling and erection.

1.2 DERATING OF EQUIPMENTS

1.2.1 The current ratings of all equipments as specified in the ‘Bill of Materials are the minimum standards current ratings at a reference ambient temperature of 50°C as per relevant Indian Standards.

1.2.2 The Bidder shall indicate clearly the derating factors employed for each component and furnish the basis for arriving at these derating duly considering the specified ambient temperature of 50°C.

1.3 POWER BUS BARS AND INSULATORS

1.3.1 All AC Distribution Boards shall be provided with three phase buses and a neutral bus bar and the DC Distribution Boards shall be provided with two busbars.

1.3.2 It busbars and jumper connections shall be high conductivity aluminium/copper of adequate size the bus bar size calculations shall be submitted for approval.

1.3.3 The Cross-Section of the busbars shall be uniform through out the length of Switchgear and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents.

1.3.4 All busbars shall be adequately supported by Non-hygroscopic, non-combustible, track resistant & high strength type Polyester fibre glass Moulded Insulators. Separate supports shall be provided for each phase and neutral busbar. If a busbar support is provided anti-tracking barriers shall be provided between the supports.

1.3.5 All busbars joints shall be provided with high tensile steel bolts. Belleville/sprint washers and nuts, so as to ensure good contacts at the joints. Non-silver plated Busbars joints shall be thoroughly cleaned at the joint locations and a suitable contact grease shall be applied just before making a joint.

1.3.6 All busbars shall be colour coded as per IS:375.
1.3.7 The Bidder shall furnish calculations along with the bid, establishing the adequacy of busbar sizes for specified current ratings, on the basis of short circuit current and temperature rise consideration at specified ambient temp.

1.4 EARTH BUS
1.4.1 A galvanized steel earthing shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded/bolted to the frame work of each panel and beaker earthing contact bar vertical bus shall be provided in each vertical section which shall in turn be bolted/welded to main horizontal ground bus.

1.4.2 The earth bus shall have sufficient cross-section to carry the monetary short circuit and short time fault currents to earth as indicated in ‘Bill of Material’s without exceeding the allowable temperature rise.

1.4.3 Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Owner’s earthing conductors. The horizontal earth bus shall project out the switchboard ends and shall have predrilled holes for this connection. A joint spaced and taps to earth bus shall be made through at least two bolts.

1.4.4 All non-current metal work of the Switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosures frame work and the truck shall be maintained even after painting.

1.4.5 The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions. SERVICES & ISOLATED, as well as through out the intermediate travel.

1.4.6 Each module frame shall get engaged to the vertical earth bus. Before the disconnecting contacts on these module are engaged to the vertical busbar.

1.4.7 All metallic cases of relays, instruments and other panel mounted equipments shall be connected to earth by independent standard copper wires of size not less than 2.5mm2. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connections and soldering is not acceptable. Looping of earth connections which would result in loss of earth connection to the devices when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths or earth bus is acceptable.

1.4.8 VT and CT secondary neutral point earthing shall be at one place only, on the terminal block. Such earthing shall be made through links so that earthing on one secondary circuit shall be removed without disturbing the earthing of other circuit.

1.4.9 All hinged doors shall be earthed through flexible earthing braid.

1.4.10 Caution nameplate ‘Caution-Live Terminals’ shall be provided at all points where the terminals are like to remain live and isolation is possible only at remote end.

1.5 AIR CIRCUIT BREAKERS
1.5.1 Circuit breakers shall be three-pole air break horizontal drawout type and shall have inherent fault making and breaking capacities as specified in “Technical Parameters”. The circuit breakers which meet specified parameter only after provision of releases or any other devices shall not be acceptable.

1.5.2 Circuit breakers shall be mounted along with operating mechanism on a wheeled carried. Suitable guides shall be provided to minimise misalignment of the breaker.

1.5.3 There shall be ‘Service’, ‘Test’ and ‘Fully withdrawn positions for the breakers. In “Test” position the circuit breaker shall be capable of being tested for operation without
energising the power circuits i.e. the power contacts shall be disconnected while Control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the ‘SERVICE’, ‘TEST’ or FULLY WITHDRAWN’ position. It shall be possible to close the door in TEST position.

1.5.4 All circuit breakers shall be provided with 4 NO and 4 NC potential free auxiliary contacts. These contacts shall be addition to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be provided in both ‘SERVICE & ‘TEST’ position of the breaker. All contacts shall be rated for making continuously carrying and breaking 10 Amps at 240 V AC and 1 Amp (Inductive) at 220 DC.

1.5.5 Suitable mechanical indications shall be provided on all circuit breakers to show ‘OPEN’, ‘CLOSE’, ‘SERVICE’, ‘TEST’ and ‘SPRING CHARGED’ positions.

1.5.6 Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half cycle of rated frequency.

1.5.7 All circuit breakers shall be provided with the interlocks as explained in further clauses.

1.5.8 Movement of a circuit breaker between SERVICE AND TEST positions shall not be possible unless it is OPEN position. Attempted with drawl of a closed circuit breaker shall trip the circuit breaker.

1.5.9 Closing of a circuit breaker shall not be possible unless it is SERVICE, TEST POSITION or in FULLY WITHDRAWN POSITION.

1.5.10 Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationery isolated contacts when the breaker is withdrawn. It shall however, be possible to open the shutters intentionally, against spring pressure for testing purpose.

1.5.11 A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.

1.5.12 Circuit breakers shall be provided with electrical anti-pumping and trip feature, even if mechanical antipumping feature is provided.

1.5.13 Mechanical tripping shall be possible by means of front mounted RED ‘TRIP’ push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.

1.5.14 Breaker controlled motors shall operate satisfactorily under the following conditions :-

i) Direct on-line starting of Induction Motors rated 110kW to 220 kW with a locked rotor current of seven times the rated current, and starting time of up to 30 seconds.

ii) Breaking on-load, full load and locked motor currents of Induction Motors for rated 100 kW to 220kW.

1.5.15 Means shall be provided to slowly close the circuit breaker in withdrawn position. If required for inspection and setting of Contacts, in service position slow closing shall not be possible.

1.5.16 Power operated mechanism shall be provided with a universal motor suitable for operation 220V DC Control supply with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class ‘E’ or better.
1.5.17 The motor shall be such that if requires not more than 30 seconds for fully charging the closing spring.

1.5.18 Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring.

1.5.19 The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close open operation shall be possible.

1.5.20 Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.

1.5.21 All circuit breakers shall be provided with closing and trip coils. The closing coils shall operate correctly at all values of Voltage between 85% to 110% at rated control voltage. The trip coil shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage.

1.5.22 Provision for mechanical closing of the breaker only in ‘TEST’ and ‘WITHDRAWN’ positions shall be made.

1.5.23 PROTECTION CO-ORDINATION

1.5.23.1 It shall be the responsibility of the Contractor to fully co-ordinate the overload and short circuit tripping of the circuit breakers with the upstream and down stream circuit breakers/fuses/motor starters, to provide satisfactory discrimination.

1.6 MOULDED CASE CIRCUIT BREAKER (MCCB) and MCB

1.6.1 MCCB shall in general conform to IS:13949 Part-2, All MCCB shall be P2 duty.

1.6.2 MCCB shall be flush mounted on the AC/DC distribution boards.

1.6.3 MCCBs shall be provided with thermo-magnetic type release for over current and short circuit protection. The setting of the thermal release shall be adjustable between 75% to 100% of the rated current. The MCCB shall have breaking capacity not less than 20kA.

1.6.4 MCCBs used for ACDB incomers and Bus coupler shall be equipped with stored energy mechanism for electrical closing and tripping. All other MCCBs shall be manually operated. The operating handle should give a clear trip indication.

1.6.5 Miniature circuit breaker (MCB) shall conform to IEC:898-1998 and IS:8928.

1.7 RELAYS

1.7.1 All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a drawout construction for easy replacement from the front. They shall either have built-up test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-drawout cases.

1.7.2 All AC relays shall be suitable for operation, at 50 Hz with 110 Volts secondary and 1 amp or 5 amp CT secondary.

1.7.3 All protective relays and timers shall have at least two potentially free output contracts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on the relay cases for applicable relaying schemes.

1.7.4 All protective relays auxiliary relays and timers shall be provided with hand rest operation indicators (flags) and analysing the case of operation.
1.7.5 All relays shall withstand a test voltage of 2 KV (rms) for one minute.

1.7.6 Motor starters shall be provided with three element, ambient temperature compensated, time lagged, hand reset type overload relays with adjustable settings. The setting ranges shall be properly selected to suit the motor ratings. These relays shall have a separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.

1.7.7 All fuse-protected contractor-controlled motors shall have phasing protection, either as a distinct feature in the overload relays (by differential movement of bimetallic strips), or as a separate device. The single phasing protection shall operate even with 80% of the set current flowing in two of the phases.

1.8 CONTACTORS

1.8.1 Motor starter contactors shall be air break, electromagnetic type rated for uninterrupted duty as per IS:13957 (Part 4).

1.8.2 Contactors shall be double break, non-gravity type and their main contacts shall be silver faced.

1.8.3 Direct on line starter contactors shall be utilisation category AC2. These contactors shall be as IS:13947 (Part 4).

1.8.4 Each contactor shall be provided with two (2) normally open (NO) and two (2) normally close (NC) auxiliary contacts.

1.8.5 Operating coils of contactors shall be of 240V AC Unless otherwise specified elsewhere. The Contactors shall operate satisfactorily between 85% to 110% of the rated voltage. The Contactor shall drop out at 70% of the rated voltage.

1.9 INSTRUMENT TRANSFORMERS

1.9.1 All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchgear is operating at its rated condition and the outside ambient temperature is 50°C.

1.9.2 All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.

1.9.3 All instrument transformer shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.

1.9.4 Current transformers may be multi or single core type. All voltage transformers shall be single phase type. The bus VTs shall be housed in a separate compartment.

1.9.5 All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides.

1.10 INDICATING INSTRUMENTS

1.10.1 All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 degree scales, and shall have an accuracy class of 2.5 or better. The covers and cases of instrument and meters shall provide a dust and vermin proof construction.
1.10.2 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustments without removing or dismantling the instruments.

1.10.3 All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.

1.10.4 Ammeters provided on Motor feeders shall have a compressed scale at the upper current region to cover the starting current.

1.10.5 Watt-hour meters shall be of 3 phase three element type, Maximum demand indicators need not be provided.

1.11 **CONTROL & SELECTOR SWITCHES**

1.11.1 Control & Selector switches shall be of rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress be preferred.

1.11.2 Circuit breaker selector switches for breaker controlled motor shall have three stay put positions marked ‘Switchgear’, ‘Normal’ and ‘Trial’ respectively. They shall have two contacts of each of the three positions and shall have black shade handles.

1.11.3 Ammeter and voltmeter selector switches shall have four stay out position with adequate number of contacts for three phase 4 wire system. These shall have oval handles Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries.

1.11.4 Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.

1.11.5 The contact ratings shall be at least the following:

   i) Make and carry continuously 10 Amp.
   ii) Breaking current at 220V DC 1 Amp (Inductive)
   iii) Breaking current at 240V DC 5 Amp (at 0.3 pf lagging)

1.12 **AIR BREAK SWITCHES**

1.12.1 Air breaker switch shall be of the heavy duty, single throw group operated, load break, fault make type complying with IS:4064.

1.12.2 The Bidder shall ensure that all switches are adequately rated so as to be fully protected by the associated fuses during all abnormal operating conditions such as overload, locked motor, short circuit etc.

1.12.3 Switch operating handles shall be provided with padlocking facilities to lock them in ‘OFF’ position.

1.12.4 Interlocks shall be provided such that it is possible to open the cubicle door only when the switch is in ‘OFF’ position and to close the switch only when the door is closed. However suitable means shall be provided to intentionally defeat the interlocks explained above.

1.12.5 Switches and fuses for AC/DC control supply and heater supply wherever required shall be mounted inside and cubicles.

1.13 **PUSH BUTTONS**

1.13.1 Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 240V and 0.5A (inductive) at 220V DC.
1.13.2 All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.

1.13.3 All push-buttons shall be provided with integral escutcheon plates marked with its function.

1.13.4 The colour of the button shall be as follows :

i) GREEN : For motor START, Breaker CLOSE
ii) RED : For motor TRIP, Breaker OPEN
iii) BLACK : For overload rest

1.13.5 All push-buttons on panels shall be located in such a way that Red-push-buttons shall always be to the left green push-buttons.

1.14 INDICATING LAMPS

1.14.1 Indicating lamps shall be of the panel mounting cluster LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary.

1.14.2 Lamps shall have translucent lamp-covers of the following colours, as warranted by the application :

i) RED : For motor ON, Breaker CLOSED
ii) GREEN : For motor OFF, Breaker OPEN
iii) WHITE : For motor Auto-trip
iv) BLUE : For all healthy conditions (e.g. control supply, and also for ‘SPRING CHARGED”
v) AMBER : For all alarm conditions (e.g. overload) Also for ‘SERVICE’ and ‘TEST’ positions indicators.

1.14.3 Lamps shall be easily replaceable from the front of the cubicle.

1.14.4 Indication lamps should be located just above the associated push buttons/control switches. Red Lamps shall invariably be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along with the centre line of control switch/push button pair. Blue and Amber lamps should normally be located above the Red and Green Lamps.

1.14.5 When associated with push-buttons, red lamps shall be directly above the green push button, and green lamps shall be directly above the red push-button. All indicating lamps shall be suitable for continuous operation at 90 to 110% of their rated voltage.

1.15 FUSES

1.15.1 All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC Circuits shall be of class 2 type, 20 kA (RMS) breaking current at 415 AC, and for DC circuits Class 1 type 5 kA breaking current.

1.15.2 Fuses shall have visible operation indicators.

1.15.3 Fuses shall be mounted on fuses carriers, which are mounted on fuse bases, wherever it is not possible to mount fuses on carriers fuses shall be directly mounted on plug in type of bases, In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

1.15.4 Fuse rating shall be chosen by the Bidder depending upon the circuit requirements and these shall be subject to approval of OWNER.
1.16 TERMINAL BLOCKS
1.16.1 Terminal blocks shall be of 1100 volts grade and have continuous rating to carry the maximum expected current on the terminals. It shall be complete with insulating barriers, clip-on-type/stud type terminals for Control Cables and identification strips. Making on terminal strip shall correspond to the terminal numbering on wiring on diagrams. It shall be similar to ‘ELEMAX’ standard type terminals, cage clamp type of Phoenix or WAGO or equivalent.

1.16.2 Terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided distributed on all terminal circuiting and earthing facilities. It shall be similar to ‘Elem’, ‘CATD’– Type.

1.16.3 In all circuit breaker panels at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks. Space for adding another 10% spare terminals shall also be available.

1.16.4 All terminal blocks shall be suitable for terminating on each side, two (2) nos. of 2.5mm square size standard copper conductors.

1.16.5 All terminals shall be numbered for identification and grouped according to the function. Engraved white-on-black labels shall be provided on the terminal blocks.

1.16.6 Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

1.16.7 Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal block. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250 mm.

1.17 NAME PLATES AND LABELS
1.17.1 All switchgears AC/DC distribution boards shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

1.17.2 All name plates shall be of non-rusting metal or 3-ply lamicoid with white engraved lettering on black background. Inscriptions and lettering sizes shall be subject to OWNER approval.

1.17.3 Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel/module. These labels shall be positioned so as to be clearly inside visible and shall give the device number as mentioned in the module wiring drawings.

1.18 SPACE HEATER
1.18.1 Space heater shall be provided in all the boards for preventing harmful moisture condensation.

1.18.2 The space heaters shall be suitable for continuous operation on 240V, AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.

1.19 CONTROL AND SECONDARY WIRING
1.19.1 All switchboards shall be supplied completely wired internally up to the terminal blocks ready to receive Owner’s control cables.

1.19.2 All inter cubicle and inter panel wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided by the bidder.
1.19.3 All internal wiring shall be carried out with 1100V grade, single core, 2.5 square mm or larger standard copper wires having colour coded, PVC insulation. CT circuits shall be wired with 2.5 square mm copper wires. Voltages and insulation shall be same as above.

1.19.4 Extra-flexible wires shall be used for wiring to device mounted on moving parts such as hinged doors.

1.19.5 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminals blocks.

1.20 **POWER CABLES TERMINATION**

1.20.1 Cable termination compartment and arrangement for power cables shall be suitable for standard aluminium conductor, armoured XLPE/PVC insulated and sheathed, single core/three core, 1100V grade cables.

1.20.2 All necessary cable terminating accessories such as Gland plates, supporting clamps and brackets, power cable lugs, hardware etc., shall be provided by successful bidder, suit the final cable sizes which would be advised later.

1.20.3 The gland plate shall be removable type and shall cover the entire cable alley. Bidder shall also ensure that sufficient space is provided for all cable glands. Gland plates shall be factory-drilled according to the cable gland sizes and number which shall be informed to the Contractor later. For all single core cables, gland plates shall be of non-magnetic Material.

1.21 **TYPE TESTS**

1.21.1 Type test reports of Panels (Switchgear and Control gear assemblies) as per IS 8623 Part-I shall be submitted for the following tests in line with clause 9.0 of Section GTR before the fabrication of switchgear is started:

i) Verification of temperature rise limits
ii) Verification of the dielectric properties
iii) Verification of short circuit strength
iv) Verification of the continuity of the protective circuit
v) Verification of clearances and creepage distances
vi) Verification of mechanical operation
vii) Verification of degree of protection

1.21.2 Contractor shall submit type test reports for the following Switchgear and Control gears before the fabrication of switchgear is started:

1. Circuit breakers / MCCB as per IS 13947 Part-II
2. Protective Relays as per IEC:60255

for the above equipments test conducted once are acceptable (i.e. The requirement of test conducted within last five years shall not be applicable).

1.22 **ERECTION, TESTING AND COMMISSIONING**

1.22.1 The Contractor shall unload, erect, install, test and put into commercial use all electrical equipment included in this specification.

1.22.2 Equipment shall be installed in a neat, workman like manner so that it is level, plumb, square and properly aligned and oriented. Tolerance shall be as established in Contractor’s drawings or as stipulated by Owner. No equipment shall be permanently bolted down to foundations until the alignment has been checked and found acceptable by the Owner.

1.22.3 Contractor shall furnish all supervision, labour tools equipment rigging materials, bolts, wedges, anchors, concrete inserts etc. in proper time required to completely install, test and commission the equipment.
1.22.4 Manufacturer’s and Owner’s instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment.

1.22.5 Contractor shall move all equipment into the respective from through the regular door or openings specifically provided for this purpose. No part of the structure shall be utilized to lift or erect any equipment without prior permission of Owner.

1.22.6 All boards shall be installed in accordance with Indian Standards IS:3072 and at Owner’s instructions. All boards shall be installed on finished surfaces, concrete or steel stills. Contractor shall be required to install and align any channel sills which form part of foundations. In joining shipping sections of switchboards together adjacent housing of panel sections or flanged throat sections shall be bolted together after alignment has been complete. Power bus, enclosures ground and control splices of conventional nature shall be cleaned and bolted together being drawn up with torque spanner of proper size or by other approved means.

1.22.7 All boards shall be made completely vermin proof.

1.22.8 Contractor shall take utmost care in holding instruments, relaying and other delicate mechanism wherever the instruments and relays are supplied separately they shall be mentioned only after the associated panels have been erected and aligned. The packing materials employed for safe transit of instrument and relays shall be removed after ensuring that panel have been completely installed and to further movement of the same should be necessary. Any damage shall be immediately reported to Owner.

1.22.9 Equipment furnished with finished coats of paint shall be touched by up Contractor if their surface is specified or marred while handling.

1.22.10 After installation of panels, power and control wiring and connections, Contractor shall perform operational tests on all switchboards, to verify proper operation of switchboards/panels and correctness of all equipment in each and every respect. The cable opening and cables entries for cables terminating to the panels shall be sealed with fire sealing materials.

1.23 COMMISSIONING CHECK TESTS
The contractor shall carry out the following commissioning checks, in addition to the other checks and tests recommended by the manufacturers.

1.23.1 General
1.23.1.1 Check name plate details according to the specification.
1.23.1.2 Check for physical damage.
1.23.1.3 Check tightness of all bolts, clamps, joints connecting terminals.
1.23.1.4 Check earth connections
1.23.1.5 Check cleanliness of insulators and bushings
1.23.1.6 Check all moving parts for proper lubrication
1.23.1.7 Check settings of all the relays

1.23.2 Circuit Breakers
1.23.2.1 Check alignment of breaker truck for free movement
1.23.2.2 Check correct operation of shutters
1.23.2.3 Check control wiring for correctness of connections, continuity and IR values
1.23.2.4 Manual operation of breaker completely assembled
1.23.2.5 Power closing/opening operation, manually and electrically
1.23.2.6 Breaker closing and tripping time
1.23.2.7 Trip free and anti-pumping operation
1.23.2.8 IR values, minimum pick up voltage and resistance of coils
1.23.2.9 Contact resistance
1.23.2.10 Simultaneous closing of all the three phases
1.23.2.11 Check electrical & mechanical interlocks provided
1.23.2.12 Check on spring charging motor, correct operation of limit switches and time of charging.
1.23.2.13 All functional checks

1.23.3 **Current Transformers**
1.23.3.1 Meggar between winding and winding terminals to body
1.23.3.2 Polarity test
1.23.3.3 Ratio identification checking of all ratios on all cores by primary injection of current.
1.23.3.4 Spare CT cores, if available, to be shorted and earthed.

1.23.4 **Voltage Transformer**
1.23.4.1 Insulation resistance test
1.23.4.2 Ratio test on all cores
1.23.4.3 Polarity test
1.23.4.4 Line connections as per connection diagram

1.23.5 **Cubicle Wiring**
1.23.5.1 Check all switch developments
1.23.5.2 Each wire shall be traced by continuity tests and it should be made sure that the wiring is as per relevant drawing. All interconnections between panels/equipment shall be similarly checked.
1.23.5.3 All the wires shall be meggered to earth
1.23.5.4 Functional checking of all control circuit e.g. closing, tripping control, interlock, supervision and alarm circuit.

1.23.6 **Relays**
1.23.6.1 Check connections and wiring
1.23.6.2 Meggar all terminals to body
1.23.6.3 Meggar AC to DC terminals
1.23.6.4 Check operating characteristics by secondary injection
1.23.6.5 Check minimum pick up voltage of DC coils
1.23.6.6 Check operation of electrical/mechanical targets
1.23.6.7 Relays settings
1.23.6.8 Check CT and VT connections with particular reference to their polarities for directional relays wherever required.

1.23.7 **Meters**
1.23.7.1 Check calibration by comparing it with a sub-standard.
1.23.7.2 Megger all insulated portions.
1.23.7.3 Check CT and VT connections with particulars reference to their polarities for power type meters.

1.24 **SPECIAL TOOLS AND TACKLES**
1.24.1 The Bidder shall include in his proposal any special tools and tackles required for erection, testing commissioning and maintenance of the equipments offered.

1.24.2 The list of these special tools and tackles shall be given in the bid proposal sheets along with their respective prices.

1.24.3 The total price of the special tools and tackles shall be included in proposal sheets.

1.25 **EQUIPMENT TO BE FURNISHED**
1.25.1 The Bidder shall quote for various AC/DC distribution boards as given in Bill of Materials and in accordance with this specification.

1.25.2 Standard scheme of interconnection of switchboards and distribution boards along with tentative feeder disposition for each board is indicated in Standard SLD of A/C & DC system enclosed bid documents. The bidder shall quote board prices on the basis of standard SLD and their estimation of feeders for entire present and future bays
requirement. Any other feeder required as per system requirement for efficient and reliable operation shall be deemed to be included in bidder’s scope.

1.25.3 The Bill of Materials for each type of module shall be as under. These are minimum indicative requirement of the system. The necessary auxiliary relays, push buttons and indicating lamps shall be provided as per scheme requirement. Any other item / component required with in a module for efficient and reliable operation shall be deemed to be included in bidder’s scope. The scheme shall have provision for remote annunciation for the followings:
   a) Station LT (415V) AC incomer supply unhealthy.
   b) 220V DCDB U/V, O/V & Earth leakage relay operated.
   c) DG set start
   d) DG set protection

1.25.4 Module Type AE (Electrically controlled circuit breaker for incoming and Bus Coupler Circuit).
   i) One (1)  Triple pole air circuit breaker complete with all accessories and power operated mechanism as specified.
   ii) Two (2)  Neutral Link.
   iii) Three (3) Current Transformer for metering.
   iv) One (1)  Ammeter with selector switch.
   v) Three (3) Current Transformer for relaying.
   vi) One (1)  Triple pole instantaneous over-current relay having the setting range of 200-800% or 500-2000% of CT secondary and adjustable definite minimum time.
   vii) One (1)  Instantaneous earth fault relay having and adjustable setting range of 10-40% or 20-80% of CT secondary current and adjustable definite minimum time. The earth fault relay shall be provided with a stabilizing resistor.

1.25.5 Module Type – M1 (Circuit Breaker Controlled Motor Feeder)
   i) One (1)  Triple pole Air Circuit Breaker complete with accessories, and power operated mechanism as specified.
   ii) One (1)  Three position 6 pole selector switch ‘SWITCHGEAR / NORMAL / TRIAL’.
   iii) Three (3) Current Transformer for meeting.
   iv) One (1)  Ammeter with Ammeter Selector Switch.
   v) Three (3) Current Transformer for relaying.
   vi) One (1)  Triple pole instantaneous over-current relay for providing positive sequence current protection in all the three phases. The relay setting range shall be continuously adjustable between 200-800% or 400-1600% of CT secondary rated current as required.
   vii) One (1)  Double pole inverse definite minimum time over current relays connected in R&B phases for over current protection of motor rated 110kw – 200kw. The relay shall have an adjustable setting range of 50%-200% of CT Secondary current and time setting range of 0-30 Second. The relay shall be CDGM-22 of EE or equivalent.
viii) One (1) Single pole adjustable definite time delay for motor overload alarm connected in Y-phase only. The relay shall have resetting ratio of not less than 90%. The relay shall have continuously adjustable time delay range of 2.5 to 25 Sec.

ix) One (1) Instantaneous earth fault relay having an adjustable setting range of 10-40% or 20-80% of CT secondary current. The earth fault relay shall be provided with a stabilizing resistor.

1.25.6 Module Type E
i) One (1) Four pole MCCB

1.25.7 Module G-1 (VT Module with under Voltage Relay)
i) Three (3) 415/\sqrt{3}/110/\sqrt{3} volts single phase voltage transformer star / star connect with star point solidity earthed mounted on common draw out chassis. Accuracy Class 0.5 for protection and metering with 50VA Burden.

ii) HRC Fuses mounted on the above chassis.

iii) One (1) Four Position voltmeter selector switch.

iv) One (1) Voltmeter (0-500V)

v) One (1) Double pole instantaneous under voltage relays with continuous variable setting range of 40-80% of 110 Volts.

vi) One (1) Time delay pick up relay having a time setting range of 0.5 to 3 secs. With 3 ‘No’. Self reset contacts, suitable for 220V DC.

vii) One (1) Auxiliary relay 220V DC with 2 No. self reset contacts.

viii) Three (3) Indicating lamps with series resistor and colour lenses (Red, Blue & Yellow).

1.25.8 Module Type G-2
i) Three (3) HRC Fuse

ii) One (1) Voltmeter (0-500V)

iii) One (1) Voltmeter selector switch four position (R-Y, Y-B, B-R OFF).

iv) Three (3) Indication lamps (Red, Blue & Yellow)

1.25.9 Module Type H & H (BC) (Isolating Switch Controlled Incoming Circuit)
i) One (1) Four pole MCCB

ii) One (1) Red Indicating lamp to indicate isolating switch closed position.

1.25.10 Module Type S : (DC Metering and Protection Module)
i) One (1) Voltmeter 300-0-300V DC for 220V DC DB.

ii) One (1) Three (3) position voltmeter selector switch

iii) One (1) Instantaneous under voltage relay with 95% of 220V DC. The resetting ratio of relay should not be more than 1.25. the relay shall be provided with a series resistor and a push button across it for resetting (pick up) the relay at about 105% of the drop out voltage.
iv) One (1) Instantaneous over voltage relay with setting range of 110% of 220V DC. The resetting ratio of relay should not be less than 0.8. the relay shall have a push button in series of resetting the relay at about 95% of the operating voltage.

v) One (1) Earth leakage relay only for 220V DC system having adjustable pick up range between 3 to 7 milliamps the relay shall be suitable for 220V DC/240V AC Auxiliary supply.

1.25.11 Module Type X
One (1) Double pole 250V MCB

1.25.12 Module Type-DC (Incomer from Battery & Chargers)
i) One (1) DC ammeter with shunt and range of 90-0-400 Amps. For 220V DC DB.

iii) Two (2) Double pole 250V DC MCCB / MCB.

iv) One (1) Double pole single throw 250V DC air Break switch connecting battery & charger sections to DC DB.

1.25.13 Module Type DG-1 (Electrically Controlled Circuit Breaker for Incomer from DG Set)
a) One (1) Triple pole circuit breaker complete with all accessories and power operated mechanism as specified.

b) One (1) Frequency meter.

c) One (1) Voltmeter with selector switch.

d) One (1) Remote/Local Selector switch.

e) Three (3) Current Transformer for Metering.

f) Six (6) Current Transformers for differential protection (out of this 3 Nos. will be supplied loose for mounting in DG set panel).

g) Three (3) Current Transformer for relaying.

h) One (1) Ammeter Selector Switch.

i) One (1) Ammeter

j) One (1) Wattmeter of range 0-300 KW

k) One (1) Three pole voltage controlled definite time delay relay having current setting range of 50-200% of CT secondary current and adjustable time delay 0.3 to 3 secs.

l) One (1) Watt hour meter with six (6) digits and minimum count of one (1) kwh.

m) One (1) Single pole definite time over current relay having a continuous setting range of 50-200% of CT secondary current and a time delay of 2.5-25 secs connected in CT of Y phase for overload alarm. The relay shall have a setting ratio of not less than 90%.
n) One (1) Three pole differential protection relay having an operating current setting range of 10-40% of generator full load current. The relay shall be high impedance type, with necessary stabilizing resistors.

o) Two (2) Push Buttons for Remote starting & stopping of DG Set (Red, Green).

1.25.14  **Module Type H1**
One (1) Double pole DC Switch with pad locking facility in off position.

1.25.15  **Module Type EL**
i) One (1) Four pole MCCB

ii) One (1) Contactor

iii) Electronic Timer suitable for continuous operation, push button and selector switch be as per scheme requirement.

1.26  **PARAMETERS**

1.26.1  **Power Supply**

1.26.1.1  **AC System** 3 phase, 4 wire, solidly earthed

a) Voltage 415 Volts, ± 10%
b) Frequency 50 Hz ± 5%
c) Combined variation ± 10% Absolute Sum in Voltage & frequency
d) fault Level 20 kA (rms)

1.26.1.2  **DC System** 2 Wire, unearthed

a) System Voltage 220V ± 10%
b) Fault Level 5 kA

1.26.2  **Control Supply Voltage**

a) Trip and closing coils 220V DC Unearthed
b) Spring charging 220V DC Unearthed

1.26.3  **Cubicle Data**

1.26.3.1  **Busbar Rating**

a) Continuous  As specified in ‘Bill of Materials’

for Vertical panels

b) Short time (1 sec.) kA (rms) 20 kA
c) Momentary (kA) 45 kA
d) Ambient Temperature 50°C
e) One Minute Power Frequency Withstand

I. Power Circuit 2500 Volts (rms)
II. Control Circuit 2500 Volts (rms)

1.26.3.2  **Cubicle Colour Finish**

a) Interior Glossy White
b) Exterior Smoke Grey shade No. 692 of IS:5

1.26.4  **Circuit Breaker**

a) Type Air break
b) No. of Poles 3
c) Voltage & Frequency: 415 ± 10%, 50 HZ ± 5%
d) Rated Operating Duty: B-3 Min, M-B-3 Min. MB
e) Symmetrical Interrupting rating: 20 kA (RMS)
f) Short Circuit making current: 45 kA (Peak)
g) Short time withstand: 20 kA (RMS) for 1 Sec.
h) Operating Mechanism: 20 kA (RMS) for 1 Sec.
i) No. of auxiliary contacts: 4 NO & 4 NC contacts for Owner’s use on fixed portion of the cubicle
j) Short Circuit breaking current
   I. AC Component: 20 kA (RMS)
   II. DC Component: As per IS:13947 (Part 2)

1.26.5 MOULDED CASE CIRCUIT BREAKER

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<tr>
<th>AC System</th>
<th>DC System</th>
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<tbody>
<tr>
<td>a) No. of poles</td>
<td>4</td>
</tr>
<tr>
<td>b) Voltage &amp; Frequency</td>
<td>415 ± 10%</td>
</tr>
<tr>
<td></td>
<td>50 HZ ± 5%</td>
</tr>
<tr>
<td>c) Rated Operating Duty</td>
<td>P2</td>
</tr>
<tr>
<td>d) Symmetrical interrupting rating</td>
<td>20 kA (RMS)</td>
</tr>
<tr>
<td>e) Short Circuit making current</td>
<td>45 kA (Peak)</td>
</tr>
<tr>
<td>f) No. of auxiliary contacts</td>
<td>2 NO &amp; 2 NC</td>
</tr>
</tbody>
</table>
| g) Short Circuit breaking current
   I. AC Component | 20 kA (RMS) | As per IS |
   II. DC Component | As per IS 13947 | As per IS 13947 |

1.26.6 Meters

a) Accuracy Class: 0.5
b) One minute power frequency withstand test voltage: 2.0kV

1.26.7 Current Transformers

a) Type: Cast resin, Bar primary
b) Voltage class & frequency: 650 V, 50 Hz
c) Class of Insulation: E or better
d) Accuracy class
   metering CT: Class 1, VA adequate for application
   but not less than 7.5 VA
e) Accuracy class
   protection CT: 5P 15, VA adequate for application,
   but not less than 7.5 VA
f) Accuracy class differential protection: PS, KPV = 300 V
g) Short Time Current rating
   (for CTs Associated with circuit breakers)
   I. Current: 20 kA (RMS)
   II. Duration: One second
   III. Dynamic Rating: 45 kA (Peak)
   IV. One minute Power frequency
      Withstand test Voltage: 2.5 kv (rms)

1.26.8 Voltage Transformer

a) Type: Cast Resin
b) Rated Voltage
Primary 415/\sqrt{3} V
Secondary 110/\sqrt{3} V
c) Method of connection
   Primary Star
   Secondary Star
d) Rated Voltage Factor 1.1 continuous, 1.5 for seconds
e) Class of insulation E or better
f) One minute power frequency withstand voltage 2.5 KV (RMS)
g) Accuracy class 0.5, not less than 20 VA

1.26.9 Relay
One minute power frequency withstand test 2 kV (rms)

1.27 AUTOMATIC CONTROL OF OUTDOOR LIGHTING
1.27.1 EL-type module of 415 V Main lighting distribution board and Emergency lighting distribution board and shall be controlled by timer and contactor module to facilitate its operation automatically.

1.28 AUTOMATIC SUPPLY CHANGEOVER
Automatic changeover between Incomer I, Income II and DG set is to be carried out during the failure of supply in one/or both the incomers. After the restoration of the supply, system shall be restored to normal condition automatically. The requirements of changeover under various conditions are as below:-

i) Under normal conditions i.e. when supply is available in both the incomers, incomers I&II of 415 V Main switchboard, ACDB shall be in closed condition and Bus couplers and DG set breaker shall be in open condition.

ii) In case of failure of either of the sources, the incomer of that source shall trip and Bus coupler shall get closed. On restoration of supply, normal conditions described above are to be established automatically.

iii) In case of failure of supply in both the sources, both incomers, incomers of ACDBs and ACDB Bus coupler shall trip and DG Set breaker switched on.

One restoration of one or both sources, DG Set breaker shall trip, DG set stopped and conditions described in paragraph (i)/(ii) shall be restored.

To avoid unnecessary operation of switchgear for momentary disturbances all changeovers from one state to another shall be intimated after a time delay, after the conditions warranting such change has been detected.
SECTION : 8

BATTERY & BATTERY CHARGER

1.1 GENERAL TECHNICAL REQUIREMENTS

1.1.1 All materials/components used in battery chargers and batteries shall be free from flaws and defects (maintenance free) and shall conform to the relevant Indian/IEC standards and good engineering practice.

1.1.2 For 220/66KV/33kV sub-stations, DC System shall consist of two (2) float-cum-boost chargers and two (2) battery sets for 220V system. The capacity of the battery indicated in the specification is tentative. The contractor shall design the size/capacity. However the capacity shall be decided for a 10 Hour discharge rate. The standard scheme drawing is enclosed with this specification.

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

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Maximum Voltage during Float operation</th>
<th>Minimum voltage available when no charger working &amp; battery fully discharged upto 1.85V per cell.</th>
</tr>
</thead>
<tbody>
<tr>
<td>220 Volt</td>
<td>242 Volt</td>
<td>198 Volt</td>
</tr>
</tbody>
</table>

Bidder shall furnish calculation in support of battery sizing, selection of number of cells, float and Boost voltages during detailed engineering for Owners acceptance. Battery sizing calculations shall be done as per IEEE- 485 on the basis of following duty cycle:

<table>
<thead>
<tr>
<th>Load</th>
<th>Duration</th>
<th>Type of Loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Load</td>
<td>3 hours</td>
<td>Relays, IEDs, Station HMIs, spring charging, Isolator interlocking load, Miscellaneous permanently connected loads etc.</td>
</tr>
<tr>
<td>Emergency Load</td>
<td>1 hour</td>
<td>Substation emergency lighting loads</td>
</tr>
<tr>
<td>Momentary Load</td>
<td>1 minute</td>
<td>Breaker closing, Tripping loads (taking simultaneous occurrence as per system)</td>
</tr>
</tbody>
</table>

1.1.4 The tele-communication/SCADA equipments shall be suitable to operate on 220V DC power supply available in the substation.

1.2 Battery

1.2.1 Type

The DC Batteries shall be VRLA (Valve Regulated Lead-Acid) type and shall be Normal Discharge type. These Batteries are intended to be used in air-conditioned atmosphere and shall be suitable for a long life under continuous float operations and occasional discharges. The 220V DC system is unearth.

1.2.2 Constructional Requirements

The design of battery shall be as per field proven practices. Partial plating of cells is not permitted. Paralleling of cells externally for enhancement of capacity is not permitted. Protective transparent front covers with each module shall be provided to prevent accidental contact with live module/electrical connections.

1.2.3 Containers

The container material shall have chemical and electro-chemical compatibility and shall be acid resistant. The material shall meet all the requirements of VRLA batteries and be consistent with the life of battery. The container shall be fire retardant and shall have an Oxygen Index of at least 28%. The porosity of the container shall be such as not to allow any gases to escape except from the regulation valve. The tensile strength of the material of the container shall be such as to handle the internal cell pressure of the cells in the worst working condition.
Cell shall not show any deformity or bulge on the sides under all working conditions. The container shall be capable of withstanding the rigours of transport, storage and handling. The containers shall be enclosed in a steel tray.

1.2.4 Cell Covers
The cell covers shall be made of suitable material compatible with the container material and permanently fixed with the container. It shall be capable to withstand internal pressure without bulging or cracking. It shall also be fire retardant. Fixing of Pressure Regulation Valve & terminal posts in the cover shall be such that the seepage of electrolyte, gas escapes and entry of electro-static spark are prevented.

1.2.5 Separators
The separators used in manufacturing of battery cells, shall be of glass mat or synthetic material having high acid absorption capability, resistant to sulphuric acid and good insulating properties. The design of separators shall ensure that there is no misalignment during normal operation and handling.

1.2.6 Pressure Regulation Valve
Each cell shall be provided with a pressure regulation valve. The valve shall be self re-sealable and flame retardant. The valve unit shall be such that it cannot be opened without a proper tool. The valve shall be capable to withstand the internal cell pressure specified by the manufacturer.

1.2.7 Terminal Posts
Both the +ve and –ve terminals of the cells shall be capable of proper termination and shall ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolt hole shall be coated with an acid resistant and corrosion retarding material. Terminal posts or any other metal part which is in contact with the electrolyte shall be made of the same alloy as that of the plates or of a proven material that does not have any harmful effect on cell performance. Both +ve and –ve posts shall be clearly and unambiguously identifiable.

1.2.8 Connectors, Nuts & Bolts, Heat Shrinkable Sleeves
Where it is not possible to bolt the cell terminals directly to assemble a battery, separate non-corroding lead or copper connectors of suitable size shall be provided to enable connection of the cells. Copper connections shall be suitably lead coated to withstand corrosion due to sulphuric acid at a very high rate of charge or discharge.
Nuts and bolts for connecting the cells shall be made of copper, brass or stainless steel. Copper or brass nuts and bolts shall be effectively lead coated to prevent corrosion. Stainless steel bolts and nuts can be used without lead coating. All inter cell connectors shall be protected with heat shrinkable silicon sleeves for reducing the environmental impact including a corrosive environment.

1.2.9 Flame Arrestors
Each cell shall be equipped with a Flame Arrestor to defuse the Hydrogen gas escaped during charge and discharge. Material of the flame arrester shall not affect the performance of the cell.

1.2.10 Battery Bank Stand
All batteries shall be mounted in a suitable metallic stand/frame. The frame shall be properly painted with the acid resistant paint. The suitable insulation shall be provided between stand/frame and floor to avoid the grounding of the frame/stand.

1.2.11 Capacity Requirements
When the battery is discharged at 10 hour rate, it shall deliver 80% of C (rated capacity, corrected at 27º Celsius) before any of the cells in the battery bank reaches 1.85V/cell.
The battery shall be capable of being recharged from the fully exhausted condition (1.75V/cell) within 10 hrs up to 90% state of charge. All the cells in a battery shall be designed for continuous float operation at the specified float voltage throughout the life. The capacity (corrected at 27º Celsius) shall also not be less than C and not more than 120% of C before any cell in the battery bank reaches 1.75V/cell. The battery voltage shall not be less than the following values, when a fully charged battery is put to discharge at C/10 rate:

(a) After Six minutes of discharge : 1.98V/cell
(b) After Six hours of discharge : 1.92V/cell
(c) After 8 hours of discharge: 1.85V/cell
(d) After 10 hours of discharge: 1.75V/cell

Loss in capacity during storage at an average ambient temperature of 35º Celsius for a period of 6 months shall not be more than 60% and the cell/battery shall achieve 85% of its rated capacity within 3 charge/discharge cycles and full rated capacity within 5 cycles, after the storage period of 6 months. Voltage of each cell in the battery set shall be within 0.05V of the average voltage throughout the storage period. Ampere hour efficiency shall be better than 90% and watt hour efficiency shall be better than 80%.

1.2.12 Expected Battery Life
The battery shall be capable of giving 1200 or more charge/discharge cycles at 80% Depth of discharge (DOD) at an average temperature of 27º Celsius. DOD (Depth of Discharge) is defined as the ratio of the quantity of electricity (in Ampere-hour) removed from a cell or battery on discharge to its rated capacity.

The battery sets shall have a minimum expected life of 20 years at float operation.

1.2.13 Routine Maintenance of Battery system
For routine maintenance of battery system, the contractor shall supply 1 set of following tools:
a) Torque wrench.
b) Cell test voltmeter(-3-0-+3) volts

1.2.14 Type Test of Battery
The contractor shall supply type tested battery. The Contractor shall submit the Battery type test reports of tests conducted on the same make, model, type & rating as offered as per the IEC 896-2 or equivalent IS/EN/BS standards.

1.2.15 List of Factory & Site Tests for Battery

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Test</th>
<th>Factory Tests</th>
<th>Site Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Physical Verification</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>2.</td>
<td>C/10 Capacity test on the cell</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>8 Hrs. Charge and 15 minutes discharge test at full rated load</td>
<td></td>
<td>√</td>
</tr>
</tbody>
</table>

1.3 Battery Charger
The DC system for 220 V DC is unearth. The Battery Chargers as well as their automatic regulators shall be of static type and shall be compatible with offered VRLA batteries. All battery chargers shall be capable of continuous operation at the respective rated load in float charging mode, i.e. Float charging the associated DC Lead-Acid Batteries at 2.15 to 2.25 Volts per cell while supplying the DC load. The chargers shall also be capable of Boost charging the associated DC Battery at 2.3 +/- 0.02 volts per cell at the desired rate. Charger shall regulate the float/boost voltage in case of prescribed temperature rise of battery as per manufacturers recommendation to avoid thermal runaway. Necessary temperature sensors shall be provided in mid location of battery banks and shall be wired up to the respective charger for feedback control. The manufacturer shall demonstrate this feature during testing of each charger. Battery charger should be thyristor controlled.

1.3.1 All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. When on automatic control mode during Float charging, the Charger output voltage shall remain within ±1% of the set value, for AC input voltage variation of ±10%, frequency variation of ±5%, a combined voltage and frequency variation of ±10%, and a DC load variation from zero to full load.

1.3.2 All battery chargers shall have a constant voltage characteristics throughout the range (from zero to full load) at the floating value of the voltage so as to keep the battery fully charged but without harmful overcharge.

1.3.3 All chargers shall have load limiters having drooping characteristic, 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 characteristics shall be such that any sustained overload or short circuit in DC System shall not 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.

1.3.4 Uniform and step less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire float charging output range specified. Step less adjustments of the Load-limiter setting shall also be possible from 80% to 100% of the rated output current for Charging mode.

1.3.5 During Boost Charging, the Battery Charger shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode.

1.3.6 The Charger output voltage shall automatically go on rising, when it is operating on Boost mode, as the Battery charges up. For limiting the output voltage of the Charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage any where in the output range specified for Boost Charging mode.

1.3.7 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 Float charging mode is used as current setting device in boost charging mode.

1.3.8 Suitable filter circuits shall be provided in all the chargers to limit the ripple content (Peak to Peak) in the output voltage to 1%, irrespective of the DC load level, when they are not connected to a Battery.

1.3.9 MCCB
All Battery Chargers shall have 2 Nos. MCCBs on the input side to receive cables from two sources. Mechanical interlock should be provided such that only one shall be closed at a time. It shall be of P2 duty and suitable for continuous duty. MCCB’s should have auxiliary contacts for annunciation.

1.3.10 Rectifier Transformer
The rectifier transformer shall be continuously rated, dry air cooled (A.N) and of class F insulation type. The rating of the rectifier transformer shall have 10% overload capacity.

1.3.11 Rectifier Assembly
The rectifier assembly shall be fully/half controlled bridge type and shall be designed to meet the duty as required by the respective Charger. The rectifier shall be provided with heat sink having their own heat dissipation arrangements with natural air cooling. Necessary surge protection devices and rectifier type fast acting HRC fuses shall be provided in each arm of the rectifier connections.

1.3.12 Instruments
One AC voltmeter and one AC ammeter alongwith selector switches shall be provided for all chargers. One DC voltmeter and DC ammeter (with shunt) shall be provided for all Chargers. The instruments shall be flush type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustment. The instruments shall be of 1.5 accuracy class. In addition to the above a centre zero voltmeter with selector switch shall also be provided for 220V chargers for testing purpose.

1.3.13 Air Break Switches
One DC output switch shall be provided in all chargers. They shall be air break type suitable for 500 volts AC/ 250 DC. The contacts of the switches shall open and close with a snap action. The operating handle of the switch shall be fully insulated from circuit. ‘ON’ and ‘OFF’ position on the switch shall be clearly indicated. Rating of switches shall be suitable for their continuous load. Alternatively, MCCB’s of suitable ratings shall also acceptable in place of Air Break Switch.

1.3.14 Fuses
All fuses shall be HRC Link type. Fuses shall be mounted on fuse carriers which are in turn mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type base. In such case one insulated fuse pulling handle shall be supplied for each charger. Fuse rating shall be chosen by the Bidder depending on the circuit requirement. All fuses in the chargers shall be monitored. Fuse failure annunciation shall be provided on the failure of any fuse.
1.3.15 Blocking Diode

Blocking diode shall be provided in the positive pole of the output circuit of each charger to prevent current flow from the DC Battery into the Charger.

1.3.16 Annunciation System

Audio-visual indications through bright LEDs shall be provided in all Chargers for the following abnormalities:

a) AC power failure
b) Rectifier/chargers fuse blown.
c) Over voltage across the battery when boost charging.
d) Abnormal voltage (High/Low)
e) Any other annunciation if required.

Potential free NO Contacts of above abnormal conditions shall also be provided for common remote indication “CHARGER TROUBLE” in Owner’s Control Board.
Indication for charger in float mode and boost mode through indication lamps shall be provided for chargers. A potential free contact for float/boost mode shall be provided for external interlocks.

1.3.17 Name Plates and Marking

The name plates shall be white with black engraved letters. On top of each Charger, on front as well as rear sides, larger and bold name plates shall be provided to identify the Charger. Name plates with full and clear inscriptions shall also be provided on and inside of the panels for identification of the various equipments and ease of operation and maintenance.

1.3.18 Charger Construction

The Chargers shall be indoor, floor-mounted, self-supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolt and hardware. The Chargers shall be fabricated from 2.0mm cold rolled sheet steel and shall have folded type of construction. Removable gland plates for all cables and lugs for power cables shall be supplied by the Contractor. The lugs for power cables shall be made of electrolytic copper with tin coat. Power cable sizes shall be advised to the Contractor at a later date for provision of suitable lugs and drilling of gland plates. The Charger shall be tropicalised and vermin proof. Ventilation louvers, if provided shall be backed with screens. All doors and covers shall be fitted with synthetic rubber gaskets. The chargers shall have hinged double leaf doors provided on front and on backside for adequate access to the Charger’s internals. All the charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-42 as per IS: 13947 Part I.

1.3.18.1 All indicating instruments, control switches and indicating lamps shall be mounted on the front side of the Charger.

1.3.18.2 Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks and ready for external connections. The control wiring shall be carried out with PVC insulated, 1.5 sq.mm. stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5 sq.mm stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 20% spare terminals shall be provided for control circuits.

1.3.18.3 The insulation of all circuits, except the low voltage electronic circuits shall withstand test voltage of 2 KV AC for one minute. An air clearance of at least ten (10) mm shall be maintained throughout for such circuits, right up to the terminal lugs. Whenever this clearance is not available, the live parts shall be insulated or shrouded.

1.3.19 Painting

All sheet steel work shall be pre-treated, in tanks, in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphating surfaces shall be rinsed and passivated prior to application of staved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint of shade-631 of IS:5 shall be applied, unless required otherwise by the Owner. The inside of the chargers shall be glossy white. Each coat of finishing synthetic enamel paint shall be properly stoved. The paint thickness shall not be less than fifty (50) microns.
1.3.20 TESTS

1.3.20.1. Battery chargers shall conform to all type tests as per relevant Indian Standard. Performance test on the Chargers as per Specification shall also be carried out on each Charger as per specification. Rectifier transformer shall conform to all type tests specified in IS: 4540 and short circuit test as per IS:2026. Following type tests shall be carried out for compliance of specification requirements:

i) Voltage regulation test
ii) Load limiter characteristics test
iii) Efficiency tests
iv) High voltage tests
v) Temperature rise test
vi) Short circuit test at no load and full load at rated voltage for sustained short circuit.

vii) Degree of protection test
viii) Measurement of ripple by oscilloscope.

1.3.20.2. The Contractor may be required to demonstrate to the OWNER that the Chargers conform to the specification particularly regarding continuous rating, ripple free output, voltage regulation and load limiting characteristic, before dispatch as well as after installation at site. At site the following tests shall be carried out:

i) Insulation resistance test

ii) Checking of proper annunciation system operation.

1.3.20.3. If a Charger fails to meet the specified requirements, the Contractor shall replace the same with appropriate Charger without affecting the commissioning schedule of the Sub-station, and without any extra cost to the OWNER.

1.3.20.4. The Contractor shall present for inspection, the type and routine test certificates for the following components whenever required by the OWNER.

(i) Switches.
(ii) Relays/MCCBs
(iii) Instruments.
(iv) DC fuses.
(v) SCR.
(vi) Diodes.
(vii) Condensers.
(viii) Potentiometers.
(ix) Semiconductor
(x) Annunciator.
(xi) Control wiring
(xii) Push buttons and contactors.

Makes of above equipment shall be subject to Owner’s approval.

1.4 THE POWER SUPPLY SYSTEM FOR SCADA SYSTEM

The tele-communication/SCADA equipments shall be suitable to operate on 220V DC power supply available in the substation.
1.0 LIGHTING SYSTEM

1.1 The scope of work comprises of design, engineering, testing, supply, installation, testing and commissioning of various lighting fixtures complete with lamps, supports and accessories, ceiling fans complete with electronic regulators, exhaust fans for toilets, pantry and battery room, lighting panels, lighting poles complete with distribution boxes, galvanized rigid steel conduits, lighting wires, G.I. Earthwire, receptacles, tag block & telephone socket, switchboards, switches, junction boxes, pull out boxes complete with accessories, lighting transformer. The lighting system shall be as per Energy Conservation Act. (Latest).

1.2 SYSTEM DESCRIPTION

A typical arrangement of lighting system shall comprise of the following:

1.2.1 AC Normal Lighting
AC lights will be connected to AC lighting panels. All the lights connected to the AC lighting system in different areas will be connected to the main lighting distribution boards.

1.2.2 AC Emergency Lighting
This system will be available in control room building, DG Set building & switchyard. AC lighting load will be connected to this system, which will be normally ‘ON’. The lighting panels of this system will be connected to the Emergency lighting board, which is fed from diesel generator during the emergency. 50% of lighting fixtures shall be connected on AC emergency lighting.

1.2.3 D.C. Emergency Lighting
A few D.C emergency lighting fixtures operated on the DC system will be provided in the strategic locations including staircase, corridors, electrical rooms, Battery charger room, LT switchgear room in control room building, and DG Set building so that the operating personnel can safely find their way even during emergency of a total AC failure. These lights will be normally ‘OFF’ and will be switched ‘ON’ automatically when under voltage occurs in the AC main lighting distribution board. GLS lamp down lighters in false ceiling area and Bulkhead fixtures in non-false ceiling area to be used.

1.2.4 Portable Fixtures
Three numbers of battery operated, portables fixtures will be provided in the Control room building and one number shall be provided in DG Set Building. These fixtures will be provided at important locations in the above-mentioned areas.

1.3 The Lux levels to be maintained in the switchyard shall be as per following:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Area</th>
<th>Average Lux Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Switchyard</td>
<td>Average Lux level 50 Lux on main Equipments (i.e Transformer, ISO) at first level (Equipment Connection level.) 20 Lux on balance area of switchyard and Road at ground level</td>
</tr>
</tbody>
</table>

The minimum Lux level to average Lux level ratio should not be less than 0.3 (i.e. Emin/Eavg>0.3), the maintenance factor for outdoor illumination design shall be considered as 0.65.

For achieving the specified Lux levels in the switchyard, the contractor can provide luminaries of 1x400W/1x250W and 2x 400W/250 W flood light as per requirement.

The contractor shall submit detailed calculation for reaching the above Lux level. Contractor shall conform the Lux levels at different locations of the switchyard and lighting by measurement.

In addition to the normal lighting provided in the switchyard area to maintain the desired Lux levels, few high beam fixtures on swivel support shall be provided in strategic locations near equipments, which shall be kept normally OFF, and these shall be switched ON in case of maintenance work.
Section 9: Lighting System

1.4 Adequate nos. of Ceiling fans (1400mm sweep, AC 230 volts) shall be provided in DG set building and all the rooms in the control room building. Wall mounted fans shall be provided in the conference room, shift manager and substation in charge rooms in control room building. In addition exhaust fans shall be provided in toilets, pantry and battery room.

1.5 One no. of aluminium ladder of each size shall be supplied by the contractor for maintenance purpose.

1.6 The following specific areas are included in the scope of lighting:
   (i) GIS cum Control Room building.
   (ii) Switchyard outside GIS cum Control Room Building.
   (iii) DG Set
   (iv) Landscape lighting around GIS cum Control Room building
   (v) Roads in the substation.

1.7 Street lighting shall be provided through HP sodium vapour lamps.

1.8 For Outdoor Illumination
   Switchyard design, detailed drawings showing the lighting layout and Electrical distribution diagram shall be prepared by the Contractor and submitted for approval. The above layout drawings will include disposition and location of lighting fixtures, receptacles, etc.

   **High Mast Lighting System**
   The High Mast shall be provided for outdoor illumination. The bidders shall design the proper height of High Mast, control panels and average illumination level for outdoor switchyard as per IS:3646 (part-2) and subjected to the Employer approval. The required quantity and rate shall be filled by the bidder in relevant BPS (Vol-III). The Mast shaft shall be provided with hot dip galvanised and suitable for wind velocity as per IS 875. It shall also include accessories for high mast including head frame, steel wire rope, trailing cable, double drum winch, galvanised Lantern carriage arrangement suitable for luminaries symmetrically & its control gear boxes and lightning finial etc. The mast shall have an integral power motor installed inside the base compartment for its operation.

   The control panel housing shall be contactor circuit for the automatic control of luminaries, outgoing terminals and control circuit for the power motor.

   **For Indoor Illumination**
   The conduit layout for substation buildings based on the tender drawings, Electrical distribution diagram for substation buildings & for landscape lighting cable schedule for substation yard etc. shall be prepared by the Contractor. All wiring including telephone wiring (tinned two pair copper) shall be in concealed conduit. Concealed MS junction boxes for sockets and light points shall be provided in all the rooms of GIS cum Control Room Building, DG Set Building etc.

   Each cable and conduct run shall be tagged with number that appears in the cable and conduit schedules. Cables and conduits shall be tagged at their entrance and / or exit from any piece of equipment, junction or pull box, floor opening etc.

   The tag shall be made up of aluminium with the number punched on it and securely attached to the cables by not less than two turns of G.I. wire Cable tags shall be rectangular in shape for power cables and circular shape for control cables.

   Location of cables laid directly under ground shall be indicated clearly by cable marker made of galvanized iron plate embedded in concrete book.

   The location of under ground cable joints if any, shall be clearly indicated with cable marker with an additional inscription “cable joint”.

   The marker, which is a concrete block, shall project 150mm above ground and shall be spaced at an interval of 30 meters and at every change of direction. It shall also be located on both sides of the road or drain crossing.

2.0 DESCRIPTION OF ITEMS
   The Contractor shall supply and install the following equipment and accessories in accordance with the specification.
2.1 LIGHTING PANELS

2.1.1 Outdoor
415 V AC lighting panel with 415V, 63A, 3 Phase 4 wire bus and one no. 63A, TPN, MCB with neutral unit as incomer and 20A, MCB as outgoing feeders, the details are as follows.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Details of Outgoing Feeders</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACP-2</td>
<td>Outdoor</td>
<td>6 nos. 32A Tripple pole MCB with Neutral suitable timer &amp; contactor for automotive switching.</td>
</tr>
<tr>
<td>ACP-3</td>
<td>Outdoor</td>
<td>3 nos., 32A Tripple pole MCB with Neutral Lighting with suitable timer &amp; contractor for automatic switching.</td>
</tr>
</tbody>
</table>

Note: The number of outgoing feeders indicated above are the minimum.

2.1.2 Indoor
415 V Indoor AC lighting panel, 63A, 3 phase, 4 wire bus and one number 63 AMP, TPN, MCB with 300ma 63 A, RCCB. Flush Mounted with per phase isolation and indication lamps din mounted. The DB will be flush mounted.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Details of Outgoing Feeders</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACP-1</td>
<td>Indoor</td>
<td>18 nos. outgoing 16-32 amp SPMCB</td>
</tr>
</tbody>
</table>

2.2. 220V DC indoor type change over board and 220V DC 32A two wire bus and one 32A contactor backed up by 32A double pole MCB as incomer. The panel shall have local push button controls. Following are the various types of panels required with control timer.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Details of Outgoing Feeders</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCP</td>
<td>Indoor</td>
<td>6 Nos. – 16A DPMCB Unit.</td>
</tr>
</tbody>
</table>

2.3. Sub-Lighting Panels

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLD</td>
<td>4 pole 32A Isolator suitable for 415V, 50 cycles AC Supply, with LILO Facility using 8 nos. terminal blocks suitable for cable upto 16m sq cable Enclosure shall be suitable for outdoor use with IP-55 degree of protection as per IS: 13947 (Part-I)</td>
</tr>
</tbody>
</table>

2.4. Lighting Fixtures and Receptacles

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IF</td>
<td>CFL/Metal Halide in recessed down light having high purity aluminum reflector electrochemically brightened and anodized. Stainless steel leaf springs and pressure die cast ceiling similar to Philips Cat. No. DN-622 Crompton greaves cat DDLV 10-BC</td>
</tr>
<tr>
<td>SF1</td>
<td>Whether proof integral Floor Lighting with housing made of corrosion resistant die cat aluminum painted black. Grey powder coated outside suitable for 150W SON-T lamp complete with all accessories and suitable for termination with conduits/flexible Cat. No. F69045 (C). Similar to Philips Cat. No. SWF230/150/Bajaj Cat. No. BGEMF-150WSV Crompton Greaves Cat No. FAD 11151H</td>
</tr>
<tr>
<td>SF2</td>
<td>2 x 400 / 2 x 250 W HP Sodium vapour lamps in high flood lighting fixture suitable for outdoor mounting with aluminum enclosure: similar to Phillips Cat. No. SNT001/Bajaj Cat. No. DJEF-22CA/Crompton Greaves Cat No. FAD 11151H</td>
</tr>
<tr>
<td>SF3</td>
<td>1 x 250 W/ 1 x 400 HP Sodium vapour lamps in high flood lighting fixture suitable for outdoor mounting with aluminum enclosure and integral control gear: similar to Phillips cat. No. SWF 330/CGL Cat. No. FAD 1114/Bajaj Cat. No. BJEF T14CA.</td>
</tr>
</tbody>
</table>
PF 1x11 W CFL/Metal Halide lamp emergency light with Battery operated portable fixture with built in chargeable Batteries and battery charger suitable for a lighting period of six hours similar to ALPHA DELUX of M/s DELTA FLASH LITE/MICRO LITE OF M/s MICRO / BPL MAKE

FB 9W CFL /Metal Halide lamp in Bulkhead fixtures with Cat Aluminium alloy body, suitable for column, wall, and ceiling mounting finished stove enameled silver grey outside white inside, to be supplied complete (with front cover, wire guard, tropicalised gasket and lamp holder taped ¾” E.T. for conduit entry) similar to Phillips Cat No. FXC 101/Bajaj Cat No. BJBE-19/Crompton Greaves.

MP 125 HP MV CFL/Metal Halide in weather proof post top lantern with case aluminium canopy, mounting piece, opal acrylic cover tropicated gasket and all other accessories for mounting on pole top similar to Phillips Cat No. HPC-101/Bajaj/Crompton Greaves. Cat No. MPT12IH/BC

IB 60/100W CFL/Metal Halide in Bulkhead fixtures with cast Aluminium alloy, body, suitable for column, wall and ceiling mounting finished stove enameled silver grey outside white inside, to be supplied complete (with front glass, wire guard, tropicalised, gasket and E.S. Porcelain, lamp holder taped ¾” E.T. for conduit entry) similar to Phillips Cat No. NXC101/Crompton Greaves IBH1110/BC

BL 2x9 or 1x18 W, CFL bollard light for landscape lighting FRP/LLDPE housing similar to Phillips FGC202/Crompton Greaves Cat No. CFBL1129

DLR 2x18 W, CFL Down light for recess mounting lighting having similar to Phillips FBH225/2x18 / Crompton Greaves Cat No DDLH218TG

DSM 1x13 WTT surface mounted CFL similar to Art Light Make Cat No. RL 3146

HL 2x18 CFL Decorative hanging down Light Similar no. Cat No Art light RL 3166/HL

CL 1x18 WATT Decorative ceiling mounted luminaries similar to Phillips Dixie Cat FL 343/118

2.5 RECEPTACLES
RO 15A, 240V, Outdoor Receptacle 3 Pole, 3 pin type
R1 5/15A, 240V Indoor receptacle 3-in type
RP 63A, 415V, Interlocked switch socket, outdoor receptacle

2.6 SWITCH BOARDS
Modular type switches, 5/15 Amp. Receptacles

2.7 CONDUITS AND ACCESSORIES
Galvanised Rigid Steel Conduits of 19mm/25mm/32mm/40mm dia

2.8 JUNCTION BOXES with 5 nos. of terminal blocks

2.9 LIGHTING POLES – Adequate nos. of lighting pole shall be provided.

2.10 CEILING FANS – 1400mm Sweep with Electronic regulator

2.11 MAINTENANCE EQUIPMENT
i) A type Aluminium ladder of 3 mtr. vertical height.
ii) Cartwheel mounted aluminium ladder Vertical Height 7.5 Mtrs. when extended.

2.12 LIGHTING TRANSFORMER
Supply, erection, testing and commissioning of 100 KVA or above (in case the capacity of transformer required is higher than 100 KVA as per approved calculations), 415/415 V, 3
Phase, 50 Hz Dry type natural air cooled lighting transformers. The technical parameters of these lighting transformers are as follows:

**Technical Parameters of Lighting Transformer**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of transformer</td>
<td>Dry Type natural air</td>
</tr>
<tr>
<td>Cooled Rating</td>
<td>100 KVA</td>
</tr>
<tr>
<td>Voltage Ratio</td>
<td>415/415 Volts</td>
</tr>
<tr>
<td>No. of Phases</td>
<td>Three</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Winding connection</td>
<td>Dyn – 1</td>
</tr>
<tr>
<td>Class of insulation</td>
<td>‘B’ Class</td>
</tr>
<tr>
<td>Impedance</td>
<td>4% ± 10%</td>
</tr>
<tr>
<td>No. of taps &amp; steps</td>
<td>5, ± 5% in steps of 2.5%</td>
</tr>
<tr>
<td>Ref. Standard</td>
<td>IS:2026</td>
</tr>
</tbody>
</table>

The enclosure for the above transformer shall have degree of protection not less than IP-42. The rating of lighting transformer should be suitable for lighting load. The contractor shall submit the supporting calculation for the rating of lighting transformer.

3.0 LIGHTING FIXTURES AND ACCESSORIES

3.1 General

All lighting fixtures and accessories shall be designed for continuous operation under atmospheric conditions existing at site, without reduction in the life or without any deterioration of materials, internal wiring.

3.2 Temperature Rise

All lighting Fixtures and accessories shall be designed to have a low temperature rise according to the relevant Indian Standards. The design ambient temperature shall be taken as 50 deg.C.

3.3 Supply Voltage

3.3.1 Lighting fixtures and accessories meant for 240V A.C. operation shall be suitable for operation on 240V A.C. 50Hz, supply voltage variation of ± 10%, frequency variation of ± 5% and combined voltage and frequency variation of ± 10%.

3.3.2 Lighting fixture and accessories meant for 220V DC operation shall be suitable for operation on 220V DC with variation between 190 to 240 Volts.

3.4 Lighting Fixtures

The lighting fixtures shall be Philips or Bajaj or Crompton Greaves make only except for fixtures type 'DSM' & 'HI/ for which make has been specified elsewhere in this section. The different types of lighting fixtures are also indicated elsewhere in this Section.

3.4.1 All Fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection.

3.4.2 All lighting fixtures shall be complete with CFL /mercury vapour/sodium vapour/metal halide lamps as specified and shall be suitably wired up.

3.4.3 High beam Fixtures shall be suitable for pendant mounting and flood lights shall have suitable base plate / frame for mounting on steel structural member. Hook mounted high beam fixtures are not acceptable.

3.4.4 Each lighting Fixture shall be provided with an earthing terminal suitable for connection to 16 SWG GI earthing conductors.

3.4.5 All light reflecting surfaces shall have optimum light reflecting co-efficient such as to ensure the overall light output as specified by the manufacturer.

3.4.6 Height of fixtures should be such that it is easy to replace the lamps with normal ladder/stool. In case the ceiling height is very high, the fixtures may be placed on the walls for ground lighting.
3.5 ACCESSORIES
3.5.1 Reflectors
The reflectors shall be manufactured from sheet steel or aluminium as applicable. They shall be securely fixed to the captive type.

3.5.2 Lamp holders and Starter Holders
Lamp holders/starter for CFL, Metal Halide Lamp and HPMV/HPSV lamps shall be of screw type, manufactured in accordance with relevant standard and designed to give long and satisfactory service.

3.5.3 Ballasts
a) The Ballasts shall be designed, manufactured and supplied in accordance with relevant standard and function satisfactorily under site condition specified. The ballasts shall be designed to have a long service life and low power loss.
b) Ballasts shall be mounted using self locking anti-vibration fixing and shall be easy to remove without dismantling the fixtures. They shall be totally enclosed units.
c) The ballasts shall be of the inductive, heavy duty type, filled with thermostetting insulating moisture repellent polyester compound filled under pressure or vacuum. The ballast wiring shall be of copper wire. They shall be free from hum. Ballasts which produce humming sound shall be replaced free of cost by the Contractor. Ballasts for high pressure mercury vapour/ HPSV lamps shall be provided with suitable tappings to set the voltage within the range specified. End connections and taps shall be brought out in a suitable terminal block, rigidly fixed to the ballast enclosure.
d) Separate ballast for each lamp shall be provided in case of multi-lamp fixtures.

3.5.4 Starters
Starters shall have bimetal electrodes and high mechanical strength. Starters shall be replaceable without disturbing the reflector or lamps and without the use of any tool. Starters shall have brass contacts and radio interference suppressing capacitor.

3.5.5 Capacitors
a) The capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits.
b) The capacitors shall be suitable for operation at supply voltage as specified and shall have a value of capacitance so as to correct the power factors of its corresponding lamp circuit to the extent of 0.98 lag.
c) The capacitors shall be hermetically sealed in a metal enclosure.

3.6 Lamps
3.6.1 General Lighting Services (GLS) lamps shall be provided with screwed caps and shall be of “clear” type unless otherwise specified.

3.6.2 Mercury vapour lamps, sodium vapour lamps shall be colour corrected type, with screwed caps.

3.7 The Bidder shall furnish typical wiring diagram for CFL/Metal Halide lamps, HPMV & HPSV fitting including all accessories. The diagram shall include technical details of accessories i.e. starters, Electronic Chokes, capacitors etc.

3.8 Flexible conduits if required, for any fixture shall be deemed to be included in Contractor’s scope.

4.0 RECEPTACLES
a) All receptacles shall be of cast steel/aluminium, heavy duty type, suitable for fixing on wall/column and complete with individual switch.
b) In general the receptacles to be installed are of the following types
   i) Type RO - 15A, 240V, 2 pole, 3 pin type with third pin grounded, metal dad with gasket having cable gland entry suitable for 2Cx6 sq.mm. PVC/aluminium armoured cable and a metallic cover tied to it with a metallic chain and suitable for installation in moist location and or outdoor. The switch shall be of rotary type. Receptacles shall be housed in an enclosure made out of 2 mm thick GI sheet with hinged doors with padlocking arrangements. Door shall be lined with good quality gasketing. This shall conform to IP-55.
   ii) Type RI - The 5/15 amp 6 pin receptacles with switches will be of Modular type with flush type switches and electroplated metal enclosures of approved make.
iii) **Type RP** - 63A, 415V, 3 phase, 4 pin interlocked plug and switch with earthing contacts. Other requirements shall be same as type RO. The receptacle shall be suitable for 3.5C x 35/3.5C x 70 sq.mm. aluminum conductor cable entry and shall also be suitable for loop-in and loop out connection of cables of identical size. Receptacle shall be suitable for outdoor application. Receptacles shall be housed in a box made out of 2mm thick G.I. sheet, with hinged door with padlocking arrangement. Door shall be lined with good quality gasketing. This shall conform to IP-55.

### 5.0  SWITCH AND SWITCHBOARD

(a) All switch board/boxes, 5/15 Amp receptacles and electronic fan regulators located in office/building areas shall be modular flush mounted type or brick wall with only the switch knob projecting outside.

(b) Switch boards/boxes shall have conduit knock outs on all the sides. Adequate provision shall be made for ventilation of these boxes.

(c) The exact number of switches including regulator for fans and layout of the same in the switchboard shall be to suit the requirement during installation.

(d) The maximum number of luminaries controlled by one no 6 amp switch would be 4 nos. For DC fixtures there will be no switch and the same shall be controlled from DC LP.

(e) The luminaries shall be wired in such a fashion that luminaries on each phase are evenly distributed all over the room.

### 6.0  CONDUITS & CONDUIT ACCESSORIES

6.1 The conduits shall conform to IS:9537. All conduits shall be seamed by welding, shall be of heavy gauge and shall be hot dip galvanised.

6.2 Flexible conduits wherever required shall be made with bright, cold rolled annealed and electro-galvanised mild steel strips.

6.3 All conduits accessories shall conform to relevant IS and shall be hot dip galvanised.

### 7.0  JUNCTION BOXES

7.1 The junction boxes shall be concealed type for indoor lighting and suitable for mounting on columns, lighting poles, structures etc., for outdoor lighting.

7.2 Junction boxes shall be of square/rectangular type of 1.6 mm sheet steel with minimum 6 mm thick pressure die cast aluminium material LM-6 and shall have bolted cover with good quality gasket lining.

7.3 The junction box and cover shall be hot dip galvanised.

7.4 The junction boxes shall be complete with conduit knockouts/threaded nuts and provided with terminal strips. The junction boxes shall be suitable for termination of conduit/glands of dia 20 mm, 25 mm, 32 mm, 40 mm on all sides. The junction boxes shall be provided with 4 way terminals suitable for two numbers 10 sq. mm. wire & for switchyard lighting suitable for 2 numbers 4C x 16 Sq.mm Al. cable.

7.5 The junction boxes shall have the following indelible markings

   (i)  Circuit Nos. on the top.

   (ii) Circuit Nos. with ferrules (inside) as per drawings.

   (iii) DANGER sign in case of 415 volt junction box.

7.6 The junction boxes shall be weather proof type with gaskets conforming to IP-55 as per IS: 13947 (Part 1). The conduit connections shall also be properly sealed to prevent entry of water.

### 8.0  TERMINAL BLOCKS

8.1 Each terminal shall be suitable for terminating upto 2 Nos. 10 sq.mm. stranded Aluminium Conductors without any damage to the conductors or any looseness of connections.

### 9.0  PULL OUT BOXES

9.1 The pull out boxes shall be concealed type for indoor lighting and suitable for mounting on column, structures etc., for outdoor lighting. The supply of bolts, nuts and screws required for the erection shall be included in the installation rates.
9.2 The pull out boxes shall be circular of cast iron or 16 SWG sheet steel and shall have cover with good quality gasket lining.

9.3 The pull out boxes and cover shall be hot dip galvanized.

9.4 The pull out boxes shall be completed with conduit knock outs/threaded hubs and provided at approximately 3 meters intervals in a conduit run.

10.0 LIGHTING PANELS (L.P.)
10.1 Each panel shall be provided with one incoming triple pole MCB with neutral link and outgoing miniature circuit breakers as per clause 2.0. The panels shall conform to IS-8623.

10.2 Constructional Features
10.2.1 Panels shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be of thickness not less than 2.00 mm (cold rolled) or 2.5 mm (hot rolled) smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary. The indoor lighting panels will be ready made DB of minimum 20 swg sheet thickness.

10.2.2 The panels shall be of single front construction, front hinged and front connected, suitable for either floor mounting on channels, sills or on walls/columns by suitable M.S. brackets.

10.2.3 Panels shall have a dead front assembly provided with hinged door(s) and out door panels will be with padlocking arrangement with single key supplied in duplicate.

10.2.4 All out door panels, removable covers, doors and plates shall be gasket all around with neoprene gaskets.

10.2.5 The panels shall be suitable for cable/conduit entry from the top and bottom. Suitable removable cable gland-plate shall be provided on the top and bottom of panels. Necessary number of double compression cable gland shall be supplied, fitted on to this gland plate. The glands shall be screwed on top and made of tinned brass.

10.2.6 The panels shall be so constructed as to permit free access to connection of terminals and easy replacement of parts.

10.2.7 Each panel shall have a caution notice fixed on it.

10.2.8 Each panel will be provided with directory holder in which printed and laminated as built circuit directory would be kept.

10.2.9 Each Outdoor lighting panel shall be provided with one no. 'ON' indicating lamp for each phase along with fuses. For indoor lighting panels din mounted phase indication lamps will be provided, mounted along side of the MCB.

10.3 Main Bus Bars
10.3.1 Bus bars shall be of aluminium alloy conforming to IS:5082 and shall have adequate cross-section to carry the rated continuous and withstand short circuit currents. Maximum operating temperature of the bus bars shall not exceed 85 deg. C. The bus bars shall be able to withstand a fault level of 9 kA for 1 sec. for AC panels and 4 KA for 1 sec. for DC panels. The Indoor lighting panels shall have copper bus bar.

10.4 Residual Current Circuit Breakers (RCCB)
10.4.1 For indoor panels 63A 4pole 300 ma conforming IS 12640 will be provided along with incomer.

10.5 Miniature Circuit Breaker (MCB)
   a) The miniature circuit breakers shall be suitable for manual closing, opening, automatic tripping under overload and short circuit. The MCBs shall also be trip free.
   b) Single pole as well as three pole versions shall be furnished as required in the Schedule of Lighting Panels.
   c) The MCBs and panel MCCB together shall be rated for full fault level. In case the MCB rating is less than the specified fault level the bidder shall co-ordinate these breaker characteristics with the back up MCCB in such a way that if fault current is higher than...
breaker rating, the MCCB should blow earlier than the breaker. If the fault current is less than MCB breaking capacity, MCB shall operate first and not the incomer MCCB.

d) The MCBs shall be suitable for housing in the lighting panels and shall be suitable for connection with stranded copper wire connection at both the incoming and outgoing side by copper lugs or for bus bar connection on the incoming side.

e) The terminals of the MCBs and the 'open' 'close' and 'trip' conditions shall be clearly and indelibly marked.

f) The tenderer shall check and co-ordinate the ratings of MCBs with respect to starting characteristics of discharge lamps. The vendor has to furnish overload and short circuit curve of MCB as well as starting characteristics curves of lamps for Employer’s approval.

g) The MCB shall generally conform to IS:8828.

10.6 Contactors

Contactors shall be of the full voltage, direct-on line air break, single throw, electro-magnetic type. They shall be provided with atleast 2 'NC' and 2 'NO' auxiliary contacts. Contactors shall be provided with the three element, positive acting, ambient temperature compensated time lagged, hand reset type thermal overload relay with adjustable settings to suit the rated current. Hand reset button shall be flush with the front of the cabinet and suitable for resetting with starter compartment door dosed. The Contactors shall be suitable for switching on Tungsten filament lamp also. The bidder shall check the adequacy of the Contactors rating wire with respect to lighting toad.

10.7 Push Buttons

All push buttons shall be of push to actuate type having 2 'NO' and 2 'NC' self reset contacts. They shall be provided with integral escutcheon plates engraved with their functions. Push buttons shall be of reputed make.

10.8 Labels

a) The lighting panels shall be provided on the front with panel designation labels on a 3 mm thick plastic plate of approved type. The letter shall be black engraved on white back ground.

b) All incoming and outgoing circuits shall be provided with labels. Labels shall be made of non-rusting metal or 3 ply lamicold. Labels shall have white letters on black or dark blue background.

10.9 Earthing Terminals

Panels shall be provided with two separate and distinct earthing terminals suitable to receive the earthing conductors of size 50x6 G.S. Flat.

10.10 Type test reports for following tests on all lighting panels shall be submitted for approval.

(i) Wiring continuity test
(ii) High voltage (2.5 KV for I minute) and insulation test
(iii) Operational test
(iv) Degree of protection (not less than IP-55 test on outdoor Lighting Panels and IP-52 test on indoor Lighting Panels as per IS 13947 (part 1)
(v) Heat run test

10.11 Lighting Transformer

Lighting transformer shall be located in MCC room, in separate enclosure. Enclosure shall have degree of protection not less than IP-42 as per IS-13947 (Part-1).

11.0 Emergency Portable Lighting Fixtures

11.1 The portable fixtures shall have a built in battery rated for six hours, battery chargers and solid state inverters. These shall be of approved make.

11.2 The portable fixtures shall be of a single unit, completely tropicalised and suitable for prolonged use with no maintenance.

11.3 The portable fixtures shall be supplied and necessary supporting brackets of galvanized steel suitable for wall/column mounting shall also be supplied.

11.4 The portable fixture shall come up automatically in the event of failure of normal supply.

Section 9 : Lighting System
12.0 LIGHTING POLES
12.1 In front of GIS cum control room building and DG Set building decorative post top lantern poles and Bollards shall be installed.

12.2 Lighting poles shall be complete with fixing brackets and junction boxes. Junction boxes should be mounted one meter above ground level.

12.3 The lighting poles shall be coated with bituminous preservating paint on the inside as well as on the embedded outside surface. Exposed outside surface shall be coated with two coats of metal primer (comprising of red oxide and zinc chromate in a synthetic medium).

12.4 Wiring from junction box at the bottom of the pole to the fixture at the top of the pole shall be done through 2.5 sq. mm wire.

12.5 Earthing of the poles should be connected to the switchyard main earth mat wherever it is available and the same should be earthed through 3M long, 20 mm dia, earth electrode.

13.0 CEILING & WALL MOUNTED FANS AND REGULATORS
13.1 The contractor shall supply and install 1400 mm sweep ceiling fans complete with electronic regulator and switch, suspension rod, canopy and accessories. The wall-mounted fans shall be of 400 mm sweep.

13.2 The contractor shall supply and install the switch, electronic regulator and board for mounting switch and electronic regulator for ceiling fans.

13.3 Winding of the fans and regulators shall be insulated with Class-E insulating material. Winding shall be of copper wire.

13.4 Electronic regulator with smooth control shall be provided.

13.5 One fan for approx 100 sq. feet area shall be provided.

Fans and electronic regulators shall be of Alstom / Crompton Greaves / Bajaj Electricals / Usha Electricals make.

14.0 LIGHTING WIRES
14.1 The wiring used for lighting shall be standard products of reputed manufacturers.

14.2 The wires shall be of 1100 V grade, PVC insulated product of reputed manufacturers.

14.3 The conductor sizes for wires used for point wiring beyond lighting panels shall be single core 4 sq. mm, 6 sq.mm and 10 sq.mm stranded aluminium wires and 2.5 sq.mm, 4 sq.mm, 6 sq.mm and 1.5 sq.mm stranded copper wire.

14.4 The wires used for connection of a lighting fixture from a nearest junction box or for loop-in loop-out connection between two CFL/Metal Halide lamps fluorescent fixtures shall be single core copper stranded conductor, 1100V grade flexible PVC insulated cords, unsheathed, conforming to IS:694 with nominal conductor cross sectional areas of 2.5 sq. mm.

14.5 The wires shall be colour coded as follows:
Red for R – Phase
Yellow for Y - Phase
Blue for B - Phase
Black for Neutral
White for DC (Positive)
Grey for DC (Negative)

15.0 PAINTING OF SHOP MADE ITEMS
15.1 All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with IS:6005 'Code of Practice for Phosphating Iron and Steel'.

15.2 Oil grease and dirt shall be thoroughly removed by emulsion cleaning.
15.3 Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

15.4 After phosphating through rinsing shall be carried out with clean water, followed by final rinsing with diluted dichromate solution and oven drying.

15.5 The phosphate coating shall be sealed by the application of two coats of ready mixed stoving type metal primer (comprising of red oxide and Zinc chromate in a synthetic medium). The first coat may be ‘flash dried’ while the second coat shall be stoved.

15.6 After application of the primer, two coats of finishing synthetic enamel paint shall be applied with each coat followed by stoving. The second finishing coat for the external of panels shall be applied after completion of tests. The panels can also be powder coated instead of painting after surface treatment as given above.

15.7 Both outside and inside of lighting panel, sheet metal fabricated junction boxes etc. and outside of lighting fixtures shall be finished in light grey (IS-5 shade 631). Inside of lighting fixtures shall be finished in white. The colour of indoor lighting panels should match with colour of wall.

15.8 Each coat of primer and finishing paint shall be of slightly different shade so as to enable inspection of the painting.

15.9 The final finished thickness of paint film on steel shall not be less than 100 microns and shall not be more than 150 microns. The final thickness of powder coating will not be less than 50 microns. For indoor lighting panels the painting will be as per approved manufacturers specification.

15.10 Finished painted appearance on equipment shall present on aesthetically pleasing appearance, free from dents and uneven surfaces.

16.0 LIGHTING SYSTEM INSTALLATION WORKS

16.1 General
16.1.1 In accordance with the specified installation instructions as shown on manufacturer’s drawings or as directed by Employer, Contractor shall unload, erect, install, test and put into commercial use all the electrical equipment included in the contract. Equipment shall be installed in a neat, workmanship manner so that it is level, plumb square and properly aligned and oriented. Tolerances shall be as established in manufacturers drawing or as stipulated by Purchaser.

16.1.2 All apparatus, connections and cabling shall be designed so as to minimise risk of fire or any damage which will be caused in the event of fire.

16.2 Conduit System
16.2.1 Contractor shall supply, store and install conduits required for the lighting installation as specified. All accessories/fittings required for making the installation complete, including but not limited to pull out boxes (as specified in specification ordinary and inspection tees and elbow, check nuts, male and female bushings (brass or galvanised steel), caps, square headed make plugs, nipples, gland sealing fittings, pull boxes, conduits terminal boxes, glands, gaskets and box covers, saddle terminal boxes, and all steel supporting work shall be supplied by the Contractor. The conduit fittings shall be of the same material as conduits. The contractor shall also supply 19 mm PVC conduit and accessories for telephone wiring.

16.2.2 All un-armoured cables shall run within the conduits from lighting panels to lighting fixtures, receptacles, etc.

16.2.3 Size of conduit shall be suitably selected by the Contractor.

16.2.4 Conduit support shall be provided at an interval of 750 mm for horizontal runs and 1000 mm for vertical runs.

16.2.5 Conduit supports shall be clamped on the approved type spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn, shall be securely fixed to the
building steel by welding and to concrete or brick work by grouting or by nylon rawl plugs. Wooden plug inserted in the masonry or concrete for conduit support is not acceptable.

16.2.6 Where conduits are alongwith cable trays they shall be clamped to supporting steel at an interval of 600 mm.

16.2.7 For directly embedding in soil, the conduits shall be coated with an asphalt-base compound. Concrete pier or anchor shall be provided wherever necessary to support the conduit rigidly and to hold it in place.

16.2.8 For long conduit run, pull boxes shall be provided at suitable intervals to facilitate wiring.

16.2.9 Conduit shall be securely fastened to junction boxes or cabinets, each with a lock nut inside and outside the box.

16.2.10 Conduits joints and connections shall be made through water-tight and rust proof by application of a thread compound which insulates the joints. White lead is suitable for application on embedded conduit and red lead for exposed conduit.

16.2.11 The entire metallic conduit system, shall be embedded, electrically continuous and thoroughly grounded. Where slip joints are used, suitable bounding shall be provided around the joint to ensure a continuous ground circuit.

16.2.12 Conduits and fittings shall be properly protected during construction period against mechanical injury. Conduit ends shall be plugged or capped to prevent entry of foreign material.

16.3 **Wiring**

16.3.1 Wiring shall be generally carried out by PVC insulated wires in conduits. All wires in a conduit shall be drawn simultaneously. No subsequent drawings of wires is permissible.

16.3.2 Wires shall not be pulled through more than two equivalent 90 deg. bends in a single conduit run. Where required, suitable junction boxes shall be used.

16.3.3 Wiring shall be spliced only at junction boxes with approved type terminal strip.

16.3.4 For lighting fixtures, connection shall be teed off through suitable round conduit or junction box, so that the connection can be attended without taking down the fixture.

16.3.5 For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/junction box.

16.3.6 Maximum two wires can be terminated to each way of terminal connections.

16.3.7 Separate neutral wires are to be provided for each circuit.

16.3.8 AC and DC wiring should not run through the same conduit.

16.4 **Lighting Panels**

16.4.1 The lighting panels shall be erected at the locations to be finalised during detailed engineering.

16.4.2 Suitable foundations/supporting structures for all outdoor type lighting panels shall be provided by the Contractor.

16.5 **Foundation & civil works**

16.5.1 Foundation for panel foundation and transformer foundation shall be done by the Contractor.

16.5.2 All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grouting of anchor bolts, sills, inserts and fastening devices shall be carried out by the Contractor including minor modification of civil works as may be required for erection.

16.5.3 Any cutting of masonary / concrete work, which is necessary shall be done by the Contractor at his own cost and shall be made good to match the original work.
SECTION: 10

LT TRANSFORMER

1.0 INTENT
This specification is intended to cover outdoor type oil filled 11 / 0.433 kV, 400 kVA transformers.

2.0 SCOPE OF WORK

2.1 Scope of Supply
- Transformers as listed above, with insulating oil, all materials and accessories, and complete in all respects.
- Gland plates, power cable, lugs, anchor bolts and hardwares.
- Mandatory & optional spares and special maintenance equipments if any.

2.2 Scope of Service
The scope includes but is not limited to the following items of work to be performed for all equipment and materials furnished under this section:

   a) Design, manufacturing, shop testing, packing & despatch.
   b) Transportation inclusive of insurance and delivery, FOR site basis
   c) Unloading, handling, storing, transportation at site upto foundations, oil filling and treatment, erection, testing and commissioning
   d) Civil Works
   e) Supply of external cables and termination as required.
   f) Fire protection system.

3.0 GENERAL INFORMATION

3.1 All temperature indicators, Buchholz relays and other auxiliary devices shall be suitable for 220 V DC Control supply. All alarm and trip Contacts shall also be suitable for connection in 220V DC Circuits.

3.2 Bidders may specifically note that Purchaser proposes to insist on short circuit test as per Clause 16.11 of IS:2026 (Part-I)-1977 and dielectric test as per IS -2026. Any deviation in this regard shall be sufficient ground for rejection of the bid.

4.0 TECHNICAL REQUIREMENTS

4.1 Core
The core shall be constructed from high grade, non-aging, cold rolled grain-oriented silicon steel laminations. The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall be such that the flux density at any tap position with 10% voltage variation from the voltage corresponding to the tap shall not exceed 1.9 Wb /sq-m.

4.2 Windings
The conductor shall be of electrolytic copper, free from scales and burrs.

4.3 Insulating Oil
The oil supplied with transformer shall be unused and have the parameters for unused new oil conforming to IS: 335 while tested at oil Contractor's premises, No inhibitors shall be used in oil. Ten percent (10%) extra oil shall be supplied for topping up after commissioning in nonreturnable containers suitable for outdoor storage.

4.4 Terminal Arrangement
a) Bushing terminals shall be provided with suitable terminal connectors of approved type and size for cable/overhead conductors termination of HV side and cable termination on LV side.
b) The neutral terminals of 433V winding shall be brought out on a bushing along with the 433 volt phase terminals to form a 4 wire system for the 415 volt. Additional neutral bushing shall also be provided for earthing.

4.5 **Off Circuit Tap Changing Equipment**
The tap change switch shall be three phase, hand operated for simultaneous switching of similar taps on the three phases by operating an external hand wheel.

4.6 **Marshalling Box**
A metal enclosed, weather, vermin & dust proof marshalling box shall be provided with each transformer to accommodate temperature indicators, terminal blocks etc. It shall have a degree of protection of IP 55 as per IS: 2147.

4.7 **Cable boxes**
Whenever cable connections are required, suitable cable boxes shall be provided and shall be air insulated. They shall be of sufficient size to accommodate Purchaser's cables and shall have suitable removable side/top cover to facilitate cable termination and inspection. Cable boxes shall be dust & vermin proof.

5.0 **INSPECTION AND TESTING**
a) The Contractor shall draw up and carry out a comprehensive inspection and testing program during manufacture and commissioning of the transformer. The programme shall be duly approved by the Employer.
b) The Contractor shall carry out all type tests and routine tests on the transformers as per relevant standards. Type tests shall be carried out on one transformer of each type and routine tests shall be carried out on all transformers.

6.0 **INSPECTION**

6.1 **Tank and Accessories**
a) Physical and dimensional check of transformer tank and accessories.
b) Crack detection of major strength weld seams by dye penetration test.

6.2 **Core**
a) Physical inspection and check of quality of varnish, if used.
b) Sample testing of core material for checking specific loss, bend properties, Magnetisation, characteristics and thickness.
c) Check on completed core for measurement of iron loss and check for any hot spot by exciting the core so as to induce the designed value of flux density in the core.
d) HV Test

6.3 **Insulating Material**
a) Sample checks for physical properties of the material
b) Check for dielectric strength
c) Check for the reaction of hot oil on insulating material

6.4 **Winding**
a) Sample check on winding conductor for mechanical properties and electrical conductivity and on installation covering.
b) Sample check on insulation paper for pH value, Bursting strength, Electric strength.

6.5 **Assembled Transformer**
a) Check complete transformer against approved outline drawing provision for all fittings, finish etc.
b) Jacking test on all the assembled transformers.

6.6 Oil
All standard tests in accordance with relevant Standards shall be carried out on oil samples taken from the transformer before and after testing of the transformer. The contractor shall also prepare a comprehensive inspection and testing programme for all bought out sub-contracted items and shall submit the same to the Purchaser for approval. Such programme shall include the following components:

a) Buchholz Relay
b) Winding temperature Indicator
c) Bushings
d) Marshaling Box
e) Tap changer switch
f) Oil temperature indicator

7.0 FACTORY TEST
7.1 All standard routine tests in accordance with latest issue of IS : 2026 shall be carried out on each transformer.

7.2 All the type tests in accordance with latest issues of IS : 2026 shall be conducted on one transformer of each rating.

7.3 In addition to all type and routine tests, following additional type tests shall also be carried out on one transformer of each rating as per IS : 2026.

a) Measurement of zero sequence impedance
b) Short circuit test
c) Measurement of acoustic noise level. This shall conform to NEMA standard publication TR-1.
d) Measurement of capacitance and tan delta of transformer winding.
e) Test on oil samples.
Sequence of testing shall be mutually agreed between Purchaser and Contractor after award.

7.4 All auxiliary equipment shall be tested as per the relevant IS Test Certificates shall be submitted for bought out items.

7.5 High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.

7.6 Tank Tests:

a) Routine Tests: As per CBIP Manual on Transformers
b) Type Tests:
   i) Vacuum Tests: As per CBIP Manual on Transformers
   ii) Pressure Test: As per CBIP Manual on Transformers

7.7 In addition to the above, the following checks should be carried out at manufacturer's works before despatch for all transformers:

a) Check for interchangeability of components of similar transformers and for mounting dimensions.
b) Check for proper packing and preservation of accessories like radiators, bushings explosion vent, dehydrating breather, Buchholz relay, conservator etc.
c) Check for proper provision of bracings to arrest the movements of core and winding assembly inside the tank.
d) Test for gas tightness and derivation of leakage rate. To ensure adequate reserve gas capacity during transit and storage.

7.8 The Contractor shall submit a detailed inspection and testing programme for field activities, covering areas right from the receipt of material stage up to commissioning stage as per IS: 1886 - Code of practice for installation and maintenance of transformers. The indicative checks and tests are given below.
   a) Physical checks on each transformer on receipt at site for any damage or short supply.
   b) Tests on oil samples
   c) Oil leakage test
   d) Physical checks for colour of silica in breather
   e) Check for oil level in breather housing, conservator tank, etc.
   f) Check for correct operation of all protections and alarms.
   g) Insulation Resistance Measurement for Main Winding, control wiring etc.
   h) Continuously observe the transformer operation at no load for 24 hours.

8.0 FITTINGS
The following fittings shall be provided with each transformer covered under this specification.
   i) Conservator with drain plug and oil filling hole with blanking plate
   ii) Plain oil Gauge
   iii) Silica gel Breather
   iv) Pressure Relief vent
   v) Pocket on tank cover for Thermometer
   vi) Valves
   vii) Earthing Terminals
   viii) Rating & Terminal Marking Plates
   ix) Lifting Lugs
   x) Rollers
   xi) Air Release Plug

The fittings listed above are only indicative and any other fittings which generally are required for satisfactory operation of transformer are deemed to be included.

9.0 SPARE PARTS
9.1 The list of spares for outdoor type transformers covered under this section shall be as specified in Section-Project

9.2 In addition, the Bidder shall also recommend optional spare parts and maintenance equipment necessary for three (3) years of successful operation of the equipment. The prices of these shall be indicated in respective schedules and these shall not be considered for the purpose of evaluation.

10.0 TECHNICAL PARAMETERS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Type</td>
<td>Two Winding</td>
</tr>
<tr>
<td>b)</td>
<td>Service</td>
<td>Outdoor</td>
</tr>
<tr>
<td>c)</td>
<td>Number of phases</td>
<td>Three</td>
</tr>
<tr>
<td>d)</td>
<td>Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>e)</td>
<td>Type of cooling</td>
<td>ONAN</td>
</tr>
<tr>
<td>f)</td>
<td>Rating</td>
<td>400 kVA</td>
</tr>
<tr>
<td>g)</td>
<td>Ratio</td>
<td>11/0.433</td>
</tr>
<tr>
<td>h)</td>
<td>Impedance at 75°C</td>
<td>0.05+10%</td>
</tr>
<tr>
<td>i)</td>
<td>Duty</td>
<td>Continuous</td>
</tr>
<tr>
<td>j)</td>
<td>Overload</td>
<td>As per IS:6600</td>
</tr>
</tbody>
</table>
k) Maximum Temp. rise over 50°C ambient
   i) Oil (Temp. rise measurement by thermometer) 50°C
   ii) Winding (Temp. rise measured by resistance method) 55°C

l) Windings
   11 kV 0.433 kV

m) System Apparent short circuit level (kA)
   400kVA as per IS: 2026 (Part-I)

n) Tap Changer
   i) Tap range +5% / -10% in steps of 2.5% on HV side
   ii) Tap control Off circuit tap change switch

o) H.V. Bushings
   i) Rated Voltage, kV 12
   ii) Rated current, Amp ------------ 100A ------------------
   iii) Basic impulse Level (kV) 170/75 (Two LT Transformer-One designed for 170kVp & another is designed for 75kVp)

p) L.V. and Neutral bushing
   i) Rated Voltage (Volts) 1100
   Suitable for 11 kV (with insulation-level one step higher) cable or O/H Conductor Cable box

q) Terminal details
   i) High Voltage
   ii) Low Voltage phase and neutral
   Suitable for 11 kV (with insulation-level one step higher) cable or O/H Conductor Cable box

r) Minimum Clearance (mm) in AIR
   i) Phase to Phase 280 25
   ii) Phase to Earth 140 25
SECTION : 11

DIESEL GENERATOR SET

1.1 SCOPE OF SUPPLY

1.1.1 The scope covers supply of Diesel Generator set of stationery type having a net electrical output of 250KVA capacity at specified site conditions of 50 deg.C ambient temperature and 100% relative humidity on FOR site basis. DG set shall be equipped with:

(i) Diesel engine complete with all accessories.
(ii) An alternator directly coupled to the engine through coupling, complete with all accessories.
(iii) Automatic voltage regulator.
(iv) Complete starting arrangement, including two nos. batteries & chargers.
(v) Base frame, foundation bolts etc.
(vi) Day tank of 990 Litre capacity.
(vii) Oil pump for transferring to Day Tank.
(viii) Engine Cooling and lubrication system.
(ix) Engine air filtering system.
(x) Exhaust silencer package.
(xi) Set of GI pipes, valves, strainers, unloading hose pipes as required.
(xii) All lubricants, consumable, touch up paints etc. for first filling, testing & commissioning at site.
(xiii) AMF panel for control, metering and alarm.

1.2. SCOPE OF SERVICE

1.2.1. The Contractor shall provide following services:

a) Design, manufacture, shop testing including assembly test.
b) Despatch, transportation to site.
c) Erection, testing & commissioning with all equipments / materials required for the purpose.
d) Drawings, data, design calculations and printed erection, operation & maintenance manual.

1.3 TECHNICAL REQUIREMENTS

1.3.1. The rating of DG sets are as follows:

1.3.1.1 DG set shall be 250KVA, 1500RPM, 0.8pf, 415V, 3 phase, 50Hz. The above ratings are the minimum requirements.

1.3.1.2 DG sets shall also be rated for 110% of full load for 1 hour/day of continuous running.

1.3.1.3. The output voltage, frequency and limits of variation from open circuit to full load shall be as follows:

- Voltage variation: ±5% of the set value provision shall exist to set adjust the value between 90% to 110% of nominal Generator voltage of 415V.
- Frequency: 50Hz ± 2%

1.3.1.4 The Diesel Generator and other auxiliary motor shall have epoxy thermosetting type insulation but limited to class-B for temperature rise consideration.

1.3.1.5 The Day tank of 990 Litre capacity shall be provided on a suitable fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent, an air breather and necessary piping. The tank shall be painted with oil resistant paint and shall be erected in accordance with Indian explosive act of 1932.

1.3.1.6 Six (6) output terminals shall be provided in alternator box. The neutral shall be formed in AMF panel. The generator terminal box shall be suitable to house necessary cables and should be made of non-magnetic material.

1.3.1.7 For transferring oil to Day tank transfer pumps are envisaged. The capacity of transfer pump shall be adequate to fill the day tank in about 30 minutes.
1.4 SYSTEM DESIGN
1.4.1 The Diesel Generators units shall be installed outdoors with sound proof enclosures as per new environment policy. Exhaust will be let out to outside atmosphere, condensate traps shall be provided on the exhaust pipe.

1.4.2. The fuel used shall be High Speed Diesel Oil (HSD) or Light Diesel Oil (LDO) as per IS:1460

1.4.3. The Diesel Engines shall be directly water cooled. Cooling of water through radiator and fan as envisaged.

1.4.4 The engine shall have closed loop lubricating system. No moving parts shall require lubrication by hand prior to the start of engine or while it is in operation.

1.5. PLANT DESIGN
1.5.1 The equipment shall be safe and proper and without undue vibration or stores for continuous operation at all loads upto rated output at operating and test conditions.

1.5.2. The equipment shall have provision for easy maintenance, overhaul, cleaning and inspection and replacement of parts. All tools for operation and maintenance of equipment shall be supplied.

1.5.3 Diesel engine shall be turbo charged multicylinder V-type in line type with mechanical fuel injection system.

1.5.4 Automatic electric starting by DC starter motor shall be provided. Two nos. battery with automatic battery charger shall be provided. Each battery shall have sufficient capacity to give 10 nos. successive starting impulse to the diesel engine.

1.6. CONTROL AND INSTRUMENTATION
1.6.1. Each D.G. sets shall be provided with suitable instruments, interlock and protection arrangement, suitable annunciation and indications etc. for proper start up, control, monitoring and safe operation of the unit. One local AMF control panel alongwith each D.G. set shall be provided by the Supplier to accommodate these instruments, protective relays, indication lamps etc. The AMF Panel shall have IP-52 degree of Protection as per IS:12063.

1.6.2. The D.G. sets shall be provided with automatic start facility to make it possible to take full load within 30 seconds of Power Supply failure.

1.6.3. Testing facility for automatic operation of D.G. set shall be provided in AMF panel.

1.6.4. A three attempt starting facility using two impulse timers and summation timer for engine shall be proved and if the voltage fails to develop within 40 sec. from receiving the first impulse, the set shall block and alarm to this effect shall be provided in the AMF panel.

1.6.5. Following instruments shall be provided with Diesel Engine.
   a) Lub Oil Pressure gauge (engine panel).
   b) Lub oil temperature thermometers (both on engine and at local panel)
   c) Water temperature thermometers (both on engine and at local panel)
   d) Exhaust gas pyrometer with temp. switch (at local panel)
   e) Engine tachometer / HR (engine panel)
   f) Any other instruments necessary for DG Set operation shall be provided.

1.6.6. DG set shall be capable of being started / stopped manually from remote as well as local. (Remote START/STOP push button shall be provided in 415V ACDB). However, interlock shall be provided to prevent shutting down operation as long as D.G. Circuit breaker is closed.

1.6.7. The diesel generator shall commence a shutdown sequence whenever any of the following conditions appear in the system :
   a) Overspeed
   b) Overload
   c) High temperature of engine, cooling water and lubricating oil.
   d) Low Lub oil Pressure.
   e) Generator differential protection.
   f) Short circuit protection.
   g) Under voltage.
h) Over voltage.
i) Further interlocking of breaker shall be provided to prevent parallel operation of DG set with normal station supply.

1.6.8. A suitable battery charger using semi-conductor rectifier shall be provided for quick and trickle charging the battery. AMF panel shall consist of complete battery charging scheme suitable for 24V DC, 25 A operation. Battery charger shall have input switch, transformer – Rectifier unit, choke, control fuses, necessary filters and suitable characteristic for charging the battery and keeping it in fully charged state. The charger shall be provided with suitable DC voltmeter, Ammeter and output voltage control facility mounted on the control cubicle and shall be suitable for connection to single phase 240V Ac supply with \( \pm 10\% \) voltage variation.

1.6.9. Following indication lamps for purposes mentioned as under shall be provided in AMF panel:

1.6.9.1 Pilot indicating lamp for the following:
a) Mains ON
b) Alternator On
c) Charger ON/OFF
d) Breaker On/OFF
e) Main LT Supply ON/OFF

1.6.9.2 Visual annunciation shall be provided for set shut down due to:
a) engine overheating
b) low oil pressure
c) lack of fuel
d) set failed to start in 30 sec after receiving the first start impulse
e) high cooling water temperature
f) low level in daily service fuel tank
g) Over speed trip
h) Audio & visual Annunciation for alternator fault.

1.6.10 Thermostatically controlled space heaters and cubicle illumination operated by Door Switch shall be provided in AMF panel. Necessary isolating switches and fuses shall also be provided.

1.6.11 AMF panel shall have facility for adjustment of speed and voltage including fine adjustments in remote as well as in local mode.

Following shall also be provided in AMF panel:
a) Frequency meter
b) 3 nos. single phase ct’s for metering
c) 3 nos. (provided by LT swgr manufacturer) single phase CT’s with KPV 300V & RCT 0.25 ohm for differential protection of DG Set on neutral side.
d) One (1) DC Ammeter (0-40A)
e) One (1) DC Voltmeter (0-30V)
f) One (1) Voltmeter Selector switch
g) One (1) AC Ammeter
h) One (1) AC Voltmeter
i) Three (3) Timers (24V DC)
j) Two (2) Auto/Manual Selector Switch
k) Two (2) Auto/test/Manual/ Selector Switch
l) Eleven (11) Aux. Contactors suitable for 24 V DC
m) One (1) motorized potentiometer for voltage adjustment
n) Two (2) set Battery charger as specified in technical specification.
o) One (1) set phase & neutral busbars.
p) Any other item required for completion of control scheme shall be deemed to be included.

1.7 TESTS

1.7.1 The Diesel generator sets shall be tested for routine and acceptance test as per the relevant IS/IEC standards.

1.7.2 Type Test
Type test reports as per relevant standard shall be submitted for purchaser’s approval.
1.7.3 **Commissioning Checks**

In addition to the checks and test recommended by the manufacturer, the Contractor shall carry out the following commissioning tests to be carried out at site.

1.7.3.1 **Load Test**

The engine shall be given test run for a period of at least 6 hours. The set shall be subjected to the maximum achievable load as decided by Purchaser without exceeding the specified DG Set rating:

During the load test, half hourly records of the following shall be taken:

- Ambient temperature
- Exhaust temperature if exhaust thermometer is fitted.
- Cooling water temperature at a convenient point adjacent to the water output from the engine jacket.
- Lubricating oil temperature where oil cooler fitted.
- Lubricating oil pressure.
- Colour of exhaust gas.
- Speed
- Voltage, wattage and current output.
- Oil tank level

The necessary load to carry out the test shall be provided by the purchaser.

1.7.3.2 **Insulation Resistance Test for Alternator**

Insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with a 500V megger shall not be less than $IR = 2 \times (\text{rated voltage in KV}) + 1$

1.7.3.3 **Check of Fuel Consumption**

A check of the fuel consumption shall be made during the load run test. This test shall be conducted for the purpose of proper tuning of the engine.

1.7.3.4 **Insulation Resistance of Wiring**

Insulation resistance of control panel wiring shall be checked by 500V Megger. The IR shall not be less than one mega ohm.

1.7.3.5 **Functional Tests**

- Functional tests on control panel.
- Functional test on starting provision on the engine.
- Functional tests on all Field devices.
- Functional tests on AVR and speed governor.

1.7.3.6 **Measurement of Vibration**

The vibration shall be measured at load as close to maximum achievable load and shall not exceed 250 microns.

1.7.3.7 **Noise Level (sound pressure level) check.**

(i) Noise level measurement shall be done generally following the guidelines given in IS:12065. The measurement shall be carried out with a calibrated interacting sound level meter as per IS:9779.

(ii) Sound level shall be measured all round the Diesel Generator set at a distance of 1m. from the nearest surface of the machine and at a height of 1.5m from the floor level as illustrated in IS:12065 for electrical machines.

(iii) A minimum of 8 pts. (5 around diesel engine and 3 around alternator) shall be covered for measurement. Additional measurement points shall be considered in case the criteria indicated in C1.3.3.3 of IS:12065 is not met.

(iv) The measurement shall be done with slow response meter on the A-weighting scale. The average of the A-weighted sound level measurement expressed in decibels to a reference of 0.0002 microbar.

(v) The tests shall be carried out with the DG set operating at rated speed and at maximum achievable load. Necessary correction for Test environment condition & background noise will be applied as per IS:12065.
SECTION : 12
SWITCHYARD ERECTION

1.0. GENERAL
The detailed scope of work includes design, engineering, manufacture, testing at works, supply on FOR destination site basis, insurance, handling, storage, erection testing and commissioning of various items and works as detailed herein.

This section covers the description of the following item

A. Supply of
- String insulators and hardware
- ACSR conductor
- Galvanized Steel Earth wire
- Aluminum Tubular Bus Bars
- Spacers
- Bus post insulators
- Earthing & Earthing materials
- Lightning protection materials
- Cabling material
- Other items

B. Erection of all items

1.1. String Insulator & hardware
The insulators for suspension and tension string shall conform to IEC60383 and long rod insulators shall conform to IEC 60433. Insulator hardware shall conform to IS: 2486.

1.1.1. Construction Features
1.1.1.1 Suspension and tension insulators shall be wet process porcelain with ball and socket connection. Insulators shall be interchangeable and shall be Suitable for forming either suspension or tension strings. Each insulator shall have rated strength markings on porcelain printed and applied before firing.

1.1.1.2 Porcelain used in insulator manufacture shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

1.1.1.3 Glazing of the porcelain shall be uniform brown colour, free from blisters, burrs and other similar defects.

1.1.1.4 When operating at normal rated voltage there shall be no electric discharge between conductor and insulator which would cause corrosion or injury to conductors or insulators by the formation of substances due to chemical action. No radio interference shall be caused when operating at normal rated voltage.

1.1.1.5 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. All ferrous part shall be hot dip galvanized in accordance with the latest edition of IS: 2629. The zinc used for galvanizing shall be of grade Zn-99.95 as per IS-209. 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.

1.1.1.6 Bidder shall make available data on all the essential features of design including the method of assembly of discs and metal parts, number of discs per insulator string insulators, the manner in which mechanical stresses are transmitted through discs to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

1.1.1.7 Clamps for insulator strings and Corona Control rings shall be of aluminum alloy as stipulated for clamps and connectors.

1.1.1.8 Insulator hardware shall be of forged steel. Malleable cast iron shall not be accepted except for insulator disc cap. The surface of hardware must be clean, smooth, without cuts, abrasion or projections. No part shall be subjected to excessive localized pressure. The metal parts shall not produce any noise generating corona under operating conditions.

1.1.1.9 The tension Insulator hardware assembly shall be designed for 11500 kg tensile load. Earth
wire tension clamp shall be designed for 1000 kg tensile load with a factor of safety of two (2).

1.1.1.10 The tension string assemblies shall be supplied along with suitable turn Buckle. Sag compensation springs if required may also be provided.

1.1.1.11 All hardware shall be bolted type.

1.2. **Long Rod Insulators**

1.2.1 As an alternative to disc insulator, Bidder can offer long rod insulators strings, with suitable hardware. The combination should be suitable for application specified and should offer the identical / equivalent parameters as would be available from insulator string comprising disc insulators and hardware combination.

1.2.2. All constructional features specified at Clause 1.1.1 of this Section shall also apply to the long rod insulator string.

1.3. **Tests**

In accordance with the stipulations of the specification, the suspension and tension strings, insulator and hardware shall be subjected to the type tests, acceptance tests and routine tests as per relevant standards.

1.4. **Parameters**

1.4.1. **Disc Insulators**

<table>
<thead>
<tr>
<th>Description</th>
<th>220KV</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Type of Insulators</td>
<td>Anti Fog type</td>
</tr>
<tr>
<td>b) Size of insulator units (mm)</td>
<td>255x145</td>
</tr>
<tr>
<td>c) Electro mechanical strength</td>
<td>120 KN</td>
</tr>
<tr>
<td>d) Creepage distance of individual insulator units (min. and as required to meet total Creepage distance)</td>
<td>430 mm</td>
</tr>
<tr>
<td>e) Markings</td>
<td>Marking on porcelain shall be printed and applied before firing 1.3 times the actual wet flashover voltage.</td>
</tr>
</tbody>
</table>

* Long rod insulators may be used in place of disc insulators subject to confirmation to equivalent electrical and mechanical parameter.

1.4.2 **INSULATOR STRING**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description</th>
<th>220 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Power frequency withstand voltage of the complete string with corona control ring (wet)</td>
<td>460</td>
</tr>
<tr>
<td>B</td>
<td>Lightning impulse withstand voltage of string with corona control ring (dry) – kVp</td>
<td>1050</td>
</tr>
<tr>
<td>C</td>
<td>Switching surge withstand voltage of string with corona control rings (wet) kVp.</td>
<td>NA</td>
</tr>
<tr>
<td>D</td>
<td>Min. corona extinction voltage level of string with corona control rings (dry)- kVrms.</td>
<td>156</td>
</tr>
<tr>
<td>E</td>
<td>RIV level in micro volts of string with corona control rings at 156 KV (rms) for 220 KV string across 300 Oh resistor at 1 MHz</td>
<td>1000 (Max.)</td>
</tr>
<tr>
<td>F</td>
<td>Total creepage distance of the insulator string (mm)</td>
<td>6125</td>
</tr>
<tr>
<td>G</td>
<td>Total no. discs per strings</td>
<td>15</td>
</tr>
</tbody>
</table>

For tension application, double insulator strings and for suspension purpose single suspension insulator string shall be used for 220 KV system.
2.0 ACSR ZEBRA CONDUCTOR

2.1 Details of conductor

2.1.1 The Conductor shall confirm to IS 398: 1982 except where otherwise specified herein.

2.1.2 The details of the conductor are tabulated below:
   a) Stranding and wire diameter  54/3.18 mm Al +7/3.18 mm steel
   b) No. of strands
      Steel  7
      Aluminium Layer  54
   c) Sectional area of Al.  418.6 mm²
   d) Total sectional area  483.1 mm²
   e) Overall diameter  28.62mm
   f) Approx. wt.  1621kg/km.
   g) Calculated d.c. resistance at 20°C  0.0680 Ohm/km
   h) Approximate calculated breaking load  13316 Kg.

Workmanship

2.2.1 The finished conductor shall be smooth, compact, uniform and free from all imperfections including spills and splits, die marks, scratches, abrasions, scuff marks, kinks (protrusion of wires), dents, press marks, cut marks, wire cross over riding, looseness (wire being dislocated by finger/hand pressure and/or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black spots (on account of reaction with trapped rain water etc.) dirt, grit etc.

2.2.2 All the Al. and steel strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die marks, scratches, abrasion and kinks after drawing and also after stranding.

2.2.3 The steel strands shall be hot dip galvanized and shall have a minimum zinc coating of 230 gm/sq.m. of the uncoated wire surface. The zinc coating shall be smooth, continuous and of uniform thickness, free from imperfections and shall withstand minimum three dips after stranding Preece tests. The finished strands and the individual wires shall be of uniform quality and have the same properties and characteristics as prescribed in ASTM designation B 498-74.

2.2.4 The steel strands shall be performed and postformed in order to prevent spreading of strands in the event of cutting composite core wire. Care shall be taken to avoid damage to galvanization during performing and post forming operation.

2.3 Joints in Wires

2.3.1 Aluminium Wires
   No joints shall be permitted in the individual wires in the outermost layer of the finished conductor. However, joints in the inner layers of the conductor shall be allowed but these joints shall be made by cold pressure butt welding.
   There shall be no joint of any kind in the finished wire entering into the manufacture of the strand. There shall also be no strand splices in any length of the completed steel core of the conductor.
2.4 Tolerances
The manufacturing tolerance to the extent of the following limits only shall be permitted in the diameter of individual Al. and steel strands and lay ratio of the conductor.

2.5 Materials

2.5.1 Aluminium
The Al. strands shall be drawn from electrolytic aluminium rods having purity not less than 99.5% and a copper content not exceeding 0.04%.

2.5.2 Steel
The steel wire strands shall be drawn high carbon steel wire rods and shall confirm to the following chemical composition.

<table>
<thead>
<tr>
<th>Element</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>0.50 to 0.85</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.50 to 1.10</td>
</tr>
<tr>
<td>Phosphorous</td>
<td>Not more than 0.035</td>
</tr>
<tr>
<td>Sulphur</td>
<td>Not more than 0.045</td>
</tr>
<tr>
<td>Silicon</td>
<td>0.10 to 0.35</td>
</tr>
</tbody>
</table>

2.5.3 Zinc
The zinc used for galvanizing shall be electrolytic High Grade Zinc of 99.95% purity. It shall confirm to and satisfy all the requirements of IS 209-1979.

2.6 Standard Length
2.6.1 The conductor shall be supplied in standard length of 2150 meters. Bidder shall indicate the standard length of the conductor to be offered by them. A tolerance of 10 m on the standard length offered by the Bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths. No joint shall be allowed within a single span of stringing.

2.6.2 Random lengths will be accepted provided no length is less than 70% of the standard length and the total quantity of random shall be more than 5% of the total quantity. In addition, for every bobbin of random length, three (3) others shall be fabricated with a tolerance 10 m and all the above four drums shall be clearly identified and shipped together to the same site so that they can be installed in the same / trench.

2.7 Tests
2.7.1 The following type, acceptance and routine tests and tests during manufacturing shall be carried out on the conductor.

2.7.2 Type Test
In accordance with the stipulation of specification, the following type test reports of the conductor shall be submitted for approval as per clause 9.2 of section GTR.

   a. UTS test on stranded conductor
   b. Corona extinction Voltage Test (dry & Wet)
   c. Radio Interference voltage test (dry & wet)
d. DC resistance test pm stranded conductor

e. Stress strain test

2.7.3 Acceptance Tests

a. Visual check for joints scratches etc. and lengths of conductor
b. Dimensional check on steel and Al. strands.
c. Check for lay ratios of various layers
d. Galvanising test on steel strands
e. Torsion and Elongation test on steel strands
f. Breaking load test on steel and Al. strands
g. Wrap test on steel and Al. strands
h. DC resistance test on Al. strands
i. Visual and dimensional check on drum

Note: All the above tests except test mentioned at (a) shall be carried out on aluminium and steel strands after stranding only.

2.7.4 ROUTINE TEST

a) Check to ensure that the joints are as per specification
b) Check that there are no cuts, fins etc. on the strands
c) Check that drums are as per specification
d) All acceptance test as mentioned in Clause 2.7.3 above to be carried out on each coil.

2.7.5 TEST DURING MANUFACTURE

a. Chemical analysis of Zinc used for Galvanizing
b. Chemical analysis of Al. used for making Al. strands
c. Chemical analysis of steel used for making steel strands

2.7.6 Sample Batch for type Testing

The contractor shall offer material for selection of samples for type testing only after getting quality assurance plans approved from owner’s Quality Assurance Deptt. The sample shall be manufactured strictly in accordance with the Quality Assurance Plan approved by Owner.

2.4 GALVANISED STEEL EARTHWIRE

3.1. Details of Earth wire

3.1.1 The galvanised steel earth wire shall generally conform to the specification of ACSR core wire as mentioned in IS: 398 (Part-II)-1976 except where otherwise specified herein.

3.1.2 The details of the earth wire are tabulated below

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stranding and wire diameter</td>
<td>7/3.66 mm steel</td>
</tr>
<tr>
<td>Number of strands</td>
<td>1</td>
</tr>
<tr>
<td>Steel core</td>
<td></td>
</tr>
<tr>
<td>Outer Steel Layer</td>
<td>6</td>
</tr>
<tr>
<td>Total sectional area</td>
<td>73.65 mm²</td>
</tr>
<tr>
<td>Overall diameter</td>
<td>10.98 mm</td>
</tr>
<tr>
<td>Approximate weight</td>
<td>583 kg/km</td>
</tr>
<tr>
<td>Calculated d.c. resistance-</td>
<td>2.5 ohms/km</td>
</tr>
<tr>
<td>tance at 20°C</td>
<td></td>
</tr>
<tr>
<td>Minimum ultimate tensile</td>
<td>68.4 kN</td>
</tr>
<tr>
<td>strength</td>
<td></td>
</tr>
<tr>
<td>Direction of lay of outer</td>
<td>Right hand</td>
</tr>
<tr>
<td>layer</td>
<td></td>
</tr>
</tbody>
</table>
3.2. TESTS
3.2.1 The following type, routine & acceptance tests and tests during manufacturing shall be carried out on the earth wire.

4.0 TUBULAR BUS CONDUCTORS

4.1 General
Aluminium used shall be grade 63401 WP (range 2) conforming to IS: 5082.

4.2 Constructional Features
4.2.1 For out side diameter (OD) & thickness of the tube there shall be no minus tolerance, other requirements being as per IS: 2678 and IS: 2673
4.2.2 The aluminum tube shall be supplied in suitable cut length to minimize wastage.
4.2.3 The welding of aluminum tube shall be done by the qualified welders duly approved by the owner.

4.3 Tests
In accordance with standards of the specification, Routine tests shall be conducted on tubular bus conductors as per IS: 5082. Also the wall thickness and ovality of the tube shall be measured by the ultrasonic method. In addition to the above tests, 0.2% proof tests on both parent metal and Aluminium tube after welding shall be conducted.

4.4 Parameters
a) Size 4"IPS (EH Type)
b) Outer diameter (mm) 114.2
c) Thickness (mm) 8.51
d) Cross-sectional area (sq.mm) 2825.61
e) Weight (kg/m) 7.7

5.0 BUS POST INSULATORS

The post insulators shall conform in general to latest IS : 2544, IEC-168 and IEC-815.

5.1 Tests
In accordance with the stipulations of the specification, the post insulators shall be subject to type, acceptance, sample and routine tests as per IS : 2544 and IEC-168.

5.2. Technical Parameters of Bus Post Insulators.

<table>
<thead>
<tr>
<th>a) Type</th>
<th>Solid Core</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) Voltage class (kV)</td>
<td>245</td>
</tr>
<tr>
<td>c) Dry and wet one minute power frequency withstand voltage (kV rms)</td>
<td>460</td>
</tr>
<tr>
<td>d) Dry lightning impulse Withstand Voltage (kVp)</td>
<td>±1050</td>
</tr>
<tr>
<td>e) Max. radio interference voltage (in micro volts) at voltage of 156kV (rms) for 220 kV between phase to ground</td>
<td>500</td>
</tr>
<tr>
<td>f) Corona extinction voltage (kV rms)</td>
<td>156 (Min.)</td>
</tr>
<tr>
<td>g) Total minimum cantilever Strength (Kg)</td>
<td>800</td>
</tr>
<tr>
<td>h) Minimum torsional moment</td>
<td>----- As per IEC-273--------</td>
</tr>
<tr>
<td>i) Total height of insulator (mm)</td>
<td>2300</td>
</tr>
<tr>
<td>(Minimum) Necessary sub-Structure/stool required to match bus height using standard structure shall be provided by the Contractor.</td>
<td></td>
</tr>
<tr>
<td>j) P.C.D</td>
<td></td>
</tr>
<tr>
<td>Top (mm)</td>
<td>127</td>
</tr>
<tr>
<td>Bottom (mm)</td>
<td>254</td>
</tr>
<tr>
<td>k) No. of bolts</td>
<td></td>
</tr>
<tr>
<td>Top</td>
<td>4</td>
</tr>
<tr>
<td>Bottom</td>
<td>8</td>
</tr>
</tbody>
</table>
I) Diameter of bolt/holes (mm)
   Top: M16
   Bottom: 18
m) Pollution level as per IEC-815: Heavy(III)
n) Minimum total creepage: 6125

5.2.1. If corona extinction voltage is to be achieved with the help of corona ring or any other similar device, the same shall be deemed to be included in the scope of the Contractor.

6.0 EARTHING
6.1 The earthing shall be done in accordance with requirements given hereunder and drawing titled ‘Earthing Details’ enclosed with the specification. The earthing design shall be done by the Contractor as per IEEE-80. The soil resistivity measurement shall also be done by the Contractor. The resistivity measurement of stone (to be used for stone spreading) shall also be done by the Contractor to confirm the resistivity value of stone considered in earthing design. For measurement purpose, one sample of stones from each source (in case stones are supplied from more than one source) shall be used. The main earthing mat shall be laid in the switchyard area in accordance with the approved design requirements.

6.2 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.

6.3 Earthing and lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.
   a) Code of practice for Earthing IS: 3043
   c) Indian Electricity Rules 1956 with latest amendments.
   d) National Electricity Safety code IEEE-80.

6.4 Details of Earthing System

<table>
<thead>
<tr>
<th>Item</th>
<th>Size</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Main Earthing Conductor to be buried in ground</td>
<td>40mm dia</td>
<td>Mild Steel rod</td>
</tr>
<tr>
<td>b) Conductor above ground &amp; earthing leads equipment</td>
<td>75x12mm</td>
<td>G.S. flat Galvanised Steel</td>
</tr>
<tr>
<td>c) Conductor above ground &amp; earth leads (for columns &amp; aux. structures)</td>
<td>75x12mm</td>
<td>G.S. flat Galvanised Steel</td>
</tr>
<tr>
<td>d) Earthing of indoor LT Panels, Control panels and out door marshalling boxes, MOM boxes, Junction boxes &amp; Lighting Panels etc</td>
<td>50x6 mm</td>
<td>G.S. flat Galvanised Steel</td>
</tr>
<tr>
<td>e) Rod Earth Electrode</td>
<td>40mm dia, 3000mm long</td>
<td>Galvanised Steel</td>
</tr>
<tr>
<td>f) Pipe Earth Electrode (in treated earth pit) as per IS</td>
<td>40mm dia, 3000mm long</td>
<td>Mild Steel</td>
</tr>
<tr>
<td>g) Earthing for motors</td>
<td>25X3 mm G.S flat</td>
<td>Galvanised Steel</td>
</tr>
<tr>
<td>h) Earthing conductor along outdoor cable trenches</td>
<td>50x66mm MS flat</td>
<td>Mild steel</td>
</tr>
<tr>
<td>i) Earthing of Lighting Poles</td>
<td>20 mm dia 3000 mm long</td>
<td>Mild steel rod</td>
</tr>
</tbody>
</table>

The sizes of the earthing conductor indicated above are the minimum sizes.

6.5 Earthing Conductor Layout
6.5.1. Earthing conductors in outdoor areas shall be buried at least 600 mm below finished ground level unless stated otherwise.
6.5.2. Wherever earthing conductor crosses cable trenches, underground service ducts, pipes, tunnels,
railway tracks etc., it shall be laid minimum 300 mm below them and shall be circumvented in case it fouls with equipment/structure foundations.

6.5.3 Tap-connections from the earthing grid to the equipment/structure to be earthed shall be terminated on the earthing terminals of the equipment/structure as per “Earthing Details”. (Drawing enclosed).

Earthing conductors or leads along their run on cable trench, ladder, walls etc. shall be supported by suitable welding/cleating at intervals of 750 mm. Wherever it passes through walls, floors etc., galvanised iron sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.

6.5.4. Earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500 mm away from such location.

6.5.5. Earthing conductors crossing the road shall be laid 300 mm below road or at greater depth to suit the site conditions.

6.5.6. Earthing conductor's embedded in the concrete shall have approximately 50 mm concrete cover.

6.6. 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.

6.7. Specific Requirement for Earthing Systems

6.7.1. Each earthing lead from the neutral of the power transformer shall be directly connected to two pipe electrodes in treated earth pit (as per IS) which in turn, shall be buried in Cement Concrete pit with a cast iron cover hinged to a cast iron frame to have an access to the joints. All accessories associated with transformer like cooling banks, radiators etc. shall be connected to the earthing grid at minimum two points.

6.7.2. Earthing terminal of each lightning arrester & capacitor voltage transformer shall be directly connected to rod earth electrode which in turn, shall be connected to station earthing grid.

6.7.3. Auxiliary earthing mat comprising of 40mm dia M.S. rods closely spaced (300 mm x 300 mm) conductors shall be provided at depth of 300mm from ground level below the operating handles of the M.O.M. Box of the isolators. M.O.M. boxes shall be directly connected to the auxiliary earthing mat.

7.0 Main Bus Bars

The brief description of the bus switching scheme, bus bar layout and equipment connection to be adopted are indicated elsewhere in the specification. The bus bar arrangements are shown in drgs enclosed with the bid documents.

7.1. The Contractor shall furnish supporting calculations for the bus bars/conductors to show adequacy of design parameters for:

- Fibre-stress
- Cantilever strength of post insulators
- Aeolian vibrations)
- Short circuit forces in bundle conductor and spacer location for each span of ACSR conductor stringing as per layout drawings.

m) Vertical deflection of bus bars

7.1.1. The welds in the aluminium tubes shall be kept to the minimum and there shall not be more than one weld per span. The procedure and details of welding shall be subject to Owner’s approval. Material for welding sleeve shall be same as that of Aluminium tube. Welding sleeve shall be of 600mm length.

7.1.2. Corona bells shall be provided wherever the bus extends beyond the clamps and on free ends, for sealing the ends of the tubular conductor against rain and moisture and to reduce the electrostatic discharge loss at the end points. There shall be a small drain hole in the corona bell. The material of Corona bell shall be Aluminium alloy similar to that of clamps & connectors.

7.1.3. To minimise the vibrations in the aluminium tubes, damping conductor shall be provided inside the aluminium tubes. For this purpose, the cut pieces of ACSR conductor which otherwise are considered wastages, shall be used as damping conductor.

7.1.4. Details of past experience of the persons proposed to be employed for Aluminium tube welding and the test reports of the welded pieces to prove the electrical and mechanical characteristics shall also
be furnished along with the bid. Welding at site shall be done by adopting a qualified procedure and employing qualified welders as per ASME-Section IX

8.0 CABLELING MATERIAL

8.1 CABLE TAGS AND MARKERS

8.1.1 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

8.1.2 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.

8.1.3 Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanised iron plate.

8.1.4 Location of underground cable joints shall be indicated with cable marker with an additional inscription “Cable joints”.

8.1.5 The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.

8.1.6 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry and at each end & turning point in cable tray/trench runs. Cable tags shall be provided inside the switchgear, motor control centres, control and relay panels etc., wherever required for cable identification, where a number of cables enter together through a gland plate.

8.2 Cable sealing system

Modular multi-diameter cable sealing system consisting of frames, blocks and accessories shall be installed where the underground and over ground cables enter or leave concrete bay kiosks/switchyard panel room & control rooms in the substations. Cable sealing system shall consist of multi-diameter type peel-able blocks of different sizes to suit the various cables. It should be simple, easy and quick to assemble & re-assemble the cable sealing system. Solid blocks shall not be used on frames. Frames & stay plate material shall be of galvanized steel and for compression, single piece wedge with galvanized steel bolts shall be used. 30% spare blocks on the frame shall be provided for expansion in future. Cable sealing system should have been tested for fire/water/smoke tightness.
MODEL TECHNICAL SPECIFICATION FOR CIVIL WORKS OF SUB-STATIONS

1.0 GENERAL TECHNICAL REQUIREMENTS

1.1 SCOPE OF WORK

1.1.1 The scope is to cover design, preparation of general arrangement drawings and working drawings, supply of materials and construction of all civil, structural and architectural works.

1.1.2 Description of the various sections of work under this specification and detailed scope are given herein after. The whole work under this scope is referred to as civil works.

1.1.3 The work to be performed under this specification consists of providing all labour, materials, plants, equipment, temporary works, constructional plant, fuel supplies, transportation and all incidental items not shown or specified but reasonably implied, or necessary for the proper completion of the work, all in strict accordance with the specifications and including revisions and amendments there to as may be required during the execution of the work.

1.1.4 The work under this specification shall consist of but not be limited to items mentioned below:

(1) GIS room cum Control Room Building, including internal electrification based on the drawings approved by the owner. The building shall be suitable for taking load of additional floor to be constructed in future.

(2) Outdoor DG Set based on the drawings approved by the owner.

(3) Pump House for pumping out the storm water of the yard and water from oil pit of transformers including supplying & installations of pumps/motors of 4.0 KW capacity & electrical fittings of ISI mark or as approved by engineer in charge for operation of the pump house.

(4) RCC frame Boundary wall with brick paneling including gates and Switchyard fencing in accordance with the approved drawing by the owner.

(5) The civil works shall include civil foundations including pile foundations, if required, for transformer, towers, lighting cum lightning mast, equipment support structures, boundary wall, road cum rail arrangement including jack pad etc. as per the requirement for establishment of the sub-station.

(6) Supply and erection of gantry structures, lighting cum, lightning masts and supporting structure for all the equipments as per material and drawings approved by owner.

(7) Construction of cable trenches including removable precast RCC covers with lifting arrangement, cable trench road crossings, necessary sumps, cable trays and proper earthing as per approved drawings/specifications shall be inclusive in the scope of work. Cable trenches for 220KV, 66kV & 33KV outgoing feeders from GIS building up to the boundary wall of the substation, as per approved drawing shall be in the scope of the Bidder.

(8) Soil sterilization and Development of yard

(9) Cement concrete roads and culverts within sub station boundary wall.

(10) Laying of sewers, storm water drains, water supply lines etc. including making connection with the municipal services after obtaining approval from Municipal Authorities by the contractor.

(11) Any other work required for functional requirement of establishment of the sub-station.
(12) Soil investigation.

(13) Making arrangement for construction water, drinking water and toilet facilities with the establishment of site office.

(14) Construction of septic tank & soak-pit etc. if municipal sewer line does not exist.

(15) Construction of soak pit with sump pit within soak pit and sump well along with pipe drain for collecting oil/ rain water from soak pits of transformers.

(16) Fire protection wall between transformers if required in accordance with Tariff advisory committee (TAC) recommendations.

(17) All buildings shall be built as Green Building in line with green building concept of Energy Conservation cell.

(18) Site surfacing (Gravelling) and anti weed treatment.

(19) Storm water drainage and rain water harvesting.

1.1.5 The scope shall also include carrying out all relevant tests required for the civil works for the project.

1.1.6 The works shall be carried out according to the design, Structural & Architectural drawings to be developed by the Contractor and approved by the owner. For all building, structures, foundations etc. necessary layout and details are to be developed by the Contractor keeping in view the functional requirement parameters/drawing. Certain minimum requirements are indicated in this specification for guidance and the bid shall cover complete requirement.

1.1.7 Fairly levelled land shall be handed over to the Contractor by the owner. Finished ground level shall be the finished formation level furnished by the owner. The sub station boundary wall and work of filling earth to raise the ground level up to the finished formation level of substation is included in the scope of Contractor. The contractor shall construct the boundary wall as per drawing approved in consultation with Owner. The layout and levels of all structures etc. shall be made by the contractor at his own cost from the general grid of the plot and bench marks given by the owner. The contractor shall give all help including instruments, materials and personnel to the owner for checking the detailed layout and correctness of the layout and levels. All the quality standards, fabrication and erection check lists, welding standards and other technical requirements shall be strictly adhered to by the Contractor.

1.1.8 The work in general, shall be executed as per detailed specifications for the civil works. However, in case specifications for a particular item are not specified, the same shall be governed as per the latest Indian Standard specifications/CPWD specifications as per directions of the owner, whose decision shall be final and binding.

1.1.9 220/66/33 KV GIS cum CONTROL ROOM BUILDING

a) The buildings shall house 220KV, 66kV and 33KV Gas Insulated Switchgear (GIS) separately and other associated equipments inside in the GIS building.

b) The bidder shall submit the design & construction proposal of the building along with necessary information, data and drawings in the techno-commercial bid according to the complete requirements.

c) Tentative dimensions of GIS cum CONTROL ROOM building is 60mX15m for 220KV and tentative dimensions of GIS hall are 20mX10m for 66kV and 20mX10m for 33KV. However, the bidder shall finalize the dimensions for 220KV, 66kV and 33KV GIS building according to the equipment offered by them providing enough space & access for erection & maintenance.
2.0 GEOTECHNICAL INVESTIGATION

2.1 GENERAL

The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate, general as well as specific information about the soil profile and the necessary soil parameters of the Site in order that the foundation of the various structures can be designed and constructed safely and rationally.

A report to the effect will be submitted by the Contractor for Purchaser’s specific approval giving details regarding data proposed to be utilised for civil structures design.

The Contractor may visit the site to ascertain the soil parameters. Any variation in soil data shall not constitute a valid reason for any additional cost & shall not affect the terms & conditions of the contract. The test must be conducted under all the critical locations i.e. Control Room Building, Lighting cum lightning mast, Tower locations, Transformers etc.

2.2 SCOPE OF WORK

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 Purchaser.

All the work shall be carried out as per latest edition of the corresponding Indian Standard Codes.

2.2.1 Bore Holes

Bore holes of 150 mm diameter in accordance with the provisions of IS: 1892 at the rate of minimum one number bore hole per hectare up to 10 meter depth or to refusal which ever occur earlier shall be drilled. In any case number of boreholes shall not be less than five. Tests shall be carried out in area wherever switchyard, building, road and other allied work has to be executed. By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration. Number of boreholes may be increased in case soil strata is varying from borehole to borehole in order to have fair idea of soil profile. In case of deep pile foundations soil investigation is to be carried out up to 25 m depth from ground level or refusal whichever is earlier. In case rock is encountered, coring in all the boreholes shall be carried out up to 3 meter in rock.

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 bore holes 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, if encountered, shall be recorded in each borehole. In case the soil investigation is carried out in winter/summer, the water table for rainy season shall be collected from reliable sources and recorded in the report.

All samples, both disturbed and undisturbed, shall be identified properly with the borehole number and depth from which they have been taken.

The sample shall be sealed at both ends of the sampling tubes with wax immediately after the sampling and shall be packed properly and transported to the Contractor’s laboratory without any damage or loss.
The logging of the boreholes shall be compiled immediately after the boring is completed and a copy of the bore log shall be handed over to the Engineer-in-charge.

2.2.1.1 Dynamic core penetration test
Dynamic core penetration test of two number shall be carried out with the circulation of bentonite slurry at specified locations and continuous record of penetration resistance (NG) upto 15m from natural ground level or the refusal shall be maintained by the contractor. IS: 4968(Part-2) shall be followed for carrying out the test and reporting results.

The location of test shall be approved by the Engineer-in-charge. On completion of the test, the results shall be presented as a continuous record as the number of blows required for every 300mm penetration of the cone into the soil.

2.2.2 Trial Pits
Trial pits shall be carried at specified one location per Hectare as directed by the Purchaser. The trial pits shall be 2 m x 2 m in size extending to 4 m depths, or as specified by the Owner. Undisturbed samples shall be taken from the trial pits as per the direction of the Purchaser.

2.2.3 Electrical Resistivity Test
This test shall be conducted to determine the Electrical resistivity of soil required for designing safety-grounding system for the entire station area. The specifications for the equipments 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 0.2 m up to a distance of 50.0 m.

2.2.4 Plate load test
Plate load test shall be conducted to determine the bearing capacity, modulus of sub grade reaction and load/settlement characteristics of soil at shallow depths by loading a plane and level steel plate kept at the desired depth and measuring the settlement under different loads, until a desired settlement takes place or failure occurs. The specification for the equipment and accessories required for conducting the test, the test procedure, field observations and reporting of results shall conform to IS: 1888. Modulus of sub grade reaction shall be conducted as per IS: 9214. The location and depth of the test shall be as given below:

(a) One at Control Room Building location at the proposed foundation depth below finished ground level for bearing capacity.

Undisturbed tube samples shall be collected at 1.0 m and 2.5m depths from natural ground level for carrying out laboratory tests.

The size of the pit in plate load test shall not be less than five times the plate size and shall be taken up to the specified depth. All provisions regarding excavation and visual examination of pit shall apply here.

Unless otherwise specified the reaction method of loading shall be adopted. Settlement shall be recorded from dial gauges placed at four diametrically opposite ends of the test plate.

The load shall be increased in stages. Under each loading stage, record of Time vs Settlement shall be kept as specified in IS: 1888.

Backfilling of the pit shall be carried out as per the directions of the Owner. Unless otherwise specified the excavated soil shall be used for this purpose. In cases of gravel-boulder or rocky strata, respective relevant codes shall be followed for tests.
2.2.5 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 air-tight containers.

2.2.6 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.

2.2.7 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 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-Ø 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 drained test with pore pressure measurement.
(h) Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, Ph value, and organic matter and any other chemical harmful to the concrete foundation.
(i) In case of rock samples following tests shall also be conducted:
   i. Rock quality designation (RQD), RMR.
   ii. UCC test.
   iii. Point load index test.

2.2.8 Test Results and Reports

2.2.8.1 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 contractor shall submit draft report and after the draft report is approved, the final report in four (4) copies shall be submitted. The test data shall bear the signatures of the Investigation Agency, Vendor and also site representative of DTL.

2.2.8.2 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, trial pits. Plate load test etc.
(b) Bore Logs: Bore logs of each bore holes clearly identifying the stratification and the type of soil stratum with depth. The values of Standard Penetration Test (SPT) at the depths where the tests were conducted on the samples collected at various depths shall be clearly shown against that particular stratum.

Test results of field and laboratory tests shall be summarized strata wise as well in combined tabular form. All relevant graphs, charts, tables, diagrams and photographs, if any, shall be submitted along with report. Sample illustrative reference calculations for settlement, bearing capacity, pile capacity shall be enclosed.

2.2.8.3 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.

(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.

(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 retention 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, equipments 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.

(h) In case of foundation in rocky strata, type of foundation and recommendation regarding rock anchoring etc. should also be given.

3 SITE PREPARATION

The owner shall make fairly leveled land available to the contractor. The contractor at his own cost shall make the layout and levels of all structures etc. from the general grid of the plot and bench set by the contractor and approved by the owner. The Contractor shall give all help including instruments, materials and personnel to the Purchaser for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels.

3.1 SCOPE

This clause covers the design and execution of the work for site preparation, such as, clearing of site, excavation and compaction of backfill for foundation, road construction, drainage, trenches and final topping by stone (broken hard stone).
3.2 GENERAL

1) The Contractor shall develop the site area to meet the requirement of the intended purpose.

2) If fill material is required, the fill material shall be suitable for the above requirement. The fill shall be such a 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-situ 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 owner.

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 engineer in charge upto authorized MCD dumping yard.

3.3 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 15 cm in thickness. (Of loose material before compaction). Each layer shall be compacted as required by means of mechanical tampers approved by the Engineer in charge. 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.

3.4 COMPACTION

1. The density to which fill materials shall be compacted shall be as per relevant IS and as per direction of engineer in charge. 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.
3.5 REQUIREMENT FOR FILL MATERIAL UNDER FOUNDATION

The thickness of fill material under the foundations shall be such that the maximum pressure from the footing, transferred through the fill material and distributed onto the original undisturbed soil will not exceed the allowable soil bearing pressure of the original undisturbed soil. For expansive soils the fill materials and other protections etc. to be used under the foundation is to be got approved by the owner.

4.0 ANTIWEED TREATMENT & STONE SPREADING

4.1 SCOPE OF WORK

The Contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification and direction of the owner.

Stone spreading along with cement concrete layer shall be done in the areas of the switchyard under present scope of work within fenced area including spare base within fenced area.

4.2 GENERAL REQUIREMENT

The material required for site surfacing/stone filling shall be free from all types of organic materials and shall be of standard quality, and as approved by the owner.

4.2.1 The material to be used for stone filling/site surfacing shall be uncrushed/crushed/broken stone of 20 mm nominal size (ungraded single size) conforming to Table of IS:383 –1970. Hardness, flakiness shall be as required for wearing courses are given below:

(a) Sieve Analysis limits (Gradation)  
(IS: 383)

(b) Hardness

Abrasion value (IS: 2386 Part-IV) – not more than 40%  
Impact value (IS: 2366 Part-IV) – not more than 30% and frequency shall be one test per 500 cu.m. with a minimum of one test per source.

(c) Flakiness Index

One test shall be conducted per 500 cu.m. of aggregate as per IS:2386 Part-I and maximum value is 25%.

4.2.2 After all the structures/equipments are erected, antiweed treatment shall be applied in the switchyard where ever stone spreading along with cement concrete is to be done and the area shall be thoroughly de-weeded including removal of roots. The recommendation of local agriculture or horticulture department may be sought where ever feasible while choosing the type chemical to be used. The antiweed chemical shall be procured from reputed manufacturers. The doses and application of chemical shall be strictly done as per manufacturer’s recommendation. Nevertheless the effectiveness of the chemical shall be demonstrated by the contractor in a test area of 10MX10M (aprx) and shall be sprinkled with water at least once in the afternoon everyday after forty eight hours of application of chemical. The treated area shall be monitored over a period of two to three weeks for any growth of weeds by the Engineer-in-charge. The final approval shall be given by Engineer-in-charge based on the results.

4.2.3 Engineer-in-charge shall decide final formation level so as to ensure that the site appears uniform devoid of undulations. The final formation level shall however be very close to the formation level indicated in the approved drawing.

4.2.4 After antiweed treatment is complete, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by Engineer-in-charge. The sub grade shall be consolidated by using half ton roller with suitable water sprinkling arrangement to form a smooth and
compact surface. The roller shall run over the sub grade till the soil is evenly and densely consolidated and behaves as an elastic mass.

4.2.5 In areas that are considered by the Engineer-in-Charge to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipments, the material shall be compacted by hand, if necessary. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling compaction.

4.2.6 The sub grade shall be in moist condition at the time the cement concrete is placed. If necessary, it should be saturated with water for not less than 6 hours but not exceeding 20 hours before placing of cement concrete. If it becomes dry prior to the actual placing of cement concrete, it shall be sprinkled with water and it shall be ensured that no pools of water or soft patches are formed on the surface.

4.2.7 Over the prepared sub grade, 75mm thick base layer of cement concrete in 1:4:8 (1 cement: 4 coarse sand : 8 stone aggregate 20/40mm nominal size) shall be provided in the area excluding roads, drains, cable trenches as per detailed engineering drawing. For easy drainage of water, the slope of 1:1000 is to be provided from the ridge to the nearest drain. The ridge shall be suitably located at the center of the area between the nearest drains.

4.2.8 The scope of work for yard development is inclusive of removal of all vegetation growth i.e. grass, shrubs, cleaning and uprooting anti –weed treatment, compaction, grading to required slope and final 3 layer of yard treatment as follows :

(i) 75mm thick base layer of cement concrete 1:4:8 (1 cement: 4 coarse sand : 8 stone aggregate 20/40mm nominal size)

(ii) 100mm thick layer of cement concrete 1:3:6 (1 cement: 3 coarse sand : 6 stone aggregate 20mm nominal size) with 6mm thick asbestos sheet upto full depth for contraction joints. Spacing of joints shall be approved by the Engineer-in-charge.

(iii) 100mm thick final layer of 20mm stone aggregate nominal size (ungraded single size)

5.0 SITE DRAINAGE

Providing rain water drainage system within the sub –station boundary under the present scope including connection at one or more points to the outfall point located outside the substation boundary wall is in the scope of contractor. Invert level of drainage system at outfall point shall be decided in such a way that the water can easily be discharged outside the substation boundary wall. In case outfall point is more than 50M away from boundary wall, only 50 meter drain outside the boundary wall is in the scope of contractor. Outfall point shall be got approved from Engineer - in- charge before commencement of construction. While designing the drainage system following points shall taken care of:

(a) The surface of the switchyard shall be sloped to prevent accumulation of water.

(b) Drain shall be constructed on both sides of roads. In the switchyard maximum spacing between two drains shall not be more than 100 meters. It will be ensured that no area is left undrained.

(c) Open surface trapezoidal drains having 300mm bottom width and sides having slope of 1horizontal: 1.5 vertical with 300mm depth at starting point of drain shall be provided.

(d) Longitudinal slope shall not be less than 1 in 1000.

(e) Open surface drains shall be constructed with minimum100mm thick plain cement concrete 1:2:4 (1 cement : 2 coarse sand: 4 stone aggregate 20mm nominal size). PCC 1:2:4 shall be laid over 75mm thick layer of PCC 1:4:8 (1cement: 4coarse sand: 8 stone aggregate 20mm nominal size.) Internal faces of drain are to be smooth and well finished with neat cement punning as final course.

(f) The side wall of the drains shall be 25 mm above the stone level to prevent falling of stone into drain. Groove of 150 mm width shall be provided at 1500 mm spacing with suitable mild steel gratings.

(g) 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.

(h) Pipe drains shall be provided in areas of switchyard where movement of crane will be necessary in operating phase of the substation.

(i) 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, RCC pipes of class NP4 shall be provided. For design of RCC pipes for drains and culverts, IS:456 and IS:783 shall be followed.

(j) Two Nos. of portable pumps of 5 hp capacity for drainage of water shall be provided by the Contractor.

(k) Pipe drains shall be connected through manholes at an interval of maximum 30m.

(l) If the invert level of outfall point is above the last drain point in the substation boundary, sump of suitable size has to be constructed with in the substation boundary.

(m) The drainage scheme and associated drawings shall be got approved from the engineer in charge before commencement of construction.

6.0 RAINWATER HARVESTING

(a) In addition to drainage of rainwater in accordance with clause 5.0 above the contractor shall make arrangement for rainwater harvesting also. Rainwater harvesting shall not be done if the depth of water table is within 8.0m from finished ground level.

(b) Providing one number recharge structure with bore wells shall do Rainwater harvesting. The recharge structure shall be suitably located within the sub-station. Branch drains from the main drain carrying rainwater from entire switchyard, constructed in accordance with clause 5.0, shall be connected to the recharge structure.

(c) The internal diameter of recharge shafts shall be 4.5 meter with 230mm thick lining of brick work upto a depth of 2.0 meter from ground level and 345mm thick brickwork below 2.0 meter depth. The brickwork shall be constructed with cement mortar 1:6 (1cement: 6 coarse sand). The overall depth of shaft shall be 5.0 meter below invert level of drain. The shaft shall be covered with RCC slab for a live load of 300 kg. per sqm. Two openings of size 0.7 x 0.7 meter shall be provided in the RCC cover slab. An iron cover made of 5mm thick chequered plate with hinges shall be provided on the openings. Galvanized M.S. rungs of 20mm diameter at spacing of 300 mm shall be provided in the wall of shaft below the opening in the RCC slab to facilitate cleaning of shaft.

(d) A 300 mm diameter bore well shall be drilled in the centre of the shaft. The depth of bore well shall be 5.0 meter more than the depth of sub soil water.

(e) A 100 mm dia medium duty MS pipe conforming to IS:1161 shall be lowered in the bore well keeping bail plug towards bottom of bore well. The pipe shall have 1.58mm holes for 4.0 meter length starting from 1.0 meter from bottom of bore well. Holes of 3.0mm diameter shall be provided for a length of 2.0 meter starting from the bottom level of coarse sand and downwards. The overall length of pipe shall be equal to total depth of bore well plus depth of shaft.

(f) Gravel of size 3mm to 6mm shall be filled around 100 diameter MS pipe in the bore well. The shaft shall be filled with 500 mm thick layers each from the bottom of shaft with boulders of size 50mm to 150mm, gravel of size 5mm to 10mm, coarse sand having particle size 1.5mm to 2.0mm and boulders of size not less than 200mm respectively.

Drawing based on above details of recharge structure for rainwater harvesting has to be prepared by contractor and to be approved from engineer in charge.

7.0 ROADS AND CULVERTS

(a) All the roads within the substation under the present scope is in the scope of contract. Layout of the roads, General detail & Arrangement drawing for the substation to be prepared by contractor and got
approved from engineer in charge. Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. Road to the transformer shall be as short and straight as possible. The top level of roads shall be 300mm above finished formation level of switchyard.

(b) The double lane cement concrete road with minimum reinforcement shall have 7.0m width, 1.6m wide 100 mm thick PCC(1:2:4) and earthen shoulder on either side of the road. Other roads shall be with 3.75 m cement concrete and 1.3 m wide 100 mm thick PCC(1:2:4) and earthen shoulder on either side of the road. All design and drawings of road shall be got approved from engineer in charge. The road from main gate upto control room building shall be double lane road and other roads in and around the 220/66/33kV substation shall be single lane road.

(c) All roads shall be designed for class “C” traffic as per relevant IRC.

(d) CPWD specification shall be followed for construction of Roads.

(e) All the culverts and allied structures (required for road/rail, drain, trench crossings etc.) shall be designed for class AA loading as per IRC standard / IS code and should be checked for transformer loading.

8.0 TRANSFORMER FOUNDATIONS, RAIL TRACK/ ROAD CUM RAIL TRACK

The Contractor shall provide a RCC Rail cum road system integrated with the transformer foundation to enable installation and the replacement of any failed unit. The transfer track system shall be suitable to permit the movement of any failed unit fully assembled (including OLTC, bushings) with oil. This system shall enable the removal of any failed unit from its foundation to the Main road. If trench/drain crossings are required then suitable R.C.C. culverts shall be provided in accordance with I.R.C. standard / relevant IS.

The Contractor shall provide a pylon support system for supporting the fire fighting system if provided.

Each transformer including oil conservator tank and cooler banks etc. shall be placed in a self-sufficient pit surrounded by retaining walls (Pit walls). The clear distance of the retaining wall of the pit from the transformer shall be 20% of the transformer height or 0.8m whichever is more. The oil collection pit thus formed shall have a void volume equal to 100% volume of total oil in the transformer. The minimum height of the retaining walls shall be 20 cm above the finished level of the ground to avoid outside water pouring inside the pit. The bottom of the pit shall have a uniform slope towards the sump pit. While designing the oil collection pit, the movement of the transformer must be taken into account. The soak pits of all transformers shall be connected to a common sump well through a piping system. The capacity of sump well shall be designed with the consideration of volume of transformer and rainwater.

The grating shall be made of MS flat of size 50mmx 5mm placed at 30mm center to center and 25mmx5mm MS flat at a spacing of 150mm at right angle to each other. Maximum length of grating shall be 1500mm and width shall not be more than 500mm. The gratings, supported on ISMB 150mm, shall be placed at the formation level and will be covered with 100mm thick layer of broken/crushed/non-crushed stone having size 40mm to 60mm which acts as an extinguisher for flaming oil.

Each oil collection pit shall be drained towards a sump pit whose role is to drain water and oil due to leakage within the collection pit so that collection pit remains dry.

8.1 MATERIAL

Complete foundation shall be made of reinforced cement concrete M25 grade and shall be designed as per guidelines for design of foundations given in relevant clauses in IS codes.

8.2 DRAINAGE

One 5.0 H.P pump of approved make for sump well shall be supplied and installed by the Contractor to evacuate the fire fighting & rain water from the sump well in to the nearest drain. Pumphouse with one door & window to accommodate pump should be constructed.
9.0 FIRE PROTECTION WALLS

9.1 GENERAL

Fire protection walls shall be provided, if required, in accordance with Tariff Advisory Committee (TAC) recommendations.

9.2 MATERIAL

The firewall may be made of reinforced cement concrete (M-25 grade) as per the system requirement. Materials used must conform to the standards of the national Fire Prevention Association & TAC Norms.

9.3 FIRE RESISTANCE

The firewall shall have a minimum fire resistance of 4 hours. The partitions, which are made to reduce the noise level, shall have the same fire resistance. The walls of the building, which are used as firewalls, shall also have a minimum fire resistance of 4 hours.

The firewall shall be designed to protect against the effect of radiant heat and flying debris from an adjacent fire.

9.4 DIMENSIONS

The barrier shall extend at least 300 mm above the transformer bushing and pressure relief vent and length wise 600 mm beyond the transformer including any radiators and tap changer enclosure.

These dimensions might be reduced in special cases, as per the approval of owner where there is lack of space. A minimum of 2.0 meter clearance shall be provided between the equipments e.g. Autotransformer and firewalls.

The building walls, which act as firewalls, shall extend at least 1 m above the roof in order to protect it.

The firewall shall be made of reinforced cement concrete (M-25 grade), as per the system requirements.

9.5 MECHANICAL RESISTANCE

The fire wall shall have the mechanical resistance to withstand local atmosphere conditions. If this wall shall serve as a support for equipment such as insulators etc, it mechanical rigidity must be increased.

10.0 CABLE & PIPE TRENCHES

(a) The cable trenches and pre-cast removable RCC covers with angle/channel nosing all around (with lifting arrangement) shall be constructed using RCC of M25 grade.

(b) The cable trench walls shall be designed for the following loads.

(i) Dead load of 155 kg/m length of cable support + 75 Kg on one tier at the outer edge of tier.

(ii) Earth pressure + uniform surcharge pressure of 2T/m2.

(c) Cable trench covers shall be designed for self-weight of top slab + concentrated load of 150 kg at center of span on each panel.

(d) Necessary sumps shall be provided and each sump shall be provided with pump of 5 HP capacity. Cable trenches shall not be used as storm water drains.
(e) The top of trenches shall be kept at least 100 mm above the final level of stone layer of yard development. The top of cable trench shall be such that the surface rainwater does not enter the trench.

(f) All metal parts inside the trench shall be connected to the earthing system.

(g) Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.

(h) The trench bed shall have a slope of 1/500 along the run & 1/250 perpendicular to the run.

(i) Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 (1cement:6 fine sand) and plaster with 12mm thick 1:6(1cement:6 fine sand) cement sand mortar.

(j) Cable trench crossing the roads/rails shall be designed for class AA loading of IRC and should be checked for transformer loading also.

(k) All the construction joints of cable trenches i.e. between base slab to the base slab and the junction of vertical wall to the base slab as well as from vertical wall to wall and all the expansion joints shall be provided with approved quality PVC water stops and approximately 230x5mm size for those sections where the ground water tube is expected to rise above the junction of base slab and vertical wall of cable trenches.

11.0 FOUNDATION /RCC CONSTRUCTION

11.1 GENERAL

(a) 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, jacking pad, pulling block, control cubicles, bus supports, transformer, marshalling kiosks, auxiliary equipments, buildings, tanks 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.

(b) Concrete shall conform to the requirements mentioned in IS:456 (latest) 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 of M25 concrete shall be used for all structural/load bearing members as per latest IS 456 (latest).

(c) 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.

(d) The switchyard foundation’s plinths and building plinths shall be minimum 300mm and 500 mm above finished ground level respectively.

(e) Minimum 75mm thick lean concrete (1:4:8) shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.

(f) 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.

(g) 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.

(h) If pile foundations are adopted, the same shall be cast-in-situ driven/bored or pre-cast 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. The bidder showing complete details of piles/pile groups, proposed to be used, shall submit detailed design calculations.
The bidder at their cost to establish the piles design capacity shall also carry out necessary initial load test. 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.

11.2 DESIGN

(a) All foundation shall be of reinforced cement concrete. The design and construction of RCC structures shall be carried out as per IS:456 and minimum grade of concrete shall be M-25. Higher grade of concrete than specified above may be used at the discretion of Contractor without any additional financial implication to the DTL.

(b) Limit state method of design shall be adopted unless specified otherwise in the specification.

(c) For detailing of reinforcement IS:2502 and SP:34 shall be followed. Cold twisted deformed bars (Fe=415 N/mm2) conforming to IS:1786 or TMT bars as per CPWD specifications 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 of 150 mm and above. Clear cover to reinforcement shall be as per IS:456 (latest).

(d) 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.

(e) 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 proposed to be used.

(f) Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.

(g) 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 foundations.

(h) RCC columns shall be provided with rigid connection at the base.

(i) 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.

(j) 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). However, for the design of substructures of any underground enclosures, earth pressure at rest shall be considered.

(k) In addition to earth pressure and ground water pressure etc., a surcharge load of 2T/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.

(l) Following conditions shall be considered for the design of water tank in pumps house, channels, sumps, trenches and other underground structures:
(1) 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).

(2) Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

(3) 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.

(m) Base slab of any underground enclosure shall also be designed for empty condition during construction and maintenance stages with maximum ground water table (GWT). Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the super-imposed loadings.

(n) Base slab of any underground enclosure like water storage tank shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum GWT. Intermediate dividing piers of such enclosures shall be designed considering water in one pump sump only and the other pumps sump being empty for maintenance.

(o) 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.

(p) The foundations of transformer and circuit breaker shall be of block type foundation. Minimum reinforcement shall be governed by IS: 2974 and IS: 456.

(q) The tower and equipment foundations shall be checked for a factor of safety of 2.2 for normal condition and 1.65 for short circuit condition against sliding, overturning and pullout. The same factors shall be used as partial safety factor over loads in limit state design also.

12.0 ADMIXTURES & ADDITIVES

(a) 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.

(b) Admixtures in concrete shall conform to IS:9103. The water proofing cement additives shall conform to IS:2645. Concrete Admixtures/ Additives shall be approved by engineer in charge.

(c) The Contractor may propose and the engineer in charge 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.

(d) The water-reducing set-retarding admixture shall be an approved brand of Ligno-sulphonate type admixture.

(e) The water proofing cement additives shall be used as required/advised by the engineer in charge.

13.0 STRUCTURES

13.1 GENERAL

The scope of specification covers design, fabrication, proto-assembly, supply and erection of galvanized steel structures for towers, girders, lightning masts and equipment support structures. All galvanized steel structure shall be of lattice structure fabricated from structural steel conforming to IS 2062 (latest).
It is the intent of the owner to provide structures, which allow interchangeability of equipments at a later stage. Accordingly equipment support structure shall be provided with the provision of stool. Stools shall be provided between the equipment and its support structure to match the bus bar height. The top of stool shall be connected to the equipment and the bottom of the stool shall be connected to the support structure.

The scope shall include supply and erection of all types of structures including bolts, nuts, washers, hangers, shackles, clamps anti climbing devices, bird guards, step bolts, inserts in concrete, gusset plates, equipment mounting bolts, structure earthing bolts, foundation bolts, spring washers, fixing plates, ground mounted marshalling boxes (AC/DC Marshalling box & equipment control cabinets), structure mounted marshalling boxes and any other items as required to complete the job.

The connection of all structures to their foundations shall be by base plates and embedded anchor/foundation bolts. All steel structures and anchor/foundation bolts shall be fully galvanized. The weight of the zinc coating shall be at least 0.610 kg/m² for anchor bolts / foundation bolts and for structural members. One additional nut shall be provided below the base plate which may be used for the purpose of leveling.

13.2 DESIGN REQUIREMENTS FOR STRUCTURES

(1) For design of steel structures loads such as dead loads, live loads, wind loads etc. shall be based on IS:875, Parts I to V.

(2) For materials and permissible stresses IS:802, Part-I, Section-2 shall be followed in general. However, additional requirements given in following paragraphs shall be also considered.

(3) Minimum thickness of galvanized tower member shall be as follows:

<table>
<thead>
<tr>
<th>Members</th>
<th>Minimum thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg members, Ground wire</td>
<td>5</td>
</tr>
<tr>
<td>Peak members/Main members</td>
<td>5</td>
</tr>
<tr>
<td>Other members</td>
<td>5</td>
</tr>
<tr>
<td>Redundant members</td>
<td>5</td>
</tr>
</tbody>
</table>

(4) Maximum slenderness ratios for leg members, other stressed members and redundant members for compression force shall be as per IS-802.

(5) Minimum distance from hole center to edge shall be 1.5 x bolt diameter. Minimum distance between center to center of holes shall be 2.5 x bolt diameter.

(6) The minimum bolt diameter shall be 16 mm.

13.3 STEP BOLTS

In order to facilitate inspection and maintenance, the structures shall be provided with climbing devices. Each tower shall be provided with step bolts not less than 16 mm diameter & 175 mm long spaced not more than 450 mm apart, staggered on faces on one leg extending from about 1.0 meters above ground level to the top of the tower. The step bolt shall conform to IS: 10238. Ladders on towers with lighting appliances shall be provided with safety guards.

13.4 DESIGN CRITERIA

a) All structures shall be designed for the worst combination of dead loads, live loads, wind loads as per code IS:875, seismic forces as per code IS:1893 (latest), Importance factor of 1.5, loads due to deviation of conductor, load due to unbalanced tension in conductor, torsional load due to unbalanced vertical and horizontal forces, erection loads, short circuit forces including “snatch” in
the case of bundled conductors etc. Short circuit forces shall be calculated considering a fault level of 40.0 kA. IEC-865 may be followed for evaluation of short circuit forces.

b) Switchyard gantry structures shall be designed for the two conditions i.e. normal condition and short circuit condition. In both conditions the design of all structures shall be based on the assumption that stringing is done only on one side i.e. all the three (phase) conductors broken on the other side.

Factor of safety of 2.0 under normal conditions and 1.5 under short circuit condition shall be considered on all external loads for the design of switchyard structures which are of lattice type.

c) Vertical load of half the span of conductors/string and the earth wires on either side of the beam shall be taken into account for the purpose of design. Weight of man with tools shall be considered as 150 kgs. for the design of structures.

d) Terminal/line take off and other gantries shall be designed for a minimum conductor tension of 2 metric tonnes per phase for 220/66/33KV or as per requirements whichever is higher. The distance between terminal gantry and dead end tower shall be taken as 100 metres. The design of these terminal gantries shall also be checked considering +/- 30 deg deviation of conductor in horizontal planes and plus 30 degree in vertical plane. For other gantries the structural layout requirements shall be adopted in design.

e) The girders shall be connected with lattice columns by bolted joints.

f) All Pipe support structures if used for supporting equipments shall be designed for the worst combination of dead loads, erection load. Wind load/seismic forces, short circuit forces and operating forces acting on the equipment and associated bus bars as per IS:806. The material specification shall be as per IS:1161 read in conjunction with IS:806.

g) If luminaries are proposed to be fixed on gantries/towers, then the proper loading for the same shall be considered while designing. Also holes for fixing the brackets for luminaries should be provided wherever required.

h) Foundation bolts shall be designed for the loads for which the structures are designed.

a) Lighting-cum-lightning Mast shall be 35m in height (32.5m lattice structure plus 2.5m pipe) and designed for diagonal wind condition. Lightning masts shall be provided with a structural steel ladder within its base up to a height of 25 metre. The ladder shall be provided with protection rings. One platform shall be provided at 25.0m height for mounting of lighting fixture. The platform shall also have protection railing. The details of lighting fixtures would be as per the approved drawings.

13.5 DESIGN DRAWINGS, BILL OF MATETRIALS AND DOCUMENTS

(1) The Contractor shall furnish design, drawing detail BOMs on basis of BOM as enclosed including shop manufacturing drawings for every member to the Purchaser after award of the Contract. However, Contractor shall have to prepare and submit any other drawings, bill of materials (BOM) additionally required during design and construction stage which the Purchaser feels necessary. In case Purchaser feels that any design drawing, BOM are to be modified even after its approval, Contractor shall modify the designs & drawings and resubmit the design drawing, BOM as required in the specification.

(2) The fabrication drawings to be prepared and furnished by the Contractor shall be based on the design approved by the Purchaser. These fabrication drawings shall indicate complete details of fabrication and erection including all erection splicing details and typical fabrication splicing details, lacing details, weld sizes and lengths. Bolt details and all customary details in accordance with standard structural engineering practice whether or not given by the owner. The fabrication drawings shall be submitted to the owner. Proto shall be made only after approval of fabrication drawings.
(3) The fabrication work shall start only after the final approval to the Fabrication drawing is accorded by the owner. The design drawing should indicate not only profile, but section, numbers and sizes of bolts and details of typical joints.

(4) Such approval shall, however, not relieve the Contractor of his responsibility for the safety of the structure and good connections and any loss or damage occurring due to defective fabrication, design or workmanship shall be borne by the Contractor.

13.6 FABRICATION OF STEEL MEMBERS

The fabrication and erection works shall be carried out generally in accordance with IS 802. A reference however may be made to IS 800 in case of non-stipulation of some particular provision in IS 802. All materials shall be completely shop fabricated and finished with proper connection material and erection marks for ready assembly in the field.

13.7 PROTO-ASSEMBLY

(1) The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified camber, if any, is provided. In order to minimize distortion in member the component parts shall be positioned by using the clamps, clips, dogs, jigs and other suitable means and fasteners (bolts and welds) shall be placed in a balanced pattern. If the individual components are to be bolted, paralleled and tapered drifts shall be used to align the part so that the bolts can be accurately positioned.

(2) Sample towers, beams and lighting-cum-lightening masts and equipment support structures shall be trial assembled in the fabrication shop and shall be inspected and cleared by Contractor based on the approved fabrication drawing before mass fabrication.

Pursuant to above the B.O.Ms along with proto-corrected fabrication drawings and shop manufacturing drawings for every member shall be prepared and submitted by the main vendor to owner as document for information. Such BOM, which shall be duly certified by the main vendor for its conformity to the approved design, shall be the basis for owner to carry out inspection.

13.8 BOLTING

i) Every bolt shall be provided with a washer under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together.

ii) All steel items, bolts, nuts and washers shall be hot dip galvanized.

iii) 2.0% extra nuts and bolts shall be supplied for erection.

13.9 WELDING

The work shall be done as per approved fabrication drawings which clearly indicate various details of joints to be welded, type of weld, length and size of weld, whether shop or site weld etc. Symbols for welding on erection and shop drawings shall be according to IS: 813. Efforts shall be made to reduce site welding so as to avoid improper joints due to constructional difficulties.

13.10 FOUNDATION BOLTS

(1) Foundation bolts for the towers and equipment supporting structures and elsewhere shall be embedded in first stage concrete while the foundation is cast. The Contractor shall ensure the proper alignment of these bolts to match the holes in the base plate.

(2) The Contractor shall be responsible for the correct alignment and leveling of all steel work on site to ensure that the towers/structures are plumb.

(3) All foundation bolts for lattice structure, pipe structure are to be supplied by the Contractor.
(4) All foundation bolts shall be fully galvanized so as to achieve 0.61 kg. per Sq.m. of Zinc Coating as per specifications.

(5) All foundation bolts shall conform to IS 5624 but the material, however shall be MS conforming to IS: 2062.

13.11 STABILITY OF STRUCTURE

The Supplier shall be responsible for the stability of the structure at all stages of its erection at site and shall take all necessary measures by the additions of temporary bracings and guying to ensure adequate resistance to wind and also to loads due to erection equipment and their operations.

13.12 GROUTING

The method of grouting the column bases shall be subject to approval of Purchaser and shall be such as to ensure a complete uniformity of contact over the whole area of the steel base. The Contractor will be fully responsible for the grouting operations.

13.13 GALVANISING

(1) All structural steel works and pipe supports shall be galvanized after fabrication.

(2) Zinc required for galvanizing shall have to be arranged by the manufacturer. Purity of zinc to be used shall be 99.95% as per IS:209.

(3) The Contractor shall be required to make arrangement for frequent inspection by the owner as well as continuous inspection by a resident representative of the owner, if so desired for fabrication work.

13.14 TOUCH-UP PAINTING

The touch up primers and paints shall consist of Red Oxide / Zinc chromate conforming to the requirements of IS: 2074 with a pigment to be specified by the owner.

13.15 INSPECTION BEFORE DISPATCH

Each part of the fabricated steel work shall be inspected as per approved quality plans and certified by the owner or his authorized representative as satisfactory before it is dispatched to the erection site. Such certification shall not relieve the Contractor of his responsibility regarding adequacy and completeness of fabrication.

13.16 TEST CERTIFICATE

Copies of all test certificates relating to material procured by the Contractor for the works shall be forwarded to the owner.

13.17 ERECTION

The Contractor should arrange on his own all plant and equipment, welding set, tools and tackles, scaffolding, trestles equipments and all other accessories and ancillaries required for carrying out erection without causing any stresses in the members which may cause deformation and permanent damage.

13.18 SAFETY PRECAUTIONS

The Contractor shall strictly follow at all stages of fabrication, transportation and erection of steel structures, raw materials and other tools and tackles, the stipulations contained in Indian Standard Code for Safety during erection of structural steel work-IS:7205.

All tests mentioned in standard field quality plans have to be carried out and conformity of materials and workmanship shall be ascertained.
14.0 CHAINLINK FENCING AND GATE

14.1 Fencing and gate shall be provided as per details given below:

1. Fencing shall be provided for complete switchyard as per drawing approved by engineer in charge. Separate gate shall be provided for men and equipment.

2. Internal fence surrounding the various equipments (if) mounted on ground or a height lower than 2.5m. Necessary gates shall be provided for each area so surrounded.

3. Drawing of fencing covering following specifications shall be prepared by contractor and shall got approved from engineer in charge.

14.2 PRODUCT MATERIALS

The minimum requirements are as follows:

Chain link fence fabric (without galvanization) in accordance to IS: 2721.

1. Size of mesh : 75mm
2. Nominal wire size : 3.15mm diameter
3. Width of chain link : 1500mm
4. Painting : Two or more coats of approved standard make synthetic enamel paint over a coat of standard steel primer.

Posts

The posts shall be of medium M.S. tubes of 50mm diameter conforming to grade Yst-22 (Kg/mm2). The tubes shall also conform to IS : 1161/IS 806. The length of tubular post shall be 2600 mm.

An M.S. base plate of size 160 X 160 X 6mm thick shall be welded with the tubular post. The post shall be provided on the top with M S plate.

The tubular post shall be welded with 8 number of M S flat of size 50 x 6mm – 75mm long. Two number of 13.5 mm diameter holes on each cleats shall be provided to bolt the fence fabric panel. The cleats shall be welded at equal spacing in such a way that 4 numbers of cleats are on one side and remaining 4 cleats are on the opposite side of the post. The cleats on the corner posts shall be welded in such a way that it suits the site requirement.

The whole assembly of tubular post shall be hot dip galvanized. The zinc coating shall be minimum 610 gram per sq. meter. The purity of zinc shall be 99.95% as per IS: 209.

Fence Fabric Panel

Chain link fencing shall be fabricated in the form of panel 1300 X 2928 mm. An M.S. flat of at least 50x6 mm size shall be welded all-round fence fabric to form a panel. Four pairs of 13.5mm diameter holes on the vertical M S flat matching the spacing of holes in cleats fixed with pipe shall be provided to fix the fence panel with the tubular posts. A washer shall also be provided below each nut. The contractor, for fixing the panels, shall supply the 12mm diameter bolts including nuts and washers. All nuts, bolts and washers shall be hot dip galvanized.

The fence panel shall be provided with two or more coats of approved standard synthetic enamel paint over approved standard steel primer.

Installation

1. Fence shall be installed along the switchyard line.
2. Post holes shall be excavated by approved method.
3. All posts shall be 3.0m apart measured parallel to ground surface.
4. Posts shall be set in 1:1.5:3 Plain Cement Concrete block of minimum 0.60x0.60x1.2m depth. 100mm thick plain cement concrete 1:4:8 shall be provided below concrete blocks. Posts shall be braced and held in plumb position and true alignment and elevation until concrete has
set.
5. Fence fabric shall not be installed until concrete has cured a minimum of 7 days.
6. Fence fabric panel shall be fixed to the post at 4 nos. MS flat each of 50x6, 75 long through 2 nos. of bolts (12 diameter) on each flat.
7. Tow wall of one brick thick over 75mm thick PCC (1:4:8) shall be provided below all fencing and between fence posts. Tow wall shall be minimum 200mm above and 500mm below finished ground level. All exposed surface of brick tow wall shall be provided with 1:6 cement sand plaster (15mm thick) and coated with two coats of cement paint over a coat of cement primer.

The painting pattern of fence panels shall be decided by Engineer-in-charge. It shall be preferable to paint the panel in different colour pattern such that it gives better aesthetic look.

**Gate**
1. The gate shall be made of medium duty M.S. pipe conforming to relevant I.S. with welded joints. The main frame (outer frame) of the gate shall be made of 65mm dia pipe and vertical pipes of 40mm dia shall be welded with the main frame. Other details shall be as per approved drawing.
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. The gates shall be provided with suitable locking arrangement.
4. The main gate shall be 6.0m wide and shall be of double leaf type. Next to the main gate, a men gate (1.25m wide single leaf) shall also be provided.
5. Two steel rollers in each leaf with rolling MS flat on road shall be provided with the gate.
6. Gate shall be installed in location as per approved drawing.

**15.0 BUILDINGS - GENERAL REQUIREMENTS**

**15.1 GENERAL**

The scope includes design, engineering and construction including anti-termite treatment, plinth protection DPC of Building including sanitary, water supply, electrification etc. of control room building, GIS Building, Boundary wall etc. The buildings shall be of RCC framed structure of concrete of M25 grade (Min.).

The Contractor shall appoint a reputed architect (to be approved by DTL) for design of architecturally pleasing building.

**15.2 AREA REQUIREMENT :-**

**(A) CONTROL ROOM BUILDING**

The position of different floors of rooms are given below:

- Control room  FF
- ACDB room  GF
- DCDB-cum-battery room  GF
- Testing Lab  FF
- Conference room  FF
- S/Stn. Incharge office  FF
- Plus attached Toilet
- Plus PS room
- Room for engineers  FF
- Room for non-executives  FF
• Lobby FF
• Corridor FF
• Portico GF
• Common toilet FF
  (ladies & gents both separate)
• Changing room FF
• Toilet attached to FF
  Conference room
• Janitor room FF
• Pantry FF
• Store GF
• GIS room GF
• Relay & Protection panels room GF
  (Adjacent to GIS room)

Any future possibility of annexes building shall be taken care of while finalizing the layout of
the control room building.

(B) GIS BUILDING :-
Dimensions of the building shall be decided by the bidder depending upon requirement. Provision for
extension of the building in future shall be made. A corridor having width of 1500 mm shall be
provided all around GIS to facilitate maintenance of equipments. Provision for service bay shall also
be made. Panels shall be kept in an air-conditioned enclosure. This enclosure shall be separated from
main GIS hall by providing glazed partition made of aluminium frame and 5.5 mm thick glass.

15.2.1 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. to 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. with materials preventing dust accumulation.

b) Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.

c) 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.

d) Permissible stresses for different load combinations shall be taken as per relevant IS Codes.

e) The building lighting shall be designed in accordance with the requirements of relevant section.

f) 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.

15.2.2 DESIGN LOADS

Building structures shall be designed for the most critical combinations of dead loads, super- imposed loads, equipment loads, crane load (if any), wind loads and seismic 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.

For crane loads an impact factor of 30% and lateral crane surge of 10% (lifted weight + trolley) shall be considered in the analysis of frame according to provisions of IS: 875. The horizontal surge shall be 5% of the static wheel load.

The wind loads shall be computed as per IS 875 - 1987, Seismic Coefficient method/Response Spectrum 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 and other loads
associated with building. Floors shall be designed for live loads as per relevant IS. Cable load shall also be considered additionally for floors where these loads are expected.

In addition, beams shall be designed for any incidental point loads to be applied at any point along the beams. The floor loads shall be subject to Purchaser’s approval.

For consideration of loads on structures, IS: 875 -1987, the following minimum superimposed live loads shall, however, be considered for the design.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Live Load (KN/M2)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Roof</td>
<td>1.5 for accessible</td>
<td>for accessible roofs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.75 for inaccessible roofs</td>
<td>for in-accessible roofs</td>
</tr>
<tr>
<td>b</td>
<td>RCC-Floor</td>
<td>5 for offices</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 (min.) for equipment floors or actual requirement, if higher than 10 kN/sqm based on equipment component weight and layout plans.</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Stairs &amp; balconies</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>Toilet Rooms</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>Chequered plate floor</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>Walkways</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Any additional load coming in the structure shall be calculated as per IS: 875 -1987.

15.2.3 SUBMISSION

The following information shall be submitted for review and approval to the Purchaser:

1. Structural design calculations and drawing (including construction/ fabrication) for all reinforced concrete and structural steel structures.

2. 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 1:50 and shall identify the major building components.

3. 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.

4. Product information of building components and materials, including walls partitions flooring ceiling, roofing, door and windows and building finishes.

5. A detailed schedule of building finishes including colour schemes.
6. 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.

15.2.4 FINISH SCHEDULE

The finishing schedule is given in subsequent clauses. Internal walls of GIS hall shall be painted with two or more coats of plastic emulsion paint (DSR item code 13.92.1). Paints used in the work shall be of best quality specified in CPWD specification.

15.2.5 FLOORING

Flooring in various rooms of control room building shall be as per detailed schedules given in Table -1. 52mm thick ironite flooring (DSR item code 11.8) shall be provided in GIS hall.

15.2.6 Walls

All the buildings shall be of framed superstructure. All walls shall be non-load bearing walls. Min. thickness of walls shall be 230 mm (one brick) with 1:6 cement sand mortar.

15.2.7 Plastering

All internal walls shall have minimum 15mm thick 1:6 cement sand plaster. The ceiling shall have 6mm thick 1:3 cement sand plaster.

15.2.8 External Finishing

External plaster 12mm thick shall be of 1:6 cement sand plaster. External surface of the control room and GIS building shall be painted with NOVALUX exterior paint as per manufacturer's specification. Minimum 20% area in elevation of control room building and GIS building shall be covered with 6mm thick coloured curtain glazing with powder coated aluminium frame for better aesthetic look in elevation.

Internal finish Schedule for control room building is given in Table -1 below:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Location</th>
<th>Flooring &amp; skirting 150mm high</th>
<th>Wall internal</th>
<th>Ceiling</th>
<th>Doors, Windows ventilators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Control Room, SCADA / communication &amp; computer rooms</td>
<td>Vitrified tiles of approved shade &amp; colour over CC flooring as specified. False ceiling</td>
<td>Surface of internal walls shall be prepared with POP putty to maintain smooth surface and line &amp; levels. The prepared surface shall be finished with plastic emulsion paint/texture paint or any other high quality paint of approved colour and shade.</td>
<td>same as for internal walls</td>
<td>Powder coated Aluminium Indal or equivalent extruded sections as per IS 733 &amp; 1285 Glazing Float glass (Min 5.5mm thick) double glazing with 12mm gap hermetically sealed.</td>
</tr>
<tr>
<td>2</td>
<td>Sub-Station in charge, officers, conference library/record, corridor, staff, protection room</td>
<td>Vitrified tiles of approved shade &amp; colour over CC flooring as specified.</td>
<td>Surface of internal walls shall be prepared with POP putty to maintain smooth surface and line &amp; levels. The prepared surface shall be finished</td>
<td>same as for internal walls</td>
<td>Powder coated Aluminium extruded sections as at 1 door shutter Windows, Ventilators</td>
</tr>
</tbody>
</table>
False ceiling with plastic emulsion paint/texture paint or any other high quality paint of approved colour and shade.

Aluminium as at 1.

3 Reception/lobby corridor Granite stone as per approved pattern. Surface of internal walls shall be prepared with POP putty to maintain smooth surface and line & levels. The prepared surface shall be finished with plastic emulsion paint/texture paint or any other high quality paint of approved colour and shade.

Powder coated Alum. Extruded Sections frame as at for S.No. 1 i.e. for entrance with glazing

4 Battery Room Acid Resistant Tiles 25mm thick DADO acid resistant title 2.1M high Acid resistant paint above 2.1 M upto ceiling Acid resistant paint Steel door 45mm thick double sheet 18G steel suitably reinforced and filled with mineral wool. Hot rolled steel framed glazed window and ventilators

5 Electrical Room, DG Bldg., platform Ironite flooring POP with emulsion paint or oil bound/ acrylic distemper POP with emulsion paint or oil bound/ acrylic distemper Steel door double sheet as above. Hot rolled steel framed glazed window and ventilators.

6 Toilet, pantry Vitrified tiles of approved shade & colour over CC flooring as specified. DADO vitrified tiles upto ceiling height for toilet and for pantry above working plateform upto 750mm. POP with emulsion paint or oil bound/ acrylic distemper Provision of water less urinal in toilet. Powder coated Alum. Frame for pantry doors and teak wood frame with flush doors for toilets.

7 Stair Granite stone with hand railing of stainless steel or decorative finish as per approval. -- Waist slab bottom face white wash inside Teak wood frame flush door shutter with Anodized Aluminium fixtures best quality Windows, ventilators aluminium as at 1.

Internal finishing of testing lab and changing room shall be as per internal finish schedule table serial no. 5 and 6 respectively.

15.2.9 ROOF

(a) Roof of the Buildings 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:

(b) 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.
(c) 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 up to 300mm height including rounding of junctions of walls and slabs.

(d) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to IS: 2645.

(e) Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement : 4 course 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.

(f) 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 Engineer-in-charge.

With average thickness of 120 mm and minimum thickness at khurra at 65 mm.

15.2.10 CABLE TRENCH IN GIS HALL

All cable trenches in GIS hall shall be covered with minimum 6mm thick MS chequered plate with suitable stiffeners and aluminium painting.

15.2.11 DOORS AND WINDOWS

The details of doors and windows of the control room building shall be as per finish schedule Table-1 conforming to relevant IS code. Rolling steel shutters and rolling steel grills shall be provided as per layout and requirement of buildings. Frameless glass (12mm thick) door with glass handle and locking arrangement shall be provided at the main entrance of control room building and entrance door of control room. Main entrance door of the control room building shall be double leaf sliding type. Etching pattern on glass of door shall be got approved.

The main control room door and GIS building entrance door shall be provided with access control system and entry shall be restricted through access cards.

15.2.12 PARTITION

Partitions, if required, shall be made of anodised aluminum frame provided with 5.5 mm thick etched glass (as per approved pattern) up to the roof and pre-laminated board up to 600mm above floor.

15.2.13 STAIRCASE

Granite (18mm thick) shall be provided in risers as well as treads. Railing shall be 50mm dia, 14 gauge of stainless steel pipe with stainless steel balusters and 12mm thick toughened glass 600mm high with etching on both sides of staircase between balusters.

15.2.14 PLUMBING & SANITATION

i. All plumbing and sanitation shall be executed to comply with the requirements of the appropriate bye-laws, 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.
ii. PVC “SYNTEX” or equivalent make Roof water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided. Minimum 2 Nos 1500 litres capacity shall be provided.

iii. Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal & external piping work for potable water supply.

iv. Sand CI pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.

v. Each toilet shall have the following minimum fittings.

(a) WC (Western type) 390 mm high with toilet paper roll holder and all fittings in toilets attached to conference and sub-station in charge office and WC (Indian Type) Orissa Pattern (580 x 440 mm) with all fittings shall be provided in common toilets.

(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.

(g) All urinals and washbasins shall be provided with built in sensors to regulate the flow of water.

vi. Water cooler for drinking water with adequate water storage facility shall be provided and located near control room and not near toilet block.

vii. 1 no. stainless steel kitchen sink with Drain board (510 x 1040 x 178 mm bowl depth) for pantry shall be provided.

viii. All fittings, fastener, grating shall be chromium plated.

ix. 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.

x. Soil, waste and drain pipes, for underground works shall be stone ware for areas not subject to traffic load. Heavy duty cast iron pipes shall be used otherwise.

15.2.15 The Furniture of Godrej/ Rittal/ Pyrotech should be supplied by the contractor for control room and other rooms for executives & non-executives. The make, size & other details should be decided during detail engineering.
For 220 kV Substations

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control room table</td>
<td>1 no.</td>
</tr>
<tr>
<td>Tables for executives</td>
<td>2 nos.</td>
</tr>
<tr>
<td>Tables for non-executives</td>
<td>3 nos.</td>
</tr>
<tr>
<td>Chairs</td>
<td>19 nos.</td>
</tr>
<tr>
<td>Lockers</td>
<td>16 nos.</td>
</tr>
<tr>
<td>Almirah</td>
<td>3 nos.</td>
</tr>
<tr>
<td><strong>Conference room equipped with projector &amp; screen of latest configuration along with conference table with chairs for 10 persons</strong></td>
<td>1 set</td>
</tr>
</tbody>
</table>

15.2.16

a) Control room table: Control room table shall be free standing table top type. The table top of the control room table shall be arc shaped for mounting monitors, keyboards and printers. It shall have concealed cable & wire way management system. The top surface of control room table shall be 30 mm thick with the top 12 mm of acrylic solid surface and the remaining 18 mm of laminated medium density fibre board. It shall consists of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, mouse pads, monitors and concealed cable & wire way management, perforated trays with covers in both horizontal and vertical directions. Sliding keyboard trays shall be provided on the control room table. The CPU’s shall be located separately on PC racks. The table shall be arranged in continuous arc shape. The exact profile of the control room table, dimensions, material, construction details etc. shall be as per the actual requirement and shall be finalized during detailed engineering.

b) Chairs: Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/ gas lift) shall be provided for the operators, sub station in-charge and other personal in control room building. These shall be designed for sitting for long duration such that these are plate covered with poly-propylene cladding. Arm-rests in one piece shall be of poly-urethane and twin wheel castor of glass filled nylon. The exact details shall be finished & approved by Employer during detailed engineering.

c) Tables:
(i) Industry standard Executive & non Executive tables shall be provided & shall be as approved by Employer during detailed engineering.
(ii) Conference room standard tables shall be provided with acrylic coat for good finish. Details shall be finalized & approved by Employer during detailed engineering.

d) Lockers: Suitable lockers shall be provided in the control room building for storing of personal articles of sub station personal. Details shall be finalized and approved by employer during detailed engineering.

e) Almirah: Steel Almirahs shall be provided for keeping documents in the control room building. The exact details and location shall be finalized and approved by employer during detailed engineering.
15.3 INTERNAL ELECTRIFICATION

Electrical wiring shall be through heavy duty concealed conduits. All fixtures and wiring shall be of best quality and ISI marked. (Fixtures shall be provided as per provision of energy conservation act), CFL Type.

15.4 All rooms like office, Conference/Library, Control Room, SCADA Room & Reception Lobby of Control Room Building shall be provided with provisions compatible with telephone, computer etc. as per approved layout plan during detailed engineering stage.

15.5 Car/scooter shed as per drawing/design as submitted by contractor of size 10X3.5M approx. and approved by engineer-in-charge with frame of steel pipes etc. and with polycarbonate sheet proofing is to be provided near control room as per concept layout plan prepared by contractor and approved by DTL.

16.0 BUILDING STORM WATER DRAINAGE FOR ALL BUILDINGS

The building drain shall be provided for the collection of storm water from the roofs. This water shall be collected in junction boxes and these boxes shall drain to the main drainage system of the station.

PVC with 10kg/cm² pressure rain water down comers with water tight joints shall be provided to drain off the rain water from the roof. These shall be suitably concealed with masonry work of cement concrete or cladding material. The number and size of down comers shall be governed by IS:1742 and IS:2527.

All drains inside the buildings shall have minimum 40 mm thick grating covers and in areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating.

For all buildings, suitable arrangement for draining out water collected from equipment blow down, leakages, floor washings fire fighting etc. shall be provided for each floor.

17.0 SWITCHYARD CIVIL WORKS

17.1 SCOPE

The scope under this item covers all structural and civil works associated with successful erection and commissioning of station switchyard. The details of scope are as follows. This is only guideline and shall not be taken as exhaustive.

(1) Design, engineering, fabrication, proto-assembly, supply and erection of galvanized steel structures for lighting-cum-lightening mast, towers, beams/girders and equipment support structures, Towers, girders, lighting/lightening mast and equipment support structures shall be lattice type structure fabricated from structural steel conforming to IS 2062 (latest). All galvanized lattice structures shall be inclusive of all fixtures such as nuts, bolts, hangers, shackles, clamps, ant l-climbing device, danger and phase plates, inserts in concrete, foundation bolts, base plates, cap plates, stiffeners, dampers fixtures, for supporting of operating mechanism boxes, control cabinet and any other item to complete the job.

(2) Design engineering, fabrication, supply, erection and painting of supports, embedment in cable trenches, bolts and nuts and any other accessories required to complete the job.

(3) Excavation, dewatering, carriage of excavated earth materials, PCC mud mat piling, casting of concrete foundations pile caps, backfilling etc.

(4) Design, Engineering, excavation, dewatering, carriage of excavated earth, P.C.C. mudmat, construction of R.C.C. cable trench and pipe trenches with necessary precast R.C.C. covers with lifting facilities, sump pit, etc. wherever trenches cross road or rail track the sections below such crossings shall be designed as per Indian Road Congress or Indian Railway Specification. Drainage of the trenches shall be suitably designed.
(5) Drainage of the area is also in Bidder's scope. It may be noted that the cable trench should not be used for drainage purpose.

(6) Drainage of the area in the switchyard is in bidder scope. The drainage water should be collected in suitable sump and arrangements for pumping out water including the provision of pump and pump house is in the bidder scope.

(7) Cable trenches / drains should be provided with RCC trench covers with angle iron nosing all round. Thickness of the trench covers should not be less than 50mm. All trench covers should be provided with suitable arrangement for lifting.

(8) The cable trenches shall be provided with suitable hangers and cable tray with proper earthing to support the cables.

(9) All foundations for the switchyard structures shall be designed as per relevant IS:4091 "Code of practice for design and construction of foundations for transmission line towers and poles" and 13:456 (latest) "Code of practice for plain and reinforced concrete".

(10) The finished level of the Civil Works in the grid sub-station should be fixed in relation to the outside road (Municipal Road) as under:

<table>
<thead>
<tr>
<th>Description</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside road (Municipal Road)</td>
<td>100.00M</td>
</tr>
<tr>
<td>Final finished level after metalling</td>
<td>(Reference Point)</td>
</tr>
<tr>
<td>Formation level</td>
<td>100.20M</td>
</tr>
<tr>
<td>Yard level</td>
<td>100.35M</td>
</tr>
<tr>
<td>Inside roads and top of trenches in yard</td>
<td>100.45M</td>
</tr>
<tr>
<td>Equipment foundations</td>
<td>100.50M</td>
</tr>
<tr>
<td>Plinth level of the control room building</td>
<td>101.20M</td>
</tr>
</tbody>
</table>

18.0 SUBSTATION BOUNDARY WALL:

SCOPE
1. The scope is to cover design, preparation of drawings for boundary wall, MS gate alongwith concertina coil on boundary wall and security room at entrance gate.
2. The height of boundary wall shall be 2.7M from FGL and 610mm dia concertina coil over boundary wall fixed with arrangement of Y shape angle grouted on RCC columns.
3. The boundary wall structure shall be RCC (M-25 grade) frame with 23cm brick filling in panels in cement mortar 1:4 (1 cement : 4 coarse sand).
4. For design of boundary wall, security room relevant IS code shall be followed.
5. The foundation of boundary wall and security room shall be designed as per site requirement.
6. The boundary wall and security room shall be finished with 12mm/15mm cement plaster mix 1:4 and acrylic smooth exterior paint on base of white cement base putty minimum thickness 1mm. Painting with synthetic enamel paint on steel work.

19.0 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 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 230mm.
(3) All underground water retaining concrete structures shall have water proofing cement additive conforming to IS:2645 water proofing for walls and base slab of all underground concrete structures like basements pump houses etc. shall be by "Injection Method".

(4) Bricks having minimum 75 kg/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. All brick work shall be designed as per latest Indian standards and shall be plastered on both faces. All brick walls shall be minimum 230mm thick (excluding plaster). All RCC ceiling shall be plastered with 6 mm thick plaster.

(5) All roofs shall have heavy duty water proofing with roof insulation and grading under bed which shall be provided to give an ultimate run off gradient of not less than 1:100 to effectively dispose off the rain water. The minimum height of RCC parapets on roof shall be 900mm and the thickness shall be 100mm (exclusive of plaster) and plaster shall be provided on both faces.

(6) Rain water down comers shall be concealed either in brick work by encasing in cement concrete or by any other suitable arrangement with approval of Engineer-in-Charge.

(7) All roofs shall be provided with access through staircase.

(8) All buildings shall have 750mm wide plinth protection all round.

(9) Monorails, Monorail girders and fixtures shall be provided by the Bidder wherever required.

(10) The scope of drainage of surface/storm water drainage shall include layout and construction of drains, including culverts and connection of drains to the trunk drains including making good the connections of these plant drains with trunk drains.

(11) The scope of disposal of foul water from toilets shall include layout and laying of all sewers for sewerage system including all fittings and fixtures ancillary works such as connections manholes inspection chambers, etc. and disposal thereof to the nearest existing Municipal drain provision of Septic tank and Soak pit. Manholes shall be provided by the Bidder at all the junctions of sewer lines with trunk sewerage line.

i. All the trenches inside the control room building will be covered with 6mm thick M.S. Chequered plates of suitable sizes. The walls of the trenches will be provided with suitable angle iron nosing for placement of the chequered plates. Suitable M.S. iron hangers will be provided in the trenches.

ii. All foundations embedment, inserts, blockouts required for equipments shall be provided by bidder.

iii. 50mm thick DPC shall be provided before laying of masonary.

iv. All steel section and fabricated structures which are required to be transported by sea shall be provided with anti corrosive paint to take care of sea worthiness.

v. All mild steel parts used in the water retaining structures shall be hot-double dip galvanized. The minimum coating of the zinc shall be 750 gm/sq. m. for galvanized 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.

vi. A screed concrete layer not less than 100 mm thick and of grade not weaker than M10 conforming to IS:456-2000 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.

vii. 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.
viii. All stairs shall have maximum riser height of 150 mm and a minimum tread width of 300 mm. Minimum width of stairs shall be 1500 mm.

ix. Angles 50x50x6 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.

x. 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.

xi. Hand-railing minimum 900mm high shall be provided around all floor/roof openings, projections/ balconies, walk ways, platforms, steel stairs etc. All handrails and ladder pipes shall be 32 mm nominal bore MS pipes (medium class) and shall be galvanized (medium-class as per IS:277). All rungs for ladder shall also be galvanized as per IS:277 medium class. For RCC stairs, hand railing with 20 mm square MS bars, balustrades with suitable MS flats & aluminium handrails shall be provided.

xii. 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.

xiii. Bidders shall submit following documents for the proposed buildings along with the offer:
   
   i) Architectural floor plans, elevations, cross-sections and perspective view in colour of all buildings. (Bidder shall submit three different schemes).

   ii) Blow-up sketch of any typical detail.

   iii) Finishing schedules of both material and colour for both internal and external areas.

20.0 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 cut outs 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.

21.0 WATER SUPPLY

(1) Water and electricity shall be arranged by the contractor at his own cost.

(2) The contractor shall carry out all the plumbing/erection works required for supply of water in control room building.

(3) The contractor shall carry out all the plumbing/erection works required for supply of water to all switch yard buildings.

(4) The details of tanks, pipes, fittings, fixtures etc for water supply shall be approved by engineer in charge.

(5) A scheme shall be prepared by the contractor indicating the layout and details of water supply which shall be got approved by the Purchaser 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.

(6) Bore wells and pumps for water supply are in the scope of contractor.

22.0 SEWERAGE SYSTEM

(1) Sewerage system shall be provided for control room building cum administrative building.

(2) The Contractor shall construct septic tank and soak pit suitable for 50 users for sub station if the municipal sewer in the vicinity does not exists. In case municipal sewer line is available in the area, the
connection of sewerage system of switch yard building with municipal sewer shall be in the scope of bidder.

(3) The system shall be designed as per relevant IS Codes.

### 23.0 STATUTORY RULES

(1) 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.

(2) Provisions for fire proof doors, number 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.

(3) Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.

(4) 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.

(5) 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.

(6) All water retaining structures designed as uncracked section shall also be tested for water tightness at full water level in accordance with clause no. 10 of IS:3370 (Part-I).

(7) Construction joints shall be as per IS: 456-2000.

(8) All underground concrete structures like basements, pumps houses, 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.

(9) All building/construction materials shall conform to the best quality specified in CPWD specifications if not otherwise mentioned in this specification.

(10) All tests as required in the standard field quality plans have to be carried out.

(11) The type and treatment of all foundation shall be as per recommendation of geo-technical investigation reports.

### 24.0 FIELD QUALITY PLAN FOR CIVIL WORKS

The field quality plan for all civil works shall be in accordance with CPWD specification and other relevant Indian Standard Codes. All quality checks and procedures shall be followed as per relevant CPWD norms.
SECTION : 14

SUBSTATION AUTOMATION SYSTEM

1.0 GENERAL

1.1 The substation automation system shall be offered from a manufacturer who must have designed, manufactured, tested, installed and commissioned substation automation system which must be in satisfactory operation on 220 kV system or higher for at least 2 (Two) nos. of similar substation automation system for 2 (two) years as on the date of bid opening.

1.2 The Substation Automation System (SAS) shall be installed to control and monitor all the sub-station equipment from local control center (ALDC).

The SAS shall contain the following main functional parts:

1. Bay control Intelligence Electronic Devices (IEDs) for control and monitoring.
2. Station Human Machine Interface (HMI)
3. Redundant managed switched Ethernet Local Area Network communication infrastructure with hot standby.
4. Gateway for remote control via industrial grade hardware (to RCC) through IEC 60870-5-101 with EMC to suit Substation Automation Environment.
5. Gateway for remote supervisory control (to ALDC), the gateway should be able to communicate with ALDC on IEC 60870-5-101 protocol. The specific protocol to be implemented shall be handed over to successful bidder. It shall be the bidder's responsibility to integrate his offered system with existing ALDC system for exchange of desired data. The exact IO point shall be decided during detailed engineering.
6. Remote HMI
7. Peripheral equipment like printers, display units, key boards, Mouse etc.
8. Bay protection Intelligent Electronic Devices (IEDs) for protection compliant to IEC 61850.
9. Integrated switches (built-in bay IEDs) are not acceptable. All the IEDs shall be directly connected to the Ethernet Interbay LAN without use of any gateways. The use of Ethernet hubs shall not be permitted.

1.3 It shall enable local station control via a PC by means of human machine interface (HMI) and control software package, which shall contain an extensive range of supervisory control and data acquisition (SCADA) functions.

1.4 It shall include communication gateway, intelligent electronic devices (IED) for bay control and inter IED communication infrastructure. An architecture drawing for SAS is enclosed at Annexure-A.

1.5 The communication gateway shall facilitate the information flow with remote control centers. The bay level intelligent electronic devices (IED) for protection and control shall provide the direct connection to the switchgear without the need of interposing components and perform control, protection, and monitoring functions.

1.6 The bidder shall ensure that proposed automation system is compatible with the existing SCADA in DTL established under unified scheme. The bidder will quote equipment for the SCADA and auxiliary power supplies and associated fiber optic communication system, for transfer of the SCADA data of the station to ALDC, SLDC and NRLDC.

The bidder shall supply the hard copies and soft copies of complete technical literature describing equipment principle design concepts and design specifications, cable schedule, operation and maintenance manual, source code for software maintenance. The vendor shall also arrange training to DTL engineers in attending emergencies, repairs and maintenance, etc.

Layout details of Automation equipment has been considered to be as follows:

Bay level intelligent electronic devices (IED) for protection and control shall be provided near each bay. Each IED will be directly connected to the Hot-standby Server PC of the...
Station Automation system (SAS) through a dual managed Ethernet LAN on fiber optic medium and shall communicate as per the IEC-61850 standard. The SAS shall be equipped with gateway for remote communication as detailed further in the specification. SCADA details will be communicated to nearest ALDC via adjoining sub stations and signal will be carried by optic fibre either OPGW for transmission line or optic fibre cable laid in the ground alongwith 220 kV under ground XLPE cable. The Contractor will make arrangement for supplying terminal equipment required for communication & for converting optic fibre signals into PLCC in case of requirement. The existing communication system works on IEC-60870 protocol and the inter operability document is enclosed in Annexure II.

The communication protocol of data concentrator must conform to existing communication protocol. Besides the Data Concentrator must support the following:-

- The Data Concentrator must be equipped with two Modems.
- The Data Concentrator shall be capable of accepting single point/double point information indication signals.
- The Data Concentrator will also accept telemeasuring signals under the form of DC.
- Data Concentrator will support single point/double point digital controls.
- The Data Concentrator must be capable of time tagging the status changes with a 10 ms resolution.

1.7 Tele-control plan for 220kV,66kV and 33 kV level is given below. Following information is required to be communicated to ALDC/SLDC.

### 220KV Level

<table>
<thead>
<tr>
<th>Tele-inf.</th>
<th>220 kV level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW</td>
<td>All feeders, Power Trfs(220/33 kV, 220/66 kV)</td>
</tr>
<tr>
<td>MVAR</td>
<td>All feeders, Power Trfs.(220/33kV, 220/66 kV)</td>
</tr>
<tr>
<td>MWH(units)</td>
<td>All feeders, Power Trfs.(220/33kV, 220/66 kV)</td>
</tr>
<tr>
<td>MVARH(units)</td>
<td>All feeders, Power Trfs.(220/33kV, 220/66 kV)</td>
</tr>
<tr>
<td>Voltage (kV)</td>
<td>1 measured per main bus limited to two only</td>
</tr>
<tr>
<td>Freq. (Hz.)</td>
<td>1 measured per sub-station</td>
</tr>
<tr>
<td>T- Taps</td>
<td>All 220/33kV &amp; 220/66 kV Power Transformers.</td>
</tr>
<tr>
<td>Current (Amps)</td>
<td>All feeders, Power Transformers (220/33kV, 220/66kV), Bus- Coupler.</td>
</tr>
<tr>
<td>Wdg. Temperature</td>
<td>For all Transformers</td>
</tr>
<tr>
<td>Oil Temp.</td>
<td>For all Transformers</td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td></td>
</tr>
<tr>
<td>CB- Double status information.</td>
<td>All feeders, Power Trfs., Bus Coupler, Bus Sections and Transfer Bus Coupler.</td>
</tr>
<tr>
<td>ISO- single status information.</td>
<td>All Bus, line and Transfer Bus isolators</td>
</tr>
<tr>
<td>Control</td>
<td>All feeders</td>
</tr>
</tbody>
</table>

### 66 kV level

<table>
<thead>
<tr>
<th>Tele-inf.</th>
<th>66 kV level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW</td>
<td>All feeders, Incomers and Bus Coupler.</td>
</tr>
<tr>
<td>MVAR</td>
<td>All feeders, Incomers and Bus Coupler.</td>
</tr>
<tr>
<td>MWH(units)</td>
<td>All feeders, Incomers and Bus Coupler.</td>
</tr>
<tr>
<td>MVARH(units)</td>
<td>All feeders, Incomers</td>
</tr>
<tr>
<td>Voltage (kV)</td>
<td>1 measured per main bus limited to two only</td>
</tr>
<tr>
<td>Freq. (Hz.)</td>
<td>1 measured per sub-station. 2 measured per Generating station.</td>
</tr>
<tr>
<td>T- Taps</td>
<td>NIL</td>
</tr>
<tr>
<td>Current (Amps)</td>
<td>All feeders, Incomers and Bus Coupler.</td>
</tr>
<tr>
<td>Wdg. Temp.</td>
<td>--</td>
</tr>
<tr>
<td>Oil Temp.</td>
<td>--</td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td></td>
</tr>
<tr>
<td>CB- Double status</td>
<td>All feeders, Incomers and Bus Coupler.</td>
</tr>
<tr>
<td>ISO- single status information.</td>
<td>All Bus and line isolators</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Control</td>
<td>For all Feeders excluding transformers</td>
</tr>
</tbody>
</table>

### 33 kV level

<table>
<thead>
<tr>
<th>Tele-inf.</th>
<th>33 kV level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW</td>
<td>All feeders, Incomers and Bus Coupler.</td>
</tr>
<tr>
<td>MVAR</td>
<td>All feeders, Incomers and Bus Coupler.</td>
</tr>
<tr>
<td>MVARH(units)</td>
<td>All feeders, Incomers and Bus Coupler.</td>
</tr>
<tr>
<td>Voltage (kV)</td>
<td>1 measured per main bus limited to two only</td>
</tr>
<tr>
<td>Freq. (Hz.)</td>
<td>1 measured per sub-station. 2 measured per Generating station.</td>
</tr>
<tr>
<td>T-Taps</td>
<td>NIL</td>
</tr>
<tr>
<td>Current (Amps)</td>
<td>All feeders, Incomers and Bus Coupler.</td>
</tr>
<tr>
<td>Wdg. Temp.</td>
<td>--</td>
</tr>
<tr>
<td>Oil Temp.</td>
<td>--</td>
</tr>
</tbody>
</table>

#### Status

| CB- Double status information. | All feeders, Incomers and Bus Coupler |
| ISO- single status information. | All Bus and line isolators |
| Control                       | For all Feeders excluding transformers |

### 1.8 Following equipments shall match/support the existing SCADA system:-

<table>
<thead>
<tr>
<th></th>
<th>1. RTU Panel</th>
<th>1 No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>SIC Panel</td>
<td>Depending upon the requirement of the scheme, no. of bays in the S/Stn.</td>
</tr>
</tbody>
</table>

#### Communication system requirement:

<table>
<thead>
<tr>
<th></th>
<th>Fiber Optical System</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>OLTE, Multiplexes, OPG cable, etc. as per communication scheme being adopted.</td>
</tr>
</tbody>
</table>

#### Cables For:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>C.T. Connection</td>
</tr>
<tr>
<td>ii.</td>
<td>P.T. Connection</td>
</tr>
<tr>
<td>iii.</td>
<td>Digital input for breaker and isolators</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>8x4 sq.mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4x2.5 sq.mm.</td>
</tr>
</tbody>
</table>

|                      | 12x.34 sq.mm. |

#### For each isolators

<table>
<thead>
<tr>
<th></th>
<th>2 NO/NC Auxiliary contacts.</th>
</tr>
</thead>
</table>

#### For each breakers

<table>
<thead>
<tr>
<th></th>
<th>4 NO/NC Auxiliary contacts.</th>
</tr>
</thead>
</table>

### 2.0 SYSTEM DESIGN

#### 2.1 General system design

The Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including future extensions.

The systems shall be of the state-of-the-art suitable for operation under electrical environment present in Extra high voltage substations, follow the latest engineering practice, ensure long-term compatibility requirements and continuity of equipment supply and the safety of the operating staff.
The offered SAS shall support remote control and monitoring from Remote Control centers via gateways.

The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.

The system shall incorporate the control, monitoring and protection functions specified, self-monitoring, signaling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

Maintenance, modification or extension of components may not cause a shutdown of the whole substation automation system. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

Bidder shall offer the bay mimic along with relay and protection panels and (described in other sections of technical specifications) housed in air-conditioned Kiosks suitably located in Station HMI in Control Room building for overall optimization in respect of cabling and control room building.

2.2 System architecture

The SAS shall be based on a decentralized architecture and on a concept of bay-oriented, distributed intelligence.

Functions shall be decentralized, object-oriented and located as close as possible to the process.
The main process information of the station shall be stored in distributed databases. The typical SAS architecture shall be structured in two levels, i.e. in a station and a bay level.

At bay level, the IEDs shall provide all bay level functions regarding control, monitoring and protection, inputs for status indication and outputs for commands. The IEDs should be directly connected to the switchgear without any need for additional interposition or transducers.

Each bay control IED shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the other bay control units of the station.

The data exchange between the electronic devices on bay and station level shall take place via the communication infrastructure. This shall be realized using fiber-optic cables, thereby guaranteeing disturbance free communication. The fiber optic cables shall be run in G.I. conduit pipes. Data exchange is to be realised using IEC 61850 protocol with a redundant managed switched Ethernet communication infrastructure.

The communication shall be made in 1+1 mode, excluding the links between individual bay IEDs to switch, such that failure of one set of fiber shall not affect the normal operation of the SAS. However it shall be alarmed in SAS. Each fiber optic cable shall have four (4) spare fibers.

At station level, the entire station shall be controlled and supervised from the station HMI. It shall also be possible to control and monitor the bay from the bay level equipment at all times.

Clear control priorities shall prevent operation of a single switch at the same time from more than one of the various control levels, i.e. RCC, station HMI, bay level or apparatus level. The priority shall always be on the lowest enabled control level.

The station level contains the station-oriented functions, which cannot be realised at bay level, e.g. alarm list or event list related to the entire substation, gateway for the communication with remote control centers.
The GPS time synchronizing signal (as specified in the section relay & protection) as per IEC 61850 Standard SNTP (Simple Network Time Protocol) for the synchronization of the entire system shall be provided.

The SAS shall contain the functional parts as described in Para 1.2 above.

2.3 FUNCTIONAL REQUIREMENTS

The high-voltage apparatus within the station shall be operated from different places:

- Remote control centers
- Station HMI.
- Local Bay controller IED (in the bays)

Operation shall be possible by only one operator at a time.

The operation shall depend on the conditions of other functions, such as interlocking, synchrocheck, etc. (See description in “Bay level control functions”).

2.3.1 Select-before-execute

For security reasons the command is always to be given in two stages: selection of the object and command for operation under all mode of operation except emergency operation. Final execution shall take place only when selection and command are actuated.

2.3.2 Command supervision

Bay/station interlocking and blocking

Software Interlocking is to be provided to ensure that inadvertent incorrect operation of switchgear causing damage and accidents in case of false operation does not take place.

In addition to software interlocking hardwired interlocking are to be provided for Bus Earth switch Interlocking.

It shall be a simple layout, easy to test and simple to handle when upgrading the station with future bays. For software interlocking the bidder shall describe the scenario while an IED of another bay is switched off or fails.

A software interlock override function shall be provided which can be enabled to bypass the interlocking function.

2.3.3 Run Time Command cancellation

Command execution timer (configurable) must be available for each control level connection. If the control action is not completed within a specified time, the command should get cancelled.

2.3.4 Self-supervision

Continuous self-supervision function with self-diagnostic feature shall be included.

2.3.5 User configuration

The monitoring, controlling and configuration of all input and output logical signals and binary inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

It shall also be possible to interconnect and derive input and output signals, logic functions, using built-in functions, complex voltage and currents, additional logics (AND-gates, OR gates and timers). (Multiactivation of these additional functions should be possible).

The Functional requirement shall be divided into following levels:
a. Bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer) Level Functions
b. System Level Functions

3.1 Bay level functions

In a decentralized architecture the functionality shall be as close to the process as possible. In this respect, the following functions can be allocated at bay level:

- Bay control functions including data collection functionality.
- Bay protection functions

Separate IEDs shall be provided for bay control function and bay protection function.

3.1.1 Bay control functions

3.1.1.1. Overview

Functions
- Control mode selection
- Select-before-execute principle
- Command supervision:
  - Interlocking and blocking
  - Double command
- Synchrocheck, voltage selection
- Run Time Command cancellation
- Transformer tap changer control (for power transformer bays)
- Operation counters for circuit breakers and pumps
- Hydraulic pump/ Air compressor control and runtime supervision
- Operating pressure supervision
- Display of interlocking and blocking
- Breaker position indication per phase
- Alarm annunciation
- Measurement display
- Local HMI (local guided, emergency mode) to display the single line diagram, status information, alarms and disturbances etc. with password protected access.
- Interface to the station HMI.
- Data storage for at least 200 events
- Extension possibilities with additional I/O's inside the unit or via fibre optic communication and process bus
- All the IEDs must be fully IEC 61850 compliant and shall be directly connected to the Ethernet Interbay LAN without use of any gateways

3.1.1.2. Control mode selection

Bay level Operation

As soon as the operator receives the operation access at bay level the operation is normally performed via bay control IED. During normal operation bay control unit allows the safe operation of all switching devices via the bay control IED.

EMERGENCY Operation

It shall be possible to close or open the selected Circuit Breaker with ON or OFF push buttons even during the outage of bay IED.

REMOTE mode

Control authority in this mode is given to a higher level (Remote Control Centre) and the installation can be controlled only remotely. Control operation from lower levels shall not be possible in this operating mode.

3.1.1.3. Synchronism and energizing check
The synchronism and energizing check functions shall be bay-oriented and distributed to the bay control and/or protection devices. These features are:

- Settable voltage, phase angle, and frequency difference.
- Energizing for dead line - live bus, live line - dead bus or dead line dead bus with no synchro-check function.
- Synchronising between live line and live bus with synchro-check function

**Voltage selection**

The voltages relevant for the Synchrocheck functions are dependent on the station topology, i.e. on the positions of the circuit breakers and/or the isolators. The correct voltage for synchronizing and energizing is derived from the auxiliary switches of the circuit breakers, the isolator, and earthing switch and shall be selected automatically by the bay control and protection IEDs.

### 3.1.1.4 Transformer tap changer control

Raise and lower operation of OLTC taps of transformer shall be facilitated through Bay controller IED.

### 3.1.2. Bay protection functions

#### 3.1.2.1 General

The protection functions are independent of bay control function. The protection shall be provided by separate protection IEDs (numerical relays) and other protection devices as per section Relay & Protection.

IEDs, shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions. The data presentation and the configuration of the various IEDs shall be compatible with the overall system communication and data exchange requirements.

**Event and disturbance recording function**

Each IED should contain an event recorder capable of storing at least 200 time-tagged events. This shall give alarm if 70% memory is full. The disturbance recorder function shall be as per detailed in section Relay and Protection.

### 3.2. System level functions

#### 3.2.1. Status supervision

The position of each switchgear, e.g. circuit breaker, isolator, earthing switch, transformer tap changer etc., shall be supervised continuously. Every detected change of position shall be immediately displayed in the single-line diagram on the station HMI screen, recorded in the event list and a hard copy printout shall be produced. Alarms shall be initiated in the case of spontaneous position changes.

The switchgear positions shall be indicated by two auxiliary switches, normally closed (NC) and normally open (NO), which shall give ambivalent signals. An alarm shall be initiated if these position indications are inconsistent or if the time required for operating mechanism to change position exceeds a predefined limit.

The SAS shall also monitor the status of sub-station auxiliaries. The status and control of auxiliaries shall be done through separate one or more IED and all alarm and analogue values shall be monitored and recoded through this IED.
3.2.2. Measurements

Analogue inputs for voltage and current measurements shall be connected directly to the voltage transformers (VT) and the current transformers (CT) without intermediate transducers. The values of active power (W), reactive power (VAR), frequency (Hz), and the rms values for voltage (U) and current (I) shall be calculated.

The measured values shall be displayed locally on the station HMI and in the control centre. The abnormal values must be discarded. The analogue values shall be updated every 2 seconds.

Threshold limit values shall be selectable for alarm indications.

3.2.3. Event and Alarm Handling

Events and alarms are generated either by the switchgear, by the control IEDs, or by the station level unit. They shall be recorded in an event list in the station HMI. Alarms shall be recorded in a separate alarm list and appear on the screen. All, or a freely selectable group of events and alarms shall also be printed out on an event printer. The alarms and events shall be time-tagged with a time resolution of 1 ms.

3.2.4. Station HMI

3.2.4.1. Substation HMI Operation:

On the HMI the object has to be selected first. In case of a blocking or interlocking conditions are not met, the selection shall not be possible and an appropriate alarm annunciation shall occur. If a selection is valid the position indication will show the possible direction, and the appropriate control execution button shall be pressed in order to close or open the corresponding object.

Control operation from other places (e.g. REMOTE) shall not be possible in this operating mode.

3.2.4.2. Presentation and Dialogues

General

The operator station HMI shall be a redundant with hot standby and shall provide basic functions for supervision and control of the substation. The operator shall give commands to the switchgear on the screen via mouse clicks or keyboard commands.

The HMI shall give the operator access to alarms and events displayed on the screen. Aside from these lists on the screen, there shall be a printout of alarms or events in an event log.

An acoustic alarm shall indicate abnormalities, and all unacknowledged alarms shall be accessible from any screen selected by the operator.

The following standard pictures shall be available from the HMI:

- Single-line diagram showing the switchgear status and measured values
- Control dialogues with interlocking and blocking details. This control dialogue shall tell the operator whether the device operation is permitted or blocked.
- Measurement dialogues
- Alarm list, station / bay-oriented
- Event list, station / bay-oriented
- System status
3.2.4.3. **HMI Design Principles**

Consistent design principles shall be adopted with the HMI concerning labels, colours, dialogues and fonts. Non-valid selections shall be dimmed out.

The object status shall be indicated using different status colours for:

- Selected object under command
- Selected on the screen
- Not updated, obsolete values, not in use or not sampled
- Alarm or faulty state
- Warning or blocked
- Update blocked or manually updated
- Control blocked
- Normal state

3.2.4.4. **Process Status Displays and Command Procedures**

The process status of the substation in terms of actual values of currents, voltages, frequency, active and reactive powers as well as the positions of circuit breakers, isolators and transformer tap-changers shall be displayed in the station single-line diagram.

In order to ensure a high degree of security against undesired operation, a "select-before-execute" command procedure shall be provided. After the "selection" of a switch, the operator shall be able to recognize the selected device on the screen, and all other switchgear shall be blocked. As communication between control centre and device to be controlled is established, the operator shall be prompted to confirm the control action and only then final execute command shall be accepted. After the "execution" of the command the operated switching symbol shall flash until the switch has reached its new position.

The operator shall be in a position to execute a command only, if the switch is not blocked and if no interlocking condition is going to be violated. The interlocking statements shall be checked by the interlocking scheme implemented at bay and station level.

After command execution the operator shall receive a confirmation that the new switching position has been reached or an indication that the switching procedure was unsuccessful with the indication of the reason for non-functioning.

3.2.4.5. **System Supervision & Display**

The SAS system shall be comprehensively self-monitored such that faults are immediately indicated to the operator, possibly before they develop into serious situations. Such faults are recorded as a faulty status in a system supervision display. This display shall cover the status of the entire substation including all switchgear, IEDs, communication infrastructure and remote communication links, and printers at the station level, etc.

3.2.4.6. **Event List**

The event list shall contain events that are important for the control and monitoring of the substation.

The event and associated time (with 1 ms resolution) of its occurrence has to be displayed for each event.

The operator shall be able to call up the chronological event list on the monitor at any time for the whole substation or sections of it.

A printout of each display shall be possible on the hard copy printer.
The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. It shall be possible to store all events in the computer for at least one month. The information shall be obtainable also from a printed event log.

The chronological event list shall contain:

- Position changes of circuit breakers, isolators and earthing devices
- Indication of protective relay operations
- Fault signals from the switchgear
- Indication when analogue measured values exceed upper and lower limits. Suitable provision shall be made in the system to define two level of alarm on either side of the value or which shall be user defined for each measurand.
- Loss of communication.

Filters for selection of a certain type or group of events shall be available. The filters shall be designed to enable viewing of events grouped per:

- Date and time
- Bay
- Device
- Function e.g. trips, protection operations etc.
- Alarm class

3.2.4.7. Alarm List

Faults and errors occurring in the substation shall be listed in an alarm list and shall be immediately transmitted to the control centre. The alarm list shall substitute a conventional alarm tableau, and shall constitute an evaluation of all station alarms. It shall contain unacknowledged alarms and persisting faults. The date and time of occurrence shall be indicated. The alarm list shall consist of a summary display of the present alarm situation. Each alarm shall be reported on one line that contains:

- The date and time of the alarm
- The name of the alarming object
- A descriptive text
- The acknowledgement state.

Whenever an alarm condition occurs, the alarm condition must be shown on the alarm list and must be displayed in a flashing state along with an audible alarm. After acknowledgement of the alarm, it should appear in a steady (i.e. not flashing) state and the audible alarm shall stop. The alarm should disappear only if the alarm condition has physically cleared and the operator has reset the alarm with a reset command. The state of the alarms shall be shown in the alarm list (Unacknowledged and persistent, Unacknowledged and cleared, Acknowledged and persistent).

Filters for selection of a certain type or group of alarms shall be available as for events.

3.2.4.8 Object picture

When selecting an object such as a circuit breaker or isolator in the single-line diagram, the associated bay picture shall be presented first. In the selected object picture, all attributes like

- Type of blocking
3.2.4.9 Control dialogues

The operator shall give commands to the system by means of mouse click located on the single-line diagram. It shall also be possible to use the keyboard for command activation. Data entry is performed with the keyboard. Dedicated control dialogues for controlling at least the following devices shall be available:

- Breaker and disconnector
- Transformer tap-changer

3.2.5 User-authority levels

It shall be possible to restrict activation of the process pictures of each object (bays, apparatus...) within a certain user authorization group. Each user shall then be given access rights to each group of objects, e.g.:

- Display only
- Normal operation (e.g. open/close of switchgear)
- Restricted operation (e.g. by-passed interlocking)
- System administrator

For maintenance and engineering purposes of the station HMI, the following authorization levels shall be available:

- No engineering allowed
- Engineering/configuration allowed
- Entire system management allowed

The access rights shall be defined by passwords assigned during the login procedure. Only the system administrator shall be able to add/remove users and change access rights.

3.2.6 Reports

The reports shall provide time-related follow-ups of measured and calculated values. The data displayed shall comprise:

- Trend reports:
  - Day (mean, peak)
  - Month (mean, peak)
  - Semi-annual (mean, peak)
  - Year (mean, peak)
- Historical reports of selected analogue Values:
• Day (at 15 minutes interval)
• Week
• Month
• Year

It shall be possible to select displayed values from the database in the process display online. Scrolling between e.g. days shall be possible. Unsure values shall be indicated. It shall be possible to select the time period for which the specific data are kept in the memory.

Following printouts shall be available from the printer and shall be printed on demand:

i. Daily voltage and frequency curves depicting time on X-axis and the appropriate parameters on the Y-axis. The time duration of the curve is 24 hours.

ii. Weekly trend curves for real and derived analogue values.

iii. Printouts of the maximum and minimum values and frequency of occurrence and duration of maximum and minimum values for each analogue parameter for each circuit in 24 hour period.

iv. Provision shall be made for logging information about breaker status like number of operation with date and time indications.

v. Equipment operation details shift wise and during 24 hours.

vi. Printout on adjustable time period as well as on demand for MW, MVAR, Current, Voltage on each feeder and transformer as well as Tap Positions, temperature and status of pumps and fans for transformers.

vii. Printout on adjustable time period as well as on demand system frequency and average frequency.

viii. Reports in specified formats which shall be handed over to successful bidder.

3.2.7. Trend display (historical data)

It shall be possible to illustrate all types of process data as trends - input and output data, binary and analogue data. The trends shall be displayed in graphical form as column or curve diagrams with a maximum of 10 trends per screen. Adjustable time span and scaling ranges must be provided.

It shall be possible to change the type of value logging (direct, mean, sum, or difference) on-line in the window. It shall also be possible to change the update intervals on-line in the picture as well as the selection of threshold values for alarming purposes.

3.2.8. Automatic disturbance file transfer

All recorded data from the IEDs with integrated disturbance recorder as well as dedicated disturbance recording systems shall be automatically uploaded (event triggered or once per day) to a dedicated computer and be stored on the hard disc.

3.2.9. Disturbance analysis

The PC-based work station shall have necessary software to evaluate all the required information for proper fault analysis.

3.2.10. IED parameter setting

It shall be possible to access all protection and control IEDs for reading the parameters (settings) from the station HMI or from a dedicated monitoring computer. The setting of
parameters or the activation of parameter sets shall only be allowed after entering a password.

3.2.11. **Automatic sequences**

The available automatic sequences in the system should be listed and described, (e.g. sequences related to the bus transfer). It must be possible to initiate pre-defined automatic sequences by the operator and also define new automatic sequences.

3.3. **Gateway**

3.3.1 **Communication Interface**

The Substation Automation System shall have the capability to support simultaneous communications with multiple independent remote master stations. The Substation Automation System shall have communication ports as follows

(a) Two ports for Remote Control Centre

(b) Two ports for Area Load Dispatch Centre (ALDC)

The communication interface to the SAS shall allow scanning and control of defined points within the substation automation system independently for each control centre. The substation automation system shall simultaneously respond to independent scans and commands from employer's control centres (RCC & ALDC). The substation automation system shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol to each remote control centre. Also, each control centre's data scan and control commands may be different for different data points within the substation automation system's database.

3.3.2 **Remote Control Centre Communication Interface**

Employer will supply communication channels between the Substation Automation System and the remote control centre. The communicator channels provided by Employer will consist of optical fibre the details of which shall be provided during detailed Engineering.

3.3.3 **Interface equipment:**

The Contractor shall provide interface equipments for communicating through optical fiber between Substation Automation system and Remote Control Centre and between Substation Automation system and area Load Dispatch Centre (ALDC).

In case of communication any modem supplied shall not require manual equalization and shall include self-test features such as manual mark/space keying, analogue loop-back, and digital loop-back. The modems shall provide for convenient adjustment of output level and receive sensitivity. The modem should be stand alone complete in all respects including power supply to interface the SAS with communication channel. The configuration of tones and speed shall be programmable and maintained in non-volatile memory in the modem. All necessary hardware and software and communication terminal equipments required to be installed for data transfer in the substation shall also be in the scope of bidder except the communication link (optical fiber) between substation control room and Remote Control Centre.

3.3.4 **Communication Protocol**

The communication protocol between gateway and station shall be open protocol / shall support IEC 60870-5-101. For all levels of communication such as Inter bay level, bay to station HMI etc. the communication protocol shall support IEC 61850.

4.0 **System hardware:**

4.1 **Redundant Station HMI, HMI View Node, Remote HMI and Disturbance Recorder Work station:**

The contractor shall provide redundant station HMI in hot standby mode.
It shall be capable to perform all functions for entire substation including future requirements as indicated in the SLD. It shall use industrial grade components. Processor and RAM shall be selected in such a manner that during normal operation not more than 30% capacity of processing and memory are used. Supplier shall demonstrate these features.

The capacity of hard disk shall be selected such that the following requirement should occupy less than 50% of disk space:

1. Storage of all analogue data (at 15 Minutes interval) and digital data including alarm, event and trend data for thirty (30) days.
2. Storage of all necessary software,
3. 20GB space for EMPLOYER’S use. Supplier shall demonstrate that the capacity of hard disk is sufficient to meet the above requirement.

**4.1.1 HMI (Human Machine Interface)**

The VDU shall show overview diagrams (Single Line Diagrams) and complete details of the switchgear with a colour display. All event and alarm annunciation shall be selectable in the form of lists. Operation shall be by a user friendly function keyboard and a cursor positioning device. The user interface shall be based on WINDOWS concepts with graphics & facility for panning, scrolling, zooming, decluttering etc.

**4.1.2 Visual Display Units/ TFT’s (Thin Film Technology)**

The contractor shall provide three display units, one for station HMI, one for redundant HMI and one for DR work station. These shall have high resolution and reflection protected picture screen. High stability of the picture geometry shall be ensured. The screen shall be at least 21” diagonally in size and capable of colour graphic displays.

The display shall accommodate resolution of 1280 X 1024 pixels. The HMI shall be able to switch the key board and cursor positioning device, as unit among all the monitors at a consol vis push button or other controls.

**4.1.3 Printer**

It shall be robust & suitable for operation with a minimum of 132 characters per line. The printing operation shall be quiet with a noise level of less than 45 dB suitable for location in the control room. Printer shall accept and print all ASCII characters via master control computer unit interface.

The printer shall have in built testing facility. Failure of the printer shall be indicated in the Station HMI. The printer shall have an off line mode selector switch to enable safe maintenance. The maintenance should be simple with provisions for ease of change of print head, ribbon changing, paper insertion etc.

All printers mounted in the control room shall be provided with a separate printer enclosure each. The enclosure shall be designed to permit full enclosure of the printers at a convenient level. Plexiglas windows shall be used to provide visual inspection of the printers and ease of reading. The printer enclosures shall be designed to protect the printers from accidental external contact & each should be removable from hinges at the back and shall be provided with lock at the front.

All reports and graphics prints shall be printed on laser printer. One dot matrix printer shall be exclusively used for hourly log printing.

All printers shall be continuously online.

**4.1.4 Mass Storage Unit**

The mass storage unit shall be built-in to the Station HMI. All operational measured values and indications shall be stored in a mass-storage unit of CD-ROM / DVD-ROM with 700 MB or more capacity. The unit should support at least Read (48X), Write (24X), and Re-Write (10X) operations, with Multi-Session capability. It should support IS09660, Rockridge and Joliet File systems. It should support formatting and use under the operating system
provided for Station HMI. The monthly back up of data shall be taken on disc. The facility of back up of data shall be inherent in the software.

4.1.5 Switched Ethernet Communication Infrastructure:

The bidder shall provide the redundant switched optical Ethernet communication infrastructure for SAS. The bidder shall keep provision of 100% spare capacity for employer use. One switch shall be provided to connect all IEDs for two bays of 220kV yard to communication infrastructure. For 66kV & 33Kv, one switch shall be provided for three bays.

4.2 Bay level unit

The bay unit shall use industrial grade components. The bay level unit, based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals. They shall incorporate select-before-operate control principles as safety measures for operation via the HMI. They shall perform all bay related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording and shall provide inputs for status indication and outputs for commands. They shall be directly connected to the switchgear. The bay unit shall acquire and process all data for the bay (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the other devices in sub-station automation system. In addition, this shall receive the operation commands from station HMI and control centre. The bay unit shall have the capability to store all the data for at least 24 hours.

One no. Bay level unit shall be provided for supervision and control of each 220kV, 66kV & 33kV bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer). The Bay level unit shall be equipped with analogue and binary inputs/outputs for handling the control, status monitoring and analogue measurement functions. All bay level interlocks are to be incorporated in the Bay level unit so as to permit control from the Bay level unit/ local bay mimic panel, with all bay interlocks in place, during maintenance and commissioning or in case of contingencies when the Station HMI is out of service.

The Bay level unit shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

4.2.1 Input/Output (I/O) modules

The I/O modules shall form a part of the bay level unit and shall provide coupling to the substation equipment. The I/O modules shall acquire all switchgear information (i.e. data coming directly from the switchgear or from switchgear interlocking devices) and transmit commands for operation of the switchgear. The measured values of voltage and current shall be from the secondaries of instrument transformers. The digital inputs shall be acquired by exception with 1 ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state.

4.3 Air-conditioned System

The following rooms shall be provided with split Air-Conditioners.

i) Bay level units, bay mimic, relay and protection panels etc. for 220KV bays.
ii) Bay level units, bay mimic, relay and protection panels etc. for 66KV bays.
iii) Bay level units, bay mimic, relay and protection panels etc. for 33kV bays.
iv) Battery room
v) Control room
vi) Electrical Lab./Protection Room
vii) Conference Room/Library
viii) Station incharge Room/DGM's Room
ix) SCADA/PLCC Room
x) Room for Engineers
xi) Room for non-executives
The design of layout plan, capacity, quantity of split AC and their control panels shall be subject to Employer's approval and conform to the IS: 1391(part-2). The split AC shall be installed atleast 4 star rated system as per the Bureau of Energy Efficiency (India). The AC rooms shall also be provided with fire alarm system with at least two detectors and it shall be wired to SAS for monitoring. The air conditionings system shall be provided with control and protection IEDs for performing substation automation and protection functions.

The high wall type split AC unit of suitable capacity shall be complete with high wall type indoor evaporator unit and air cooled outdoor condensing unit having hermetically sealed compressor.

The indoor units shall be high wall type. The indoor unit shall be compact and shall have elegant appearance. They shall have low noise centrifugal blowers driven by special motors and copper tube aluminium finned cooling coils. Removable and washable polypropylene filters shall be provided.

Outdoor unit shall comprise of hermetically sealed reciprocating/ rotary compressors mounted on vibration isolators, propeller type axial flow fans and copper tube aluminium finned coils all assembled in a sheet metal casing. The casing and the total unit shall be properly treated and shall be weatherproof type. They shall be compact in size and shall have horizontal discharge of air. The compressor shall be very reliable, trouble free and require less maintenance.

Copper refrigerant piping complete with insulation between the indoor and remote outdoor condensers as required. PVC drain piping from the indoor units upto the nearest drain point. Power and control cabling between the indoor unit and outdoor unit and earthing.

The air conditioning is required for critical application i.e. for maintaining the temperature for critical sub-station control and protection equipment. To provide redundancy for such critical applications, each split AC shall be installed with environment control system comprising of air conditioners working in conjunction through a micro processor based controller for desired operation. The system shall be designed for 24 Hours, 365 days of the year to maintain proper temperature for operation of the critical equipment. One of the air conditioner shall be standby mode and on failure of the any unit, the same shall start automatically. To ensure longer life of the system, all the functional units and standby unit shall also be running in cyclic operation through the controller.

4.4 Extendibility in future

Offered substation automation system shall be suitable for extension in future for additional bays. During such requirement, all the drawings and configurations, alarm/event list etc. displayed shall be designed in such a manner that its extension shall be easily performed by the employer. During such event, normal operation of the existing substation shall be unaffected and system shall not require a shutdown. The contractor shall provide all necessary software tools along with source codes to perform addition of bays in future and complete integration with SAS by the user. These software tools shall be able to configure IED, add additional analogue variable, alarm list, event list, modify interlocking logics etc. for additional bays/equipment which shall be added in future with IEDs of same manufacture/ different manufacture.

5.0 Software structure

The software package shall be structured according to the SAS architecture and strictly divided in various levels. Necessary firewall shall be provided at suitable points in software to protect the system. An extension of the station shall be possible with lowest possible efforts. Maintenance, modification or an extension of components of any feeder may not force a shutdown of the parts of the system, which are not affected by the system adaptation.

5.1.1 Station level software

5.1.1.2 Human-machine interface (HMI)
The base HMI software package for the operator station shall include the main SAS functions and it shall be independent of project specific hardware version and operating system. It shall further include tools for picture editing, engineering and system configuration. The system shall be easy to use, to maintain, and to adapt according to specific user requirements. Systems shall contain a library with standard functions and applications.

5.1.2 Bay level software

5.1.2.1 System software

The system software shall be structured in various levels. This software shall be placed in a non-volatile memory. The lowest level shall assure system performance and contain basic functions, which shall not be accessible by the application and maintenance engineer for modifications. The system shall support the generation of typical control macros and a process database for user specific data storage. In case of restoration of links after failure, the software along with hardware shall be capable of automatically synchronising with the remaining system without any manual interface. This shall be demonstrated by contractor during integrated system test.

5.1.2.2 Application software

In order to ensure robust quality and reliable software functions, the main part of the application software shall consist of standard software modules built as functional block elements. The functional blocks shall be documented and thoroughly tested. They form part of a library. The application software within the control/protection devices shall be programmed in a functional block language.

5.1.2.3 Network Management System

The contractor shall provide network management system software for following management functions:

a. Configuration Management
b. Fault Management
c. Performance Monitoring

This system shall be used for management of communication devices and other IEDs in the system. This NMS can be loaded in DR work-station and shall be easy to use, user friendly and menu based. The NMS shall monitor all the devices in the SAS and report if there is any fault in the monitored devices. The NMS shall
(a) Maintain performance, resource usage, and error statistics for all managed links and devices and present this information via displays, periodic reports and on demand reports.
(b) Maintain a graphical display of SAS connectivity and device status.
(c) Issue alarms when error conditions occurs
(d) Provide facility to add and delete addresses and links

5.1.2.4 The contractor shall provide each software in two copies in CD to load into the system in case of any problem related with Hardware/Communication etc.

6.0 TESTS

The substation automation system offered by the bidder shall be subjected to following tests to establish compliance with IEC 61850 for EHV sub station equipment installed in sheltered area in the outdoor switchyard specified ambient conditions:

6.1 Type Tests:

6.1.1 Control IEDs and Communication Equipment

a. Power Input:
   i Auxiliary Voltage
   ii Current Circuits
b. **Accuracy Tests:**
   i. Operational Measured Values
   ii. Currents
   iii. Voltages
   iv. Time resolution

c. **Insulation Tests:**
   i. Dielectric Tests
   ii. Impulse Voltage withstand Test

d. **Influencing Quantities:**
   i. Limits of operation
   ii. Permissible ripples
   iii. Interruption of input voltage

e. **Electromagnetic Compatibility Test:**
   i. 1 MHz burst disturbance test
   ii. Electrostatic Discharge Test
   iii. Radiated Electromagnetic Field Disturbance Test
   iv. Electrical Fast transient Disturbance Test
   v. Conducted Disturbances Tests induced by Radio Frequency Field
   vi. Magnetic Field Test
   vii. Emission (Radio interference level) Test.
   viii. Conducted Interference Test

f. **Function Tests:**
   i. Indication
   ii. Commands
   iii. Measured value Acquisition
   iv. Display Indications

g. **Environmental tests:**
   i. Cold Temperature
   ii. Dry Heat
   iii. Wet heat
   iv. Humidity (Damp heat Cycle)
   v. Vibration
   vi. Bump
   vii. Shock

6.2 **Factory Acceptance Tests:**

The supplier shall submit a test specification for factory acceptance test (FAT) and commissioning tests of the station automation system for approval. For the individual bay level IED's applicable type test certificates shall be submitted.

The manufacturing phase of the SAS shall be concluded by the factory acceptance test (FAT). The purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. If the FAT comprises only a certain portion of the system for practical reason, it has to be assured that this test configuration contains at least one unit of each and every type of equipment incorporated in the delivered system.

If the complete system consists of parts from various suppliers or some parts are already installed on site, the FAT shall be limited to sub-system tests. In such a case, the complete system test shall be performed on site together with the Site Acceptance Test (SAT).

6.3 **Integrated Testing:**
The integrated system tests shall be performed as detailed in subsequent clauses as per following configuration:

- Redundant Station HMI, DR work station, switches along with all IEDs and printers.

All other switches for complete sub-station as detailed in section project shall be simulated as needed.

6.3.1 Hardware Integration Tests:

The hardware integration test shall be performed on the specified systems to be used for Factory tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware integration tests.

6.3.2 Integrated System Tests:

Integrated system tests shall verify the stability of the hardware and the software. During the tests all functions shall run concurrently and all equipment shall operate a continuous 100 Hours period. The integrated system test shall ensure the SAS is free of improper interactions between software and hardware while the system is operating as a whole.

6.4 Field Tests:

The field tests shall completely verify all the features of SAS hardware and software.

7.0 SYSTEM OPERATION

7.1 Substation Operation

7.1.1 Normal Operation

Operation of the system by the operator from the remote RCC or at the substation shall take place via industry standard HMI (Human Machine interface) subsystem consisting of graphic colour VDU, a standard keyboard and a cursor positioning device (mouse).

The coloured screen shall be divided into 3 fields:

i) Message field with display of present time and date
ii) Display field for single line diagrams
iii) Navigation bar with alarm/condition indication

For display of alarm annunciation, lists of events etc a separate HMI View node shall be provided.

All operations shall be performed with mouse and/or a minimum number of function keys and cursor keys. The function keys shall have different meanings depending on the operation. The operator shall see the relevant meanings as function tests displayed in the command field (i.e. operator prompting). For control actions, the switchgear (i.e. circuit breaker etc.) requested shall be selectable on the display by means of the cursor keys. The switching element selected shall then appear on the background that shall be flashing in a different color. The operator prompting shall distinguish between:-

- Prompting of indications e.g. fault indications in the switchgear, and
- Prompting of operational sequences e.g. execution of switching operations

The summary information displayed in the message field shall give a rapid display of alarm/message of the system in which a fault has occurred and alarm annunciation lists in which the fault is described more fully.

Each operational sequence shall be divided into single operation steps which are initiated by means of the function keys/WINDOW command by mouse. Operator prompting shall
be designed in such a manner that only the permissible keys are available in the command field related to the specific operation step. Only those switching elements shall be accessed for which control actions are possible. If the operation step is rejected by the system, the operator prompting shall be supported by additional comments in the message field. The operation status shall be reset to the corresponding preceding step in the operation sequence by pressing one of the function keys. All operations shall be verified. Incorrect operations shall be indicated by comments in the message field and must not be executed.

The offer shall include a comprehensive description of the system. The above operation shall also be possible via WINDOWS based system by mouse.

8.0 Power Supply

Power for the substation automation system shall be derived from substation 220V DC system. Inverter of suitable capacity shall be provided for station HMI and its peripheral devices e.g. printer etc. In the event of Power failure, necessary safeguard software shall be built for proper shutdown and restart.

9.0 Documentation

The following documents shall be submitted for employer's approval during detailed engineering:

(a) System Architecture Drawing
(b) Hardware Specification
(c) Sizing Calculations of various components
(d) Response Time Calculation
(e) Functional Design Document

The following documentation to be provided for the system in the course of the project shall be consistent, CAD supported, and of similar look/feel. All CAD drawings to be provide in "dxf" format.

- List of Drawings
- Substation automation system architecture
- Block Diagram
- Guaranteed technical parameters, Functional Design Specification and Guaranteed availability and reliability
- Calculation for power supply dimensioning
- I/O Signal lists
- Schematic diagrams
- List of Apparatus
- List of Labels
- Logic Diagram (hardware & software)
- Kiosk layout drawing
- GA of kiosk and GTP
- Control Room Lay-out
- Test Specification for Factory Acceptance Test (FAT)
- Product Manuals
- Assembly Drawing
- Operator's Manual
- Complete documentation of implemented protocols between various elements
- Listing of software and loadable in CD ROM
- Other documents as may be required during detailed engineering

Two sets of hard copy and four sets of CD ROM containing all the as built documents/drawings shall be provided.
10.0 TRAINING, SUPPORT, SERVICES, MAINTENANCE AND SPARES

10.1 Training

Contractor personnel who are experienced instructors and who speak understandable English shall conduct training. The contractor shall arrange on its own cost all hardware training platform required for successful training and understanding in India. The Contractor shall provide all necessary training material. Each trainee shall receive individual copies of all technical manuals and all other documents used for training. These materials shall be sent to Employer at least two months before the scheduled commencement of the particular training course. Class materials, including the documents sent before the training courses as well as class handouts, shall become the property of Employer. Employer reserves the right to copy such materials, but for in-house training and use only. Hands-on training shall utilize equipment identical to that being supplied to Employer.

For all training courses the travel (e.g. airfare) and pre-diem expenses will be borne by the participants.

The schedule, location, and detailed contents of each course will be finalized during employer and contractor discussions.

10.2 Computer System Hardware Course

A computer system hardware course shall be offered, but at the system level only. The training course shall be designed to give Employer hardware personnel sufficient knowledge of the overall design and operation of the system so that they can correct obvious problems, configure the hardware, preventive maintenance run diagnostic programs, and communicate with contract maintenance personnel. The following subjects shall be covered:

a) **System Hardware Overview**: Configuration of the system hardware.

b) **Equipment Maintenance**: Basic theory of operation, maintenance techniques and diagnostic procedures for each element of the computer system, e.g. processors, auxiliary memories, LANs, routers and printers. Configuration of all the hardware equipments.

c) **System Expansion**: Techniques and procedures to expand and add equipment such as loggers, monitors and communication channels.

d) **System Maintenance**: Theory of operation and maintenance of the redundant hardware configuration, failover hardware, configuration control panels and failover switches. Maintenance of protective devices and power supplies.

e) **Subsystem Maintenance**: Theory of design and operation, maintenance techniques and practices, diagnostic procedures, and (where applicable) expansion techniques and procedures. Classes shall include hands-on training for the specific subsystems that are part of Employer’s equipment or part of similarly designed and configures subsystems. All interfaces to the computing equipment shall be taught in detail.

f) **Operational Training**: Practical training on preventive and corrective maintenance of all equipment, including use of special tools and instruments. This training shall be provided on Employer equipment, or on similarly configures systems.

10.3 Computer System Software Course

The Contractor shall provide a computer system software course that covers the following subjects:

(a) **System Programming**: 

Including all applicable programming languages and all stand-alone service and utility packages provided with the system. An introduction to software architecture, Effect of tuning parameters (OS software, Network software, database software etc.) on the performance of the system.

(b) **Operating System:**
Including the user aspects of the operating system, such as program loading and integrating procedures; scheduling, management, service, and utility functions and system expansion techniques and procedures

(c) **System Initialization and Failover:**
Including design, theory of operation, and practice Diagnostics:

(d) Including the execution of diagnostic procedures and the interpretation of diagnostic outputs,

(e) **Software Documentation:** Orientation in the organization and use of system software documentation.

(f) **Hands-on Training:** One week, with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

### 10.4 Application Software Course

The Contractor shall provide a comprehensive application software courses covering all applications including the database and display building course. The training shall include:

(a) **Overview:** Block diagrams of the application software and data flows. Programming standards and program interface conventions.

(b) **Application Functions:** Functional capabilities, design, and major algorithms. Associated maintenance and expansion techniques.

(c) **Software Development:** Techniques and conventions to be used for the preparation and integration of new software functions.

(d) **Software Generation:** Generation of application software from source code and associated software configuration control procedures.

(e) **Software Documentation:** Orientation in the organization and use of functional and detailed design documentation and of programmer and user manuals.

(f) **Hands-on Training:** One week, with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

### 10.5 Requirement of training:

The contractor shall provide training for two batches for two weeks each for following courses.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Name of Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Computer System Hardware</td>
</tr>
<tr>
<td>2</td>
<td>Computer System Software</td>
</tr>
<tr>
<td>3</td>
<td>Application Software</td>
</tr>
</tbody>
</table>

### 11.0 MAINTENANCE

#### 11.1 Maintenance Responsibility during the Guaranteed Availability Period.

During Guaranteed Availability Period, the Contractor shall take continual actions to ensure the guaranteed availability and shall make available all the necessary resources such as specialist personnel, spare parts, tools, test devices etc. for replacement or repair of all defective parts and shall have prime responsibility for keeping the system operational.

### 12.0 RELIABILITY AND AVAILABILITY

The SAS shall be designed so that the failure of any single component, processor, or device shall not render the system unavailable. The SAS shall be designed to satisfy the very high demands for reliability and availability concerning:

- Mechanical and electrical design
- Security against electrical interference (EMI)
- High quality components and boards
• Modular, well-tested hardware
• Thoroughly developed and tested modular software
• Easy-to-understand programming language for application programming
• Detailed graphical documentation and application software
• Built-in supervision and diagnostic functions
• Security
  - Experience of security requirements
  - Process know-how
  - Select before execute at operation
  - Process status representation as double indications
• Distributed solution
• Independent units connected to the local area network
• Back-up functions
• Panel design appropriate to the harsh electrical environment and ambient conditions
• Panel grounding immune against transient ground potential rise

Outage terms

1) Outage
The state in which substation automation system or a unit of SAS is unavailable for Normal Operation as defined in the clause 7.1 due to an event directly related to the SAS or unit of SAS. In the event, the Employer has taken any equipment system other than Sub-station Automation System for schedule/forced maintenance, the consequent outage to SAS shall not be considered as outage for the purpose of availability.

2) Actual outage duration (AOD)
The time elapsed in hours between the start and the end of an outage. The time shall be counted to the nearest 1/4th of an hour. Time less than 1/4th of an hour shall be counted as having duration of 1/4th of an hour.

3) Period Hours (PH)
The number of hours in the reporting period. In a full year the period hour are 8760h (8784h for a leap year).

4) Actual Outage hours (AOH)
The sum of actual outage duration within the reporting period
AOH = ΣAOD

5) Availability
Each SAS shall have a total availability of 99.98 % i.e. the ratio of total time duration minus the actual outage duration to total time duration.

12.1 Guarantees Required

The availability for the complete SAS shall be guaranteed by the Contractor. Bidder shall include in their offer the detailed calculation for the availability. The contractor shall demonstrate their availability guaranteed by conducting the availability test on the total sub-station automation system as a whole after commissioning of total Sub-station Automation system. The test shall verify the reliability and integrity of all sub-systems. Under these conditions the test shall establish an overall availability of 99.98%. After the lapse of 1000 Hours of cumulative test time, test records shall be examined to determine the conformance with availability criterion. In case of any outage during the availability test, the contractor shall rectify the problem and after rectification, the 1000 Hours period start after such rectification. If test object has not been met the test shall continue until the specified availability is achieved.

The contractor has to establish the availability in a maximum period of three months from the date of commencement of the availability test.

After the satisfactory conclusion of test both contractor and employer shall mutually agree to the test results and if these results satisfy the availability criterion, the test is considered to be completed successfully. After that the system shall be taken over by the employer and then the guarantee period shall start.
13.0 Spares

13.1 Consumables:

All consumables such as paper, cartridges shall be supplied by the contractor till the SAS is taken over by the Employer.

13.2 Availability Spares:

In addition to mandatory spares as listed in section project for SAS, the bidder is required to list the spares, which may be required for ensuring the guaranteed availability during the guaranteed availability period. The final list of spares shall form part of scope of supply and accordingly the price thereof shall be quoted by the bidder and shall be considered in the evaluation of the bids. During the guaranteed availability period, the spare parts supplied by the Contractor shall be made available to the Contractor for usage subject to replenishment at the earliest. Thus, at the end of availability period the inventory of spares with the Employer shall be fully replenished by the Contractor. However, any additional spares required to meet the availability of the system (which are not a part of the above spares supplied by the Contractor) would have to be supplied immediately by the Contractor free of cost to the Employer.

14.0 LIST OF EQUIPMENTS

Quantity of equipments shall be decided by bidder in order to achieve guaranteed reliability and availability as declared by bidder.

i) Station HMI
ii) Redundant Station HMI (in Hot-stand by mode)
iii) Bay level units along with bay mimic
iv) Disturbance Recorder Work Station (Maintenance HMI)
v) Colour Laser Printer - 1 No. (For Reports & Disturbance records)
vi) Dot matrix printers - (one each for Alarms and log sheets)
vii) All interface equipment for gateway to RCC and ALDC
viii) Communication infrastructure between Bay level units. Station HMI, Printers, gateways, redundant LAN etc. as required
ix) Remote workstation including HMI and along with one printer
x) Any other equipment as necessary.
SYSTEM ARCHITECTURE 220kV SAS

NOTES:
1. CONTROL WIRING SHALL BE DONE FROM BAY MARSHALLING KNOX EQUIPMENT UP TO BAY.
2. ALL OTHER WIRING SHALL BE OF OPTIC FIBER CABLE.
Annexure-I

Basic Monitoring requirements are:

- Switchgear status indication
- Measurements (U, I, P, Q, f)
- Event
- Alarm
- Winding temperature of transformers
- Ambient temperature
- Status and display of 415V LT system & 220V DC system
- Status of display of Fire protection system and Air conditioning system.
- Acquisition of all counters for inter-tripping counting the receive/send commands.
- Acquisition of alarm and fault record from protection relays
- Disturbance records
- Monitoring the state of batteries by displaying DC voltage, charging current and load current etc.
- Tap-position of Transformer

List of Inputs
The list of input for typical bays is as below:-

**Analogue inputs**

i) For line

| Current | R phase  
|---------|---------|
|         | Y phase  
|         | B phase  

| Voltage | R-Y phase  
|---------|------------|
|         | Y-B phase  
|         | B-R phase  

ii) For transformer

| Current | R phase  
|---------|---------|
|         | Y phase  
|         | B phase  

WTI (for transformer)

Tap position (for transformer only)

iii) For bus coupler

| Current | R phase  
|---------|---------|
|         | Y phase  
|         | B phase  

iv) Common

a) Voltage for Bus-1, Bus-II

| Voltage | R-Y phase  
|---------|------------|
|         | Y-B phase  
|         | B-R phase  

b) Frequency for Bus-1 and Bus-II

b) Ambient temperature (switchyard).

d) LT system

i) Voltage R-Y, Y-B, B-R of Main Switch Board section-I

ii) Voltage R-Y, Y-B, B-R of Main Switch Board section-II

iii) Voltage R-Y, Y-B, B-R of Diesel Generator

iv) Current from Diesel Generator

v) Voltage of 220V DCDB-I

vi) Voltage of 220V DCDB-II

vii) Current from 220V Battery set-I

viii) Current from 220V Battery set-II

ix) Current from 220V Battery charger-I

xi) Current from 220V Battery charger-I

xii) **Current from LT Tfr.-1**

xiii) **Current from LT Tfr.-2**
Digital Inputs

The list of input for various bays/SYSTEM is as follows:

1. Line bays
   i) Status of each pole of CB, Isolator, Earth switch
   ii) CB trouble
   iii) CB operation/closing lockout
   iv) Pole discrepancy optd
   v) Trip coil faulty
   vi) LBB optd
   vii) Bus bar proton trip relay optd
   viii) Main bkr auto recloser operated
   ix) auto recloser operated
   x) A/r lockout
   xi) Direct trip-l/ll sent
   xii) Direct trip-l/ll received
   xiii) Main 1/ Main II blocking
   xiv) Main 1/ Main II -Inter trip send
   xv) Main 1/ Main II-Inter trip receive
   xvi) O/V stage-I operated
   xvii) O/V stage-II operated
   xviii) FAULT LOCATOR FAULTY
   xix) MAIN-1/ Main II PT FUSE FAIL
   xx) MAIN-1 PROTN TRIP
   xx1) MAIN-1 PROTN TRIP
   xx2) MAIN-1 PSB ALARM
   xx3) MAIN-1 SOTF TRIP
   xx4) MAIN-1 R-PH TRIP
   xx5) MAIN-1 Y-PH TRIP
   xx6) MAIN-1 B-PH TRIP
   xx7) MAIN-1 START
   xx8) MAIN-1/ Main II inter trip
   xx9) MAIN-1/ Main II fault in reverse direction
   xxx) MAIN-1/ Main II ZONE-2 TRIP
   xxx1) MAIN-1/ Main II ZONE-3 TRIP
   xxx2) MAIN-1/ Main II weak end infeed optd
   xxx3) MAIN-1/ Main II PSB alarm
   xxx4) MAIN-1 SOF TRIP
   xxx5) MAIN-1 R-PHTRIP
   xxx6) MAIN-1 Y-PH TRIP
   xxx7) MAIN-1 B-PH TRIP
   xxx8) MAIN-1 START
   xxx9) MAIN-1 inter trip
   xl) MAIN-1/ MAIN-II fault in reverse direction
   xli) Back-up o/c optd
   xlii) Back-up e/f optd
   xliii) 220V DC-I/II source fail
   xlv) SPEECH CHANNEL FAIL
   xli) Optic fiber Protection Channel-1 FAIL
   xlii) Optic fiber Protection Channel-11 FAIL
   xliii) Under frequency Relay Trip (In case of 33kV)

2. Transformer bays
   i) Status of each pole of CB, Isolator, Earth switch
   ii) CB trouble
   iii) CB operation/ closing lockout
   iv) Pole discrepancy optd
   v) Trip coil faulty
   vi) LBB optd
   vii) Bus bar proton trip relay optd
   viii) REF OPTD
   ix) DIF OPTD
   x) OVERFLUX ALARM (MV)
xi) OVERFLUX TRIP (MV)

xii) OVERFLUX ALARM (HV)

xiii) OVERFLUX TRIP (HV)

xiv) HV BUS VT 1/2 FUSE FAIL

xv) MV BUS VT 1/2 FUSE FAIL

xvi) OTI ALARM/TRIP

xvii) PRD OPTD

xviii) OVERLOAD ALARM

xix) BUCHOLZ TRIP

xx) BUCHOLZ ALARM

xxi) OLTC BUCHOLZ ALARM (O.S.R)

xxii) OLTC BUCHOLZ TRIP

xxiii) OIL LOW ALARM

xxiv) Back-up o/c (HV) optd

xxv) Back-up e/f (HV) optd

xxvi) 220V DC-I/II source fail

xxvii) TAP MISMATCH

xxviii) GR-A PROTN OPTD

xxix) GR-B PROTN OPTD

xxx) Back-up o/c (MV) optd

xxxi) Back-up e/f (MV) optd

xxxii) SPR Optd.

3. Busbar Protection

i) Bus bar Main trip

ii) Bus bar Check trip

iii) Bus bar zone-I CT open

iv) Bus bar zone-II CT open

v) Bus transfer CT sup. Optd

vi) Bus protection relay fail

4. Auxiliary system

i) Incomer-I On/Off

ii) Incomer-II On/Off

iii) 415V Bus-I/II U/V

iv) 415V Bus coupler breaker on/off

v) DG set bkr on/off

vi) Alarm/trip signals as listed in Section : DG set

vii) LT transformer-I Buchholz alarm and trip

viii) LT transformer-II Buchholz alarm and trip

ix) LT transformer-I WTI alarm and trip

x) LT transformer-II WTI alarm and trip

xi) LT transformer-I OTI alarm and trip

xii) LT transformer-II OTI alarm and trip

xiii) Communication exchange fail

xiv) Time sync. Signal absent

xv) Alarm trip signals as listed in

xvi) Battery and Battery charger

xvii) 220V dc-I earth fault

xviii) 220V dc-II earth fault

xix) Alarm/trip signals as listed in Section: Fire protection system

The exact number and description of digital inputs shall be as per detailed engineering requirement. Apart from the above-mentioned digital inputs, minimum of 200 inputs shall be kept for DTL use in future.
INTEROPERABILITY DOCUMENT

1. Network Configuration

- Point to Point
- Point to multi point

2. Physical Layer

Transmission speed (In monitoring and control direction)
- 200 bps
- 300 bps
- 600 bps
- 1200 bps
- 2400 bps
- 4500 bps
- 9600 bps

3. Link Layer

Frame Format: FT 1.2
Link transmission procedure: Unbalanced
Address field of the Link: 1 Octet

4. Application Layer

Common address of ASDU: 1 Octet
Information Object address: 2 Octets
Cause of transmission: 1 Octet
Selection of Standard ASDUs.

Monitoring Direction

- 1: Single –point information M_SP_NA_1.
- 2: Single –point information with time tag M_SP_TA_1
- 3: Double –point information M_DP_NA_1.
- 4: Double –point information with time tag M_DP_TA_1.
- 5: Step position information M_ST_NA_1.
- 6: Step position information with time tag M_ST_TA_1
- 11: Measured value, scaled value M_ME_NB_1.
- 12: Measured value, scaled value with time tag M_ME_TB_1
- 15: Integrated totals M_IT_NA_1
- 16: Integrated totals with time tag M_IT_TA_1.
- 70: End of initialization M_EI_NA_1

Control Direction

- 45: Single command C_SC_NA_1
- 46: Double command C_DC_NA_1.
- 47: Regulating step command C_RC_NA_1.
- 49: Set point command, scaled value C_SE_NB_1
- 100: Interrogation command C_I_C_NA_1.
- 101: Counter Interrogation command C_CI_NA_1.
- 102: Read command C_RD_NA_1.
- 103: Clock synchronization command C_CS_NA_1.
- 105: Reset process command C_RP_NA_1.

File Transfer
• 120: File ready F_FR_NA_1.
• 121: Section ready F_SR_NA_1.
• 122: Call Directory, select file ,call file , call section F_SC_NA_1.
• 123: Last section , last segment F_LS_NA_1.
• 124: Ack file,ack section F_AF_NA_1.
• 125: Segment F_SG_NA_1.
• 126: Directory F_DR_TA_1.

**Note:** File transfer is used for uploading the RTU's configuration file, and also to acquire Sequence of Events on demand.
SECTION : 15
CONTROL AND RELAY PANELS
(Applicable for Sub-station with Automation System)

1. CONSTRUCTIONAL FEATURES

1.1. Simplex panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from rear for control panels & either front or rear for relay panels. In case of panel having width more than 800mm, double leaf-doors shall be provided. Doors shall have handles with either built-in locking facility or will be provided with pad-lock.

1.2 Relay panels shall be of simplex type design as indicated. It is the responsibility of the Contractor to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control schemes is properly accommodated in the panels without congestion and if necessary, provide panels with larger dimensions. No price increase at a later date on this account shall be allowed. However, the width of panels that are being offered to be placed in GIS rooms, should be in conformity with the space availability in the GIS room.

1.3 Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-42.

1.4 Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation.

1.5 All doors, removable covers and panels shall be gasketed all around with synthetic rubber gaskets Neoprene/EPDM generally conforming with provision of IS 11149. However, XLPE gaskets can also be used for fixing protective glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh.

1.6 Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces tune and smooth.

1.7 Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Anti vibration strips made of shock absorbing materials which shall be supplied by the contractor, shall be placed between panel & base frame.

1.8 Cable entries to the panels shall be from the bottom. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the panel/station through a flexible braided copper conductor rigidly.

1.9 Relay panels of modern modular construction would also be acceptable.

2. MOUNTING

2.1 All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panel shall be mounted flush. No equipment shall be mounted on the doors.

2.2 Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible.

2.3. The Contractor shall carry out cut out, mounting and wiring of the free issue items supplied by others which are to be mounted in his panel in accordance with the corresponding equipment manufacturer's drawings. Cut outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.

2.4 The centre lines of switches, push buttons and indicating lamps shall be not less than 750mm from the bottom of the panel. The centre lines of relays, meters and recorders shall be not less than 450mm from the bottom of the panel.

2.5. The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Like wise the top lines of all meters, relays and recorders etc. shall be matched.
2.6. No equipment shall be mounted on the doors.

3.0 PANEL INTERNAL WIRING
3.1. Panels shall be supplied complete with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally.
3.2. All wiring shall be carried out with 1100V grade, single core, stranded copper conductor wires with PVC insulation. The minimum size of the multi-stranded copper conductor used for internal wiring shall be as follows:
   - All circuits except current transformer circuits and voltage transformer circuits meant for energy metering – one 1.5mm sq. per lead.
   - All current transformer circuits one 2.5 sq.mm lead.
   - Voltage transformer circuit (for energy meters): Two 2.5 mm sq. per lead.
3.3. 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.
3.4. Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels.
3.5. Wire termination shall be made with solder less crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule.
3.6. Longitudinal troughs extending throughout the full length of the panel shall be preferred for inter panel wiring. Inter-connections to adjacent panel shall be brought out to a separate set of terminal blocks located near the slots of holes meant for taking the inter-connecting wires.
3.7. Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipments.

4. TERMINAL BLOCKS
4.1. All internal wiring to be connected to external equipment shall terminate on terminal blocks. Terminal blocks shall be 1100 V grade and have 10 Amps. Continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.
4.2. Disconnecting type terminal blocks for current transformer and voltage transformer secondary leads shall be provided. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.
4.3. At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.
4.4. Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of external cable on each side.
   - All CT & PT circuits: minimum of two of 2.5mm Sq. copper.
   - AC/DC Power Supply Circuits: One of 6mm Sq. Aluminum.
   - All other circuits: minimum of one of 2.5mm Sq. Copper.
4.5. There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate or panel side wall. Also the clearance between two rows of terminal blocks edges shall be minimum of 150mm.
4.6. Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side of the wiring-duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the Owner's external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.
4.7. The number and sizes of the Owner's multi core incoming external cables will be furnished to the Contractor after placement of the order. All necessary cable terminating accessories such as gland plates, supporting clamps & brackets, wiring troughs and gutters etc. (except glands & lugs) for external cables shall be included the scope of supply.
5. **PAINTING**
   5.1. All sheet steel work shall be phosphated in accordance with the IS: 6005 "Code of practice for phosphating iron and steel".
   5.2. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.
   5.3. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water rinsing with a slightly alkaline hot water and drying.
   5.4. After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.
   5.5. The phosphate coating shall be sealed with application of two coats of ready mixed, stoved type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.
   5.6. After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting. The exterior colour of paint shall be of a slightly different shade to enable inspection of the painting.
   5.7. A small quantity of finished paint shall be supplied for minor touching up required at site after installation of the panels.
   5.8. In case the bidder proposes to follow any other established painting procedure like electrostatic painting, the procedure shall be submitted for DTL’s review and approval.

6. **NAME PLATES AND MARKINGS**
   6.1. All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. Also on the top of each panel on front as well as rear side, large and bold nameplates shall be provided for circuit/feeder designation.
   6.2. All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.
   6.3. All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.
   6.4. Name Plates shall be made of non-rusting metal or 3 ply lamicoid. Name plates shall be black with white engraving lettering.
   6.5. All the panels shall be provided with name plate mounted inside the panel bearing LOA No & Date, Name of the Substation & feeder and reference drawing number.

7. **MISCELLANEOUS ACCESSORIES**
   7.1. **Plug Point:**
      240V, Single phase 50Hz, AC socket with switch suitable to accept 5 Amps and 15 Amps pin round standard Indian plug, shall be provided in the interior of each cubicle with ON-OFF switch.
   7.2. **Interior Lighting:**
      Each panel shall be provided with a fluorescent lighting fixture rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch. Adequate lighting shall also be provided for the corridor in Duplex panels.
   7.3. **Switches and Fuses:**
      Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breakers (MCB). Selection of the main and sub-circuit MCB rating shall be such as to ensure selective clearance of sub-circuit faults. MCBs shall confirm to IS: 13947. Each MCB shall be provided with one potential free contact and the same shall be wired for annunciation purpose. However voltage transformer circuits for relaying and metering shall be protected by fuses. All fuses shall be HRC cartridge type conforming to IS: 13703 mounted on plug-in type fuse bases. Fuse carrier base as well as MCBs shall have imprints of the fuse 'rating' and 'voltage'.
   7.4. **Space Heater:**
      Each panel shall be provided with a space heater rated for 240V, single phase, 50 Hz Ac supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit.

8. **EARTHING**
   8.1. All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq. mm perforated copper with threaded holes at a gap of 50mm with a provision of bolts and nuts for
8.1 Connection with cable armours and mounted equipment etc for effective earthing. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of Contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

8.2 Provision shall be made on each bus bar of the end panels for connecting Substation earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of Contractor.

8.3 All metallic cases of relays, instruments and other panel mounted equipment including gland plate, shall be connected to the earth bus by copper wires of size not less than 2.5 sq. mm. The colour code of earthing wires shall be green.

8.4 Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. Earthing may be done in such a manner that no circulating current shall flow in the panel.

8.5 VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

8.6 An electrostatic discharge point shall be provided in each panel connected to earth bus via 1 Mega Ohm resistor.

8.7 ENERGY METERS:- ABT meters (Microprocessor-based 3 Phase, 4 wire bi directional TriVector meter) of 0.2 accuracy class with open communication protocol (DLMS) of reputed make shall be supplied for each line protection panel and transformer panel for metering purpose. They shall be type tested as per IS / IEC. Details of the same shall be submitted to the Employer.

9. RELAYS

9.1 All relays shall conform to the requirements of IS:3231/IEC-60255/IEC 61000 or other applicable standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear.

9.2 All main protective relays shall be of numerical type and communication protocol shall be as per IEC 61850. Further, the test levels of EMI as indicated in IEC 61850 shall be applicable to these. All the relays shall be directly connected to the inter bay bus using fiber optic cables and shall support peer to peer communication. The relay shall generate GOOSE message as per IEC 61850 standards for interlocking and shall also ensure interoperability with 3rd Party relays. Each relay shall also generate an ICD file in XML format for engineering / integration to a vendor independent SCADA System. The relays should have a port for local communication for relay settings, modifications etc.

9.3 All protective relays shall be in draw out or plug-in type/modular cases with proper testing facilities. Necessary test plugs/test handles shall be supplied loose and shall be included in contractor's scope of supply.

9.4 All AC operated relays shall be suitable for operation at 50 Hz. AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 1 amp CT secondary. All DC operated relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation

9.5 The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts suit contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme; contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts.

9.6 All protective relays, auxiliary relays and timers except the lock out relays and interlocking relays specified shall be provided with self-reset type contacts. All protective relays and timers shall be provided with externally hand reset positive action operation indicators with inscription. All protective relays which do not have built-in hand-reset operation indicators shall have additional auxiliary relays with operating indicators (Flag relays) for this purpose. Similarly, separate operating indicator (auxiliary relays) shall also be provided in the trip circuits of protections located outside the board such as Buchholz relays, oil and winding temperature protection, sudden pressure devices, fire protection etc.
9.7. Timers shall be of solid state type. Time delay in terms of milliseconds obtained by the external capacitor resistor combination is not preferred and shall be avoided.

9.8. No control relay which shall trip the power circuit breaker when the relay is de-energised shall be employed in the circuits.

9.9. Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

9.10. Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured:
   (a) The operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.
   (b) Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously.
   (c) Impedance of the seal-in-unit shall be small enough to permit satisfactory operation of the trip coil on trip relays when the D.C. Supply Voltage is minimum.
   (d) Trip-circuit seal-in is required for all trip outputs, irrespective of the magnitude of the interrupted current. The trip-circuit seal-in logic shall not only seal-in the trip output(s), but also the relevant initiation signals to other scheme functions, (e.g. initiate signals to the circuit-breaker failure function, reclosing function etc.), and the alarm output signals.
   (e) Two methods of seal-in are required, one based on the measurement of AC current, catering for those circumstances for which the interrupted current is above a set threshold, and one based on a fixed time duration, catering for those circumstances for which the interrupted current is small (below the set threshold).
   (f) For the current seal-in method, the seal-in shall be maintained until the circuit-breaker opens, at which time the seal-in shall reset and the seal-in method shall not now revert to the fixed time duration method. For this seal-in method, the seal-in shall be maintained for the set time duration. For the line protection schemes, this time duration shall be independently settable for single- and three-pole tripping.
   (g) Seal-in by way of current or by way of the fixed duration timer shall occur irrespective of whether the trip command originates from within the main protection device itself (from any of the internal protection functions), or from an external device with its trip output routed through the main protection device for tripping. Trip-circuit seal-in shall not take place under sub-harmonic conditions (e.g. reactor ring down).

9.11. All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

9.12. The setting ranges of the relays offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.

9.13. Any alternative/additional protections or relays considered necessary for providing complete effective and reliable protection shall also be offered separately. The acceptance of this alternative/additional equipment shall lie with the DTL.

9.14. The bidder shall include in his bid a list of installations where the relays quoted have been in satisfactory operation.

9.15. All relays and their drawings shall have phase indications as R-Red, Y-Yellow, B-blue

9.16. For numerical relays, the scope shall include the following:
   a) Necessary software and hardware to up/down load the data to/from the relay from/to the personal computer installed in the substation. However, the supply of PC is not covered under this clause.
   b) The relay shall have suitable communication facility for future connectivity to SCADA. The relay shall be capable of supporting IEC 870-5-103 and IEC 61850 protocol.

10. TRANSMISSION LINE PROTECTION
10.1. The line protection relays are required to protect the line and clear the faults on line within shortest possible time with reliability, selectivity and full sensitivity to all type of faults on lines.

The general concept is to have two fast operating distance protection scheme preferably with two different operating principles. The Main-I and Main-II will generally be operated from signal from different cores of line VT. In case line VT is out due to any reason manual selection for Bus VT will be made. The Main-I and Main-II protections having equal performance requirement specially in respect of time as called for Main-I and Main-II for 220KV transmission lines. In case of 220KV XLPE cables Distance protection will be used as Main-I whereas the current differential protection will be used as Main-II protection without auto-reclosing. The general concept is to have distance protection for 66kV & 33kV line feeder as main protection.
10.2. The Transmission system for which the line protection equipment are required is shown in the reference drawing/document(s). The length of lines and the line parameters (Electrical Constants) shall be provided during detailed engineering.

10.3. The maximum fault current could be as high as 40 kA for 220 KV system and 31.5 KA for 66kV & 33kV, but the minimum fault current could be as low as 20% of rated current of CT secondary. The starting & measuring relays characteristics should be satisfactory under these extremely varying conditions.

10.4. The protective relays shall be suitable for use with capacitor voltage transformers having non-electronic damping and transient response as per IEC.

10.5. Fault Recorder, Distance to fault Locator and Over voltage relay (stage -1) functions if offered as an integral part of line protection relay, shall be acceptable provided these meet the technical requirements as specified in the respective clauses.

10.6. Auto reclose relay function if offered as an integral part of line distance protection relay, shall be acceptable for 220kV, 66kV and 33 KV (wherever applicable) lines only provided the auto reclose relay feature meets the technical requirements as specified in the respective clause.

10.7. The following protections shall be provided for each of the Transmission lines:

For 220KV

Main-I: Numerical distance protection scheme (with back up IDMT earth protection)
Main-II: Numerical distance protection scheme (with back up IDMT earth fault protection) of a different principle from that of Main –I

For 66KV

Main : Numerical distance protection scheme
Back up: Directional over current and Earth fault Protection

For 33KV

Main : Numerical distance protection scheme
Back up: Directional over current and Earth fault Protection

10.8. The detailed description of the above line protections is given here under

10.8.1. Main-I and Main-II Numerical Distance Protection scheme:
(a) Shall have continuous self monitoring and diagnostic feature.
(b) Shall be non-switched type with separate measurements for all phase to phase and phase to ground faults
(c) Shall have stepped time-distance characteristics and three independent zones (zone 1, zone-2 and zone-3)
(d) Shall have mho or quadrilateral or other suitably shaped characteristics for zone-1, zone-2 and zone- 3.
(e) shall have following maximum operating time (including trip relay time, if any) under given set of conditions and with CVT being used on line (with all filters included
(i) for 220 KV, 66kV & 33kV lines:

<table>
<thead>
<tr>
<th>Descriptions</th>
<th>220 kV</th>
<th>66kV</th>
<th>33kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source to Impedance ratio</td>
<td>4</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Relay setting (Ohms)</td>
<td>10 or 20</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Fault Locations (as % of relay setting)</td>
<td>50</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Fault resistance (Ohms)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maximum operating time</td>
<td>40 for all faults (Milliseconds)</td>
<td>45 for 3 ph. Faults &amp; 60 for all other faults</td>
<td>45 for 3 ph. Faults &amp; 60 for all other faults</td>
</tr>
</tbody>
</table>
(f) The relay shall have an adjustable characteristics angle setting range of 30 - 85 degree or shall have independent resistance(R) and reactance(X) setting.

(g) Shall have two independent continuously variable time setting range of 0-3 seconds for zone-2 and 0-5 seconds for zone-3.

(h) Shall have resetting time of less than 55 milli-seconds (including the resetting time of trip relays)

(i) Shall have variable residual compensation.

(j) Shall have memory circuits with defined characteristics in all three phases to ensure correct operation during close-up 3-phase faults and other adverse conditions and shall operate instantaneously when circuit breaker is closed to zero-volt 3 phase fault

(k) Shall have weak end in-feed feature

(l) Shall be suitable for single and three phase tripping except for 33KV where three phase tripping shall be provided.

(m) Shall have a continuous current rating of two times of rated current. The voltage circuit shall be capable of operation at 1.2 times rated voltage. The relay shall also be capable of carrying a high short time current of 70 times rated current without damage for a period of 1 sec.

(n) Shall be provided with necessary self reset type trip duty contacts for completion of the scheme (Minimum number of these trip duty contacts shall be four per phase) either through built in or through separate high speed trip relays. Making capacity of these trip contacts shall be 30 amp for 0.2 seconds with an inductive load of L/R > 10 mill seconds. If separate high speed trip relays are used, the operating time of the same shall not be more than 10 milliseconds

(o) Shall be suitable for use in permissive under reach / over reach /blocking communication mode.

(p) Shall have suitable number of potential free contacts for inter Tripping, Auto reclosing, CB failure, Disturbance recorder & Data acquisition system.

(q) Include power swing blocking protection which shall
- have suitable setting range to encircle the distance protection described above.
- block tripping during power swing conditions.
- release blocking in the event of actual fault

(r) include fuse failure protection which shall monitor all the three fuses of V.T. and associated cable against open circuit.
- inhibit trip circuits on operation and initiate annunciation.
- have an operating time less than 7 milliseconds
- remain inoperative for system earth faults

(s) include a directional back up Inverse Definite Minimum Time (IDMT) earth fault relay with normal inverse characteristics as per IEC 60255-3 as a built in feature or as a separate unit for transmission lines

(t) In case the numerical distance relay is not having the built in feature as per above clause (s), the same can be supplied as an independent relay

(u) Must have a current reversal guard feature.

10.8.2 Back-up Directional over Current and Earth fault protection scheme

(a) Shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s)

(b) Shall be of Numerical type

(c) Shall include necessary VT fuse failure relays for alarm purposes.

(d) Shall
- have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting
- have a variable setting range of 50-200% of rated current
- have a characteristic angle of 30/45 degree lead
- include hand reset flag indicators or LEDs

(e) Shall
- have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting
- have a variable setting range of 20-80% of rated current
- have a characteristic angle of 45/60 degree lag
- include hand reset flag indicators or LEDs
- include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay

10.8.3 All trip relays used in transmission line protection scheme shall be of self/electrical reset type depending on application requirement

11.0 Circuit Breaker Protection:
This shall include following function

11.1. AUTO RECLSOING function shall be separate from Main-I and Main-II protection, alternatively in built function of bay controller IED is also acceptable and shall

(a) Have single phase or/and three phase reclosing facilities.
(b) Have a continuously variable single phase dead time range of 0.1-2 seconds.
(c) Have a continuously variable three phase dead time range of 0.1-2 seconds.
(d) Have a continuously variable reclaim time range of 5-300 seconds.
(e) Incorporate a four-position selector switch from which single phase/three phase/single and three phase auto reclosure and non-auto reclosure mode can be selected. Alternatively, the mode of auto reclosing can be selected through programming.
(f) Have facilities for selecting check synchronizing or dead line charging features. It shall be possible at any time to change the required feature by reconnection of links.
(g) Be of single shot type.
(h) be acceptable as built in with line distance relay for 220kV, 66kV and 33KV lines
(i) Include check synchronizing relay which shall
• Have a time setting continuously variable between 0.5-5 seconds. with a facility of additional 10 seconds
• Have a response time within 200 milli seconds with the timer disconnected.
• have a phase angle setting not exceeding 35 degree
• have a voltage difference setting not exceeding 10%
• include dead line charging relay which shall
• have two sets of relays and each set shall be able to monitor the three phase voltage where one set shall be connected to the line CVTs with a fixed setting of 20% of rated voltage and the other set shall be connected to he bus CVTs with a fixed setting of 80% of rated voltage.
• Incorporate necessary auxiliary relays and timers to give comprehensive scheme.

11.2 LOCAL BREAKER BACK-UP PROTECTION SCHEME shall
(a) Be triple pole type for 220 KV, 66kV and 33KV.
(b) Have an operating time of less than 15 milli seconds
(c) Have a resetting time of less than 15 milli seconds
(d) Have three over current elements
(e) be arranged to get individual initiation from the corresponding phase of main protections of line for each over current element. However, common three phase initiation is acceptable for other protections and transformer equipment protections.
(f) Have a setting range of 20-80% of rated current
(g) have a continuous thermal withstand two times rated current irrespective of the setting
(h) Have a timer with continuously adjustable setting range of 0.1-1 seconds.
(i) Have necessary auxiliary relays to make a comprehensive scheme.

11.3. TRIP CIRCUIT SUPERVISION RELAY
(a) The relay shall be capable of monitoring the healthiness of each 'phase' trip-coil and associated circuit of circuit breaker during 'ON' and 'OFF' conditions.
(b) The relay shall have adequate contacts for providing connection to alarm and event logger.
(c) The relay shall have time delay on drop-off of not less than 200 milli seconds and be provided with operation indications for each phase.

12. LINE OVER VOLTAGE PROTECTION RELAY shall
a. monitor all three phases
b. have two independent stages and stage- 1 & II relay are acceptable as built in with line distance relays Main I & II respectively
c. have an adjustable setting range of 100-170% of rated voltage with an adjustable time delay range of 1 to 60 seconds for the first stage.
d. Have an adjustable setting range of 100-170% of rated voltage with a time delay of 100-200 milliseconds for the second stage.
e. be tuned to power frequency
f. Provided with separate operation indicators (flag target) for each stage relays.
g. Have a drop-off to pick-up ratio greater than 95%.
h. provide separate out-put contacts for each 'Phase' and stage for breaker trip relays, event logger and other scheme requirements

13. TRANSFORMER PROTECTION
13.1. Numerical Transformer differential protection scheme shall
(a) Be triple pole type, with faulty phase identification/ indication
(b) have an operating time not greater than 30 milli seconds at 5 times the rated current.
(c) Have three instantaneous high set over-current units
(d) Have an adjustable bias setting range of 20-50%
(e) Be suitable for rated current of 1 Amp.
(f) have second harmonic or other inrush proof features and also should be stable under normal over fluxing conditions. Magnetising inrush proof feature shall not be achieved through any intentional time delay e.g. use of timers to block relay operation or using disc operated relays

(g) Have an operating current setting of 15% or less

(h) include necessary separate interposing current transformers for angle and ratio correction or have internal feature in the relay to take care of the angle & ratio correction

(i) have a disturbance recording feature to record graphic form of instantaneous values of current in all three windings in six analogue channels for voltage transformers, during faults and disturbances for the pre fault and post fault period. The disturbance recorder shall have the facility to record the following external digital channel signals apart from the digital signals pertaining to differential relay.

i. REF protection operated
ii. HV breaker status
iii. LV breaker status
iv. Buchholz /OLTC Buchholz alarm / trip
v. WTI/OTI/PRD alarm/trip of transformer

Necessary hardware and software for down loading the data captured by disturbance recorder to the personal computer available in the substation shall be included in the scope.

14. Over fluxing protection Relays shall

(a) Operate on the principle of Voltage to frequency ratio and shall be phase to phase connected

(b) Have inverse time characteristics, matching with transformer overfluxing withstand capability curve.

(c) Provide an independent 'alarm' with the time delay continuously adjustable between 0.1 to 6.0 seconds at values of 'v/f' between 100% to 130% of rated values

(d) Tripping time shall be governed by 'v/f Vs. time characteristics of the relay

(e) have a set of characteristics for Various time multiplier settings. The maximum operating time of the relay shall not exceed 3 seconds and 1.5 seconds at 'v/f' values of 1.4 and 1.5 times, the rated values, respectively.

(f) Have an accuracy of operating time, better than ±10%.

(g) Have a resetting ratio of 95 % or better.

(h) Be acceptable as a built in feature of numerical transformer differential relay

14.1. Numerical Restricted Earth Fault Protection shall

(a) Be single pole type

(b) Be of current/voltage operated high impedance type

(c) Have a current setting range of 10-40% of 1 Amp./ suitable voltage setting range.

(d) Be tuned to the system frequency

14.2. Numerical Back-up Over Current and Earth fault protection scheme with high set feature

(a) Shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s).

(b) The scheme shall include necessary VT fuse failure relays for alarm purposes

(c) Over current relay shall

• have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current

• have low transient, over reach high set instantaneous unit of continuously variable setting range 500-2000 % of rated current

• have a characteristic angle of 30/45 degree lead

(d) Earth fault relay shall

• have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 20-80% of rated current

• have low transient, over reach high set instantaneous unit of continuously variable setting range 200-800 % of rated current

• have a characteristic angle of 45/60 degree lag

• include hand reset flag indicators or LEDs

• include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay.

14.3. Transformer Overload Protection Relay shall

a. be of single pole type

b. be of definite time over-current type

c. have one set of over-current relay element, with continuously adjustable setting range of 50%-200% of rated current
d. Have one adjustable time delay relay for alarm having setting range of 1 to 10.0 seconds, continuously.

e. Have a drop-off/pick-up ratio greater than 95%.

f. be acceptable as built in feature of numerical transformer differential relay

15. **TRIPPING RELAY**

High Speed Tripping Relay shall

(a) Be instantaneous (operating time not to exceed 10 milliseconds).

(b) Reset within 20 milliseconds

(c) Be D.C. operated

(d) have adequate contacts to meet the requirement of scheme, other functions like auto-reclose relay, LBB relay as well as cater to associated equipment like event logger, Disturbance recorder, fault Locator, etc.

(e) Be provided with operation indicators for each element/coil.

16. **DC SUPPLY SUPERVISION RELAY**

(a) The relay shall be capable of monitoring the failure of D.C. supply to which, it is connected.

(b) It shall have adequate potential free contacts to meet the scheme requirement.

(c) The relay shall have a 'time delay on drop-off' of not less than 100 milliseconds and be provided with operation indicator/flag.

17. **BUS BAR PROTECTION**

17.1 Single bus bar protection scheme shall be provided for each bus for 220KV voltage level.

17.2 Each Bus Bar protection scheme shall

(a) Have maximum operating time up to trip impulse to trip relay for all types of faults of 25 milliseconds at 5 times setting value.

(b) Operate selectively for each bus bar

(c) Give hundred percent securities up to 40 KA fault level for 220KV

(d) Incorporate continuous supervision for CT secondary against any possible open circuit and if it occurs, shall render the relevant zone of protection inoperative and initiate an alarm

(e) Not give false operation during normal load flow in bus bars.

(f) Incorporate clear zone indication.

(g) Be of phase segregated and triple pole type

(h) Provide independent zones of protection

(i) include individual high speed electrically reset tripping relays for each feeder.

(j) Be transient free in operation

(k) not cause tripping for the differential current below the load current of heaviest loaded feeder. Bidder shall submit application check for the same.

(l) Shall include necessary C.T. Switching relays wherever C.T. Switching is involved and have 'CT' selection incomplete alarm

(m) Include protection 'IN/OUT' switch for each zone.

(n) shall include trip relays, CT switching relays(if applicable), auxiliary CTs (if applicable) as well as additional power supply modules, input modules etc. as may required to provide a Bus-bar protection scheme for the complete bus arrangement i.e. for all the bay or breakers under this specification as per the Single line diagram for new substations.

17.3 Built-in Local Breaker Backup protection feature as a part of bus bar protection scheme shall also be acceptable.

17.4 At existing substations, Bus-bar protection scheme with independent zones for each bus will be available. All necessary co-ordination for 'AC' and 'DC' interconnections between existing schemes (Panels) and the bays proposed under the scope of this contract shall be fully covered by the bidder. Any auxiliary relay, trip relay, flag relay and multi tap auxiliary CTs (in case of biased differential protection) required to facilitate the operation of the bays covered under this contract shall be fully covered in the scope of the bidder.

(a) The test terminal blocks (TTB) to be provided shall be fully enclosed with removable covers and made of moulded, non-inflammable plastic material with boxes and barriers moulded integrally. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring. Terminal block shall have shorting, disconnecting and testing facilities for CT circuits.

18. **FAULT RECORDER**

18.1 Fault recorder shall be microprocessor based and shall be used to record the graphic
form of instantaneous values of voltage and current in all three phases, open delta
voltage & neutral current, open or closed position of relay contacts and breakers during the
system disturbances and built-in feature of line distance relay is acceptable provided
the requirements of following clauses are met.

18.2 The fault recorder shall consist of individual acquisition units, one for each feeder and an
Evaluation unit which is common for the entire Substation. Whenever, more than one
acquisition units are connected to an Evaluation unit, necessary hardware and software shall also
be supplied for on line transfer of data from all acquisition units to Evaluation unit. If there are any
constraints for one Evaluation unit to accept the data from number of acquisition units under the
present scope, adequate number of Evaluation units shall be supplied. In case of extension of
existing substation(s), one set of Evaluation unit shall be supplied for each substation where ever
Fault recorders are specified.

18.3 Fault recorder shall have 8 analog and 16 digital channels for each feeder.

18.4 Acquisition units shall acquire the fault data for the pre-fault and post-fault period and
transfer them to Evaluation unit automatically to store in the hard disk. The acquisition units
shall be located in the protection panels of the respective feeders.

18.5 The acquisition unit shall be suitable for inputs from current transformers with 1A rated secondary
and capacitive voltage transformers with 63.5V (phase to neutral voltage) rated secondary.
Any device required for processing of input signals in order to make the signals compatible to
the Fault recorder equipment shall form an integral part of it. However, such processing of
input signals shall in no way distort its waveform.

18.6 The equipment shall be carefully screened, shielded, earthed and protected as may be required
for its safe functioning. Also, the Fault recorder shall have stable software, reliable hardware,
simplicity of maintenance and immunity from the effects of the hostile environment of EHV
switchyard which are prone to various interference signals typical y from large switching
transients.

18.7 The Evaluation unit shall consist of a desktop personal computer (including TFT colour monitor,
mouse and keyboard) and printer. The desktop PC shall be of latest configuration.

18.8 Necessary software for transferring the data automatically y from local evaluation unit to a remote
station and receiving the same at the remote station through owner's PLCC//LEASED LINE
shall be provided.

18.9 Evaluation software shall be provided for the analysis and evaluation of the recorded data
made available in the PC under DOS/WINDOWS environment. The Software features shall
include repositioning of analog and digital signals, selection and am-plification of time and
amplitude scales of each analog and digital channel, calculation of MAX/MIN frequency, phase
difference values, recording of MAX/MIN values etc. of analog channel, group of signal to be
drawn on the same axis etc, listing and numbering of all analog and digital channels and current,
voltage, frequency and phase difference values at the time of fault/tripping. Also, the software
should be capable of carrying out. Fourier /Harmonic analysis of the current and voltage wave
forms. The Fault records shall also be available in COMTRADE format (IEEE standard-
Common Format for Transient data Exchange for Power System )

18.10 The Evaluation unit shall be connected to the printer obtain the graphic form of
disturbances whenever desired by the operator.

18.11 Fault recorder acquisition units shall be suitable to operate from 220V DC or 110V DC as
available at sub-station Evaluation unit along with the printer shall normal y be connected to
230V, single phase AC supply. In case of failure of AC supply, Evaluation unit and printer
shall be switched automatically to the station DC through Inverter of adequate capacity
which shall form a part of Fault recorder system.

18.12 The acquisition unit shall have the following features
(a) Facility shall exist to alarm operator in case of any internal faults in the acquisition units such as
power supply fail, processor / memory fail etc and same shall be wired to annunciation
system.
(b) The frequency response shall be 5 Hz on lower side and 250 Hz or better on upper side.
(c) Scan rate shall be 1000 Hz/channel or better.
(d) Pre-fault time shall not be less than 100 milliseconds and the post fault time shall not be less than
2 seconds (adjustable). If another system disturbance occurs during one post-fault run time, the
recorder shall also be able to record the same. However, the total memory of acquisition unit shall
not be less than 5.0 seconds
(e) The open delta voltage and neutral current shall be derived either through software or externally
by pr through software or externally by providing necessary auxiliary transformers.
(f) The acquisition unit shall be typically used to record the following digital channels:
1. Main CB R phase open
2. Main CB Y phase open
3. Main CB B phase open
4. Main-1 carrier received
5. Main-1 protection operated
6. Direct Trip received
7. Main-2 carrier received
8. Main-2/Back Up protection operated
9. Bus bar protection operated
10. LBB operated of main circuit breaker

(g) In case the Fault recorder is in-built part of line distance protection, above digital channels may be interfaced either externally or internally.

(h) Any digital signal can be programmed to act as trigger for the acquisition unit. Analog channels should have programmable threshold levels for triggers and selection for over or under levels should be possible.

18.13 The printer shall be compatible with the desktop PC and shall use Plain paper. The print out shall contain the Feeder identity, Date and time (in hour, minute and second up to 100th of a second), identity of trigger source and Graphic form of analogue and digital signals of all the channels. Two packets of paper (500 sheets in each packet) suitable for printer shall be supplied.

18.14 Each Fault recorder shall have its own time generator and the clock of the time generator shall be such that the drift is limited to +0.5 seconds/day, if allowed to run without synchronization. Further, Fault recorder shall have facility to synchronizes its time generator from Time Synchronization Equipment having output generator from Time Synchronization Equipment having output of following types.
- Voltage signal: (0-5V continuously settable, with 50m Sec. minimum pulse duration
- Potential free contact (Minimum pulse duration of 50 m Sec.).
- IRIG-B
- RS232C

19. DISTANCE TO FAULT LOCATOR

a) Be electronic or microprocessor based type.
b) Be 'On-line' type
c) Be suitable for breaker operating time of 2 cycles
d) Have built-in display unit
e) The display shall be directly in percent of line length or kilometers without requiring any further calculations
f) have an accuracy of 3% or better for the typical conditions defined for operating timings measurement of distance relays.
g) The above accuracy should not be impaired under the following conditions:
   - presence of remote end infeed
   - predominant D.C. component in fault current
   - high fault arc resistance
   - severe CVT transients
   - Shall have mutual zero sequence compensation unit if fault locator is to be used on double circuit transmission line.
   - built in feature of line distance relay is acceptable provided the requirements of above clauses are met

20. TIME SYNCHRONISATION EQUIPMENT

20.1 The Time synchronisation equipment shall receive the coordinated Universal Time (UTC) transmitted through Geo Positioning Satellite System (GPS) and synchronise equipments to the Indian Standard Time in a substation.
20.2 Time synchronisation equipment shall include antenna, all special cables and processing equipment etc.
20.3 It shall be compatible for synchronisation of Event Loggers, Disturbance recorders and SCADA at a substation through individual port or through Ethernet realised through optic fibre bus.
20.4 Equipment shall operate up to the ambient temperature of 50 degree centigrade and 100% humidity.
20.5 The synchronisation equipment shall have 2 micro second accuracy. Equipment shall give real time corresponding to IST (taking into consideration all factors like voltage, & temperature variations, propagation & processing delays etc).
20.6 Equipment shall meet the requirement of IEC 60255 for storage & operation.
20.7 The system shall be able to track the satellites to ensure no interruption of synchronisation signal.
20.8 The output signal from each port shall be programmable at site for either one hour, half hour, minute or second pulse, as per requirement.
20.9 The equipment offered shall have six (6) output ports. Various combinations of output ports shall be selected by the customer, during detailed engineering, from the following:
- Voltage signal: Normally 0-5V with 50 milliseconds minimum pulse duration. In case any other voltage signal is required, it shall be decided during detailed engineering.
- Potential free contact (Minimum pulse duration of 50 milli Seconds.)
- IRIG-B
- RS232C

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

20.11 Time synchronization equipment shall be suitable to operate from 220V DC or 110V DC as available at Substation.

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

21 RELAY TEST KIT
21.1 One automatic relay test kit suitable for both steady state and dynamic testing of all types of relay (voltage, current, frequency, distance and differential) electromechanical/static/numerical/alongwith all accessories, test leads, carrying case etc. shall be supplied by bidder. The make of the test set shall be approved by DTL before placement of order. It should be suitable for testing of relay supplied.

22 TYPE TESTS
22.1 The reports for following type tests shall be submitted by the bidder for the Protective relays, Fault locator, Disturbance recorder and Event Logger
a) Insulation tests as per IEC 60255-5
b) High frequency disturbance test as per IEC 60255-4(Appendix -E) Class III(not applicable for electromechanical relays)
c) Fast transient test as per IEC 1000-4, Level III (not applicable for electromechanical relays)
d) Relay characteristics, performance and accuracy test as per IEC 60255
   - Steady state Characteristics and operating time
   - Dynamic Characteristics and operating time for distance protection relays and current differential protection relays
   - For Disturbance recorder and Event logger only performance tests are intended under this item.
e) Tests for thermal and mechanical requirements as per IEC 60255-6
f) Tests for rated burden as per IEC 60255-6
g) Contact performance test as per IEC 60255-0-20 (not applicable for Event logger, Distance to fault locator and Disturbance recorder).

22.2 Steady state & Dynamic characteristics test reports on the distance protection relays, as type test, shall be based on test programme specified in Appendix A on simulator/network analyzer/PTL. Alternatively, the files generated using Electromagnetic transient Programme (EMTP) can also be used for carrying out the above tests. Single source dynamic above tests. Single source dynamic tests on transformer differential relay shall be/should have been conducted based on general guidelines specified in CIGRE committee 34 report on Evaluation of characteristics and performance of Power system protection relays and protective systems.

23 CONFIGURATION OF RELAY AND PROTECTION PANELS
The following is the general criteria for the selection of the equipments to be provided in each type of panel.

LINE PROTECTION PANEL
The Line Protection panel for transmission lines shall consist of following relays and protection schemes.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>220kV</th>
<th>66kV</th>
<th>33kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Main-1 Numerical Distance protection scheme</td>
<td>1 Set</td>
<td>1 Set</td>
<td>1 Set</td>
</tr>
<tr>
<td>2</td>
<td>Main-2 Numerical Distance protection scheme (Current differential relay in case of XLPE cable)</td>
<td>1 Set</td>
<td>NIL</td>
<td>NIL</td>
</tr>
<tr>
<td>3</td>
<td>Disturbance Recorder</td>
<td>1 Set</td>
<td>NIL</td>
<td>NIL</td>
</tr>
<tr>
<td>4</td>
<td>Distance to fault Locator</td>
<td>1 Set</td>
<td>1 Set</td>
<td>1 Set</td>
</tr>
</tbody>
</table>
5 | 3 phase Trip Relays | 2 Nos | 2 Nos | 2 Nos
---|------------------|-------|-------|-------
6 | Flag relays, carrier receive relays, aux. Relays timers etc as per scheme Requirements | Lot | Lot | Lot
7 | Under Voltage relay for isolator/earth switch | 2 Nos | 2 Nos | 2 Nos
8 | ABT meters (Microprocessor-based 3 Phase, 4 wire bi directional TriVector meter) of 0.2 accuracy class with open communication protocol (DLMS) - 02 nos. (one main & one check meter) for 220, 66kV & 33 kV level | 1 Set | 1 Set | 1 Set
9 | Directional back up Over current and E/F protection scheme | NIL | 1 Set | 1 Set

In a substation where 220 KV lines are under the scope of the contract, bidder is required to give Main 1 and main 2 distance protection scheme.

**NOTE:** The configuration of relay protection panel may be reviewed by the bidder considering requirements of the different clauses of the NIT document.

Similar Current Differential relay (in case of XLPE cable) for Sending end also needs to be supplied for matching with receiving end.

Synchronizing scheme shall be provided on 220KV Feeder.

### 24. TRANSFORMER PROTECTION PANEL

The protection panel for Auto transformer/Transformer shall consists of the following equipments:

<table>
<thead>
<tr>
<th>S No.</th>
<th>Description</th>
<th>HV side</th>
<th>MV/LV side</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transformer Differential Protection scheme</td>
<td>1 Nos.</td>
<td>Nil</td>
</tr>
<tr>
<td>2</td>
<td>Restricted Earth fault protection scheme</td>
<td>1 Nos.</td>
<td>1 Nos.</td>
</tr>
<tr>
<td>3</td>
<td>Directional back up O/C and E/F relay with non directional high set feature</td>
<td>1 set</td>
<td>1 set</td>
</tr>
<tr>
<td>4</td>
<td>Over Fluxing Protection scheme</td>
<td>1 Nos.</td>
<td>Nil</td>
</tr>
<tr>
<td>5</td>
<td>Overload protection scheme</td>
<td>1 Nos.</td>
<td>Nil</td>
</tr>
<tr>
<td>6</td>
<td>Three phase trip relays</td>
<td>2 nos.</td>
<td>2 nos.</td>
</tr>
<tr>
<td>7</td>
<td>CVT selection relays as per scheme requirement</td>
<td>Lot</td>
<td>Lot</td>
</tr>
<tr>
<td>8</td>
<td>Flag relays, aux. relays, timers etc as per scheme requirement including transformer alarms and trip functions</td>
<td>Lot</td>
<td>Lot</td>
</tr>
<tr>
<td>9</td>
<td>ABT meters (Microprocessor-based 3 Phase, 4 wire bi directional TriVector meter) of 0.2 accuracy class with open communication protocol (DLMS)</td>
<td>1 set</td>
<td>1 set</td>
</tr>
</tbody>
</table>

#### Bus Coupler Protection Panel

A Protection Panel for Bus Coupler shall consist of following equipments:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>220 KV</th>
<th>66kV</th>
<th>33kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IDMT over current &amp; earth fault relays</td>
<td>1 set</td>
<td>1 set</td>
<td>1 set</td>
</tr>
<tr>
<td>2</td>
<td>DC Supply Supervision Relays</td>
<td>2 Nos.</td>
<td>2 Nos.</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>3</td>
<td>CT Switching Relays (if applicable)</td>
<td>1 set</td>
<td>1 set</td>
<td>Nil</td>
</tr>
<tr>
<td>4</td>
<td>Trip Circuit Supervision Relay</td>
<td>6 nos.</td>
<td>3 nos.</td>
<td>3 nos.</td>
</tr>
<tr>
<td>5</td>
<td>Flag Relays, Auxiliary Relays, Timers, Trip Relays etc. as per scheme requirement</td>
<td>Lot</td>
<td>Lot</td>
<td>Lot</td>
</tr>
<tr>
<td>6</td>
<td>PT Fuse Failure Relays</td>
<td>1 set</td>
<td>1 set</td>
<td>1 set</td>
</tr>
</tbody>
</table>

**BREAKER RELAY PANEL**
The breaker relay panel shall comprise of the following:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>With A/R</th>
<th>With out A/R</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Breaker failure Protection Scheme</td>
<td>1 No.</td>
<td>1 No.</td>
</tr>
<tr>
<td>2</td>
<td>DC supply Supervision relay</td>
<td>2 Nos.</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>3</td>
<td>Trip Circuit supervision relays</td>
<td>6 Nos.</td>
<td>6 Nos.</td>
</tr>
<tr>
<td>4</td>
<td>Auto reclose scheme with check synchronizing and dead line charging relay</td>
<td>1 Nos.</td>
<td>NIL</td>
</tr>
<tr>
<td>5</td>
<td>Flag relays, aux relays, timers, trip relays as per scheme requirements.</td>
<td>Lot</td>
<td>Lot</td>
</tr>
</tbody>
</table>

25. **ERECTION AND MAINTENANCE TOOL EQUIPMENTS**

All special testing equipment required for the installation and maintenance of the apparatus, instruments devices shall be furnished in relevant schedule.

26. **TROPICALISATION**

Control room will be normally air-cooled/air-conditioned. All equipments shall however be suitable for installation in a tropical monsoon area having hot, humid climate and dry and dusty seasons with ambient conditions specified in the specification. All control wiring, equipment and accessories shall be protected against fungus growth, condensation, vermin and other harmful effects due to tropical environment.
TEST PROGRAMME FOR DISTANCE RELAYS

General Comments:

1. These test cases are evolved from the report of working group 04 of study committee 34 (Protection) on evaluation of characteristics and performance of power system protection relays and protective systems. For any further guidelines required for carrying out the tests, reference may be made to the above document.

2. The test shall be carried out using network configuration and system parameters as shown in the figure-1.

3. All denotations regarding fault location, breakers etc are referred in figure –1.

4. The fault inception angles are referred to R- N voltage for all types of faults.

5. The fault inception angle is zero degree unless otherwise specified.

6. Where not stated specifically, the fault resistance ($R_f$) shall be zero or minimum as possible in simulator.

7. Single pole circuit breakers are to be used.

System parameters

System voltage =220kV
CTR= 1000/1
PTR = 220000/110 (with CVT, the parameters of CVT model are shown in figure –2)

| Positive Sequence Resistance, ($r_1$) | 0.02897 Ω |
| Positive Sequence Reactance ($x_1$) | 0.3072 Ω |
| Zero Sequence Resistance ($r_0$) | 0.2597 Ω |
| Zero Sequence Reactance ($x_1$) | 1.0223 Ω |
| Zero Sequence Mutual Resistance ($r_m$) | 0.2281 Ω |
| Zero Sequence Mutual Reactance ($x_m$) | 0.6221 Ω |
| Zero Sequence suceptance ($b_0$) | 2.347 μ mho |
| Positive Sequence suceptance ($b_1$) | 3.630 μ mho |

* Alternatively, the tests can be done with 10 Ω secondary impedance and source impedance may accordingly be modified.

<table>
<thead>
<tr>
<th>Type of line</th>
<th>Short</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary line impedance</td>
<td>2 Ω</td>
<td>20 Ω*</td>
</tr>
<tr>
<td>Length of line in Kms</td>
<td>23.57</td>
<td>235.7</td>
</tr>
<tr>
<td>SIR</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Source impedance (pry) (at a Time constant of 50 ms)</td>
<td>29.09 Ω (5500 MVA)</td>
<td>109.09 Ω (1467 MVA)</td>
</tr>
</tbody>
</table>

CVT Model

C1 Tuning Circuit (RI,LI) Damping Circuit (Ra, La)
C2 Load (Rc)

Capacitive Intermediate Transformer

Table: Capacitive Intermediate Transformer

| XC1 | 1.455 μ mho |
| XC2 | 27.646 μ mho |
| RL | 320 Ω |
| XL1 | 34243 Ω |
| Ra | 4.200 Ω |
| Xla | 197.92 Ω |
| Rc | 14.00 Ω |
| Transformation ratio of Intermediate transformer | 181.8 |
## DETAILS OF FAULT CASES TO BE DONE

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Description</th>
<th>Single source with short line (2 Ω)</th>
<th>Single source long line (20 Ω)</th>
<th>Double source with short double line (2 Ω)</th>
<th>Double source with long single line (20Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dynamic accuracy for zone 1</td>
<td>CLOSE C1, OPEN C2,C3,C4</td>
<td>SIR=4</td>
<td>Tests to be done at 2 locations (84 % and 76 % of line length) X 4 faults (RN, YB, YBN, RYB) X 2 fault inception angle(0°,90°) = 16 cases</td>
<td>Tests to be done at 2 locations (84 % and 76 % of line length) X 4 faults (RN, YB, YBN, RYB) X 2 fault inception angle(0°,90°) = 16 cases</td>
</tr>
<tr>
<td>2</td>
<td>Operating time for zone 1 at SIR =4</td>
<td>Tests to be done at 3 locations (0%, 40% and 64% of line length) X 4 faults (RN, YB, YBN, RYB) X 4 fault inception angle (0°, 30°, 60° and 90°) = 48</td>
<td>SIR=15</td>
<td>Tests to be done at 3 locations (0%, 40% and 64% of line length) X 4 faults (RN, YB, YBN, RYB) X 4 fault inception angle (0°, 30°, 60° and 90°) = 48 cases</td>
<td>Tests to be done at 3 locations (0%, 40% and 64% of line length) X 4 faults (RN, YB, YBN, RYB) X 4 fault inception angle (0°, 30°, 60° and 90°) = 48 cases</td>
</tr>
<tr>
<td>3</td>
<td>Operating time for zone II and Zone III</td>
<td>Tests to be done at 1 location (100 % of line length) X 1 faults (RN, YB, YBN, RYB) X 2 zones (II and III) = 2 cases</td>
<td>SIR = 4</td>
<td>Tests to be done at 1 location (100 % of line length) X 1 faults (RN, YB, YBN, RYB) X 2 zones (II and III) = 2 cases</td>
<td>Tests to be done at 1 location (100 % of line length) X 1 faults (RN, YB, YBN, RYB) X 2 zones (II and III) = 2 cases</td>
</tr>
<tr>
<td>4</td>
<td>Switch on to fault feature</td>
<td>Tests to be done at 2 locations (0% and 32%) X 1 faults (RYB) Any fault inception angle = 2 cases</td>
<td>SIR = 4</td>
<td>Tests to be done at 2 locations (0% and 32%) X 1 faults (RYB) Any fault inception angle = 2 cases</td>
<td>Tests to be done at 2 locations (0% and 32%) X 1 faults (RYB) Any fault inception angle = 2 cases</td>
</tr>
</tbody>
</table>

---

Section 15 : C&R Panel  Page 17 of 19
<table>
<thead>
<tr>
<th></th>
<th>Operation during current reversal</th>
<th></th>
<th></th>
<th>Tests to be done at 2 location (0 % and 80 % of line length) X 1 faults (RN) X 1 fault inception angle (0 degrees)= 2 cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>CLOSE C1, OPEN C2,C3,C4</td>
<td>5</td>
<td>CLOSE C1, OPEN C2,C3,C4</td>
<td>CLOSE C1, C2,C3,C4</td>
</tr>
<tr>
<td></td>
<td>SIR=4</td>
<td>SIR=15</td>
<td>SIR =4</td>
<td>SIR = 4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Operation at simultaneous faults</th>
<th></th>
<th></th>
<th>Tests to be done at 2 location (8 % and 64 % of line length) X 2 faults (RN in circuit 1 to BN in circuit 2 and RN in circuit 1 to RYN in circuit 2 in 10 ms) X 1 fault inception angle (0°) = 4 cases (*1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Directional sensitivity</th>
<th></th>
<th></th>
<th>Tests to be done at 1 location (0% reverse) X 6 faults(RN,YB ,YBN , RYB,RN with Rf=13.75 ohm(sec) and RYN with Rf=13.75 Ohm (sec) X 2 fault inception angle (0° ,90°)= 12 cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Limit for fault resistance</th>
<th></th>
<th></th>
<th>Tests to be done at 2 location (0% and 68 % of line length) X 1 fault (RN with Rf=13.75 ohm(sec) X</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operation at evolving faults</td>
<td>Measure fault location for all cases under 1 and 2</td>
<td>Measure fault location for all cases under 1 and 2</td>
<td>Measure fault location for all cases under 1 and 2</td>
</tr>
<tr>
<td>----</td>
<td>------------------------------</td>
<td>---------------------------------------------------</td>
<td>---------------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>9</td>
<td>2 fault inception angle (0°,90°)= 4 cases</td>
<td>Tests to be done at 2 location (32% and 0% of line length) X 2 faults (RN to RYN) x in 2 timings (10 ms and 30 ms) X 2 load direction (from A to B and from B to A) =16 cases</td>
<td>Measure fault location for all cases under 1 and 2</td>
<td>Measure fault location for all cases under 1 and 2</td>
</tr>
<tr>
<td>10</td>
<td>Fault locator function, in case the same is offered as built in feature</td>
<td>Measure fault location for all cases under 1 and 2</td>
<td>Measure fault location for all cases under 1 and 2</td>
<td>Measure fault location for all cases under 1 and 2</td>
</tr>
</tbody>
</table>
SECTION : 16

POWER & CONTROL CABLES

1.0 1.1 KV GRADE POWER & CONTROL CABLES

1.1. CRITERIA FOR SELECTION OF POWER & CONTROL CABLES

1.1.1. Aluminium conductor XLPE insulated armored cables shall be used for main power supply purpose from LT Aux. Transformers to control room.

1.1.2. Aluminium conductor PVC insulated armored power cables shall be used for various other applications in switchyard area/control room except for control/protection purposes.

1.1.3. For all control/protection/instrumentation purposes PVC insulated armored control cables of minimum 2.5 sq.mm. size with stranded Copper conductors shall be used.

1.1.4. Bidders are to estimate the quantity of cables and quote accordingly. The sizes of power cables to be used per feeder in different application shall be as follows:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>From</th>
<th>To</th>
<th>Cable size</th>
<th>Cable Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Main Switch Board</td>
<td>LT Transformer</td>
<td>2-1C X 630 mm² per phase 1-1C X 630 mm² for neutral</td>
<td>XLPE</td>
</tr>
<tr>
<td>2</td>
<td>Main Switch Board</td>
<td>AC Distribution Board</td>
<td>2-3½C X 300 mm²</td>
<td>XLPE</td>
</tr>
<tr>
<td>3</td>
<td>Main Switch Board</td>
<td>Air Conditioning Board</td>
<td>1-3½C X 300 mm²</td>
<td>XLPE</td>
</tr>
<tr>
<td>4</td>
<td>Main Switch Board</td>
<td>Oil Filtration Unit</td>
<td>1-3½C X 300 mm²</td>
<td>XLPE</td>
</tr>
<tr>
<td>5</td>
<td>AC Distribution Board</td>
<td>D.G. Set AMF Panel</td>
<td>2-3½C X 300 mm²</td>
<td>XLPE</td>
</tr>
<tr>
<td>6</td>
<td>Main Switch Board</td>
<td>Lighting transformer</td>
<td>1-3½C X 70 mm²</td>
<td>XLPE</td>
</tr>
<tr>
<td>7</td>
<td>Lighting transformer</td>
<td>Main Lighting DB</td>
<td>1-3½C X 70 mm²</td>
<td>XLPE</td>
</tr>
<tr>
<td>8</td>
<td>AC Distribution Board</td>
<td>Emergency Lighting Transformer</td>
<td>1-3½C X 70 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>9</td>
<td>Emergency Lighting transformer</td>
<td>Emergency Lighting DB</td>
<td>1-3½C X 70 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>10</td>
<td>AC distribution Board</td>
<td>ICT MB</td>
<td>1-3½C X 70 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>11</td>
<td>AC Distribution Board</td>
<td>Bay MB</td>
<td>1-3½C X 35 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>12</td>
<td>AC Distribution Board</td>
<td>Battery Charger 1-3½C X 70 mm²</td>
<td>PVC</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>DCDB</td>
<td>Battery</td>
<td>2-1C X 150 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>14</td>
<td>DCDB</td>
<td>Battery charger</td>
<td>2-1C X 150 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>15</td>
<td>DCDB</td>
<td>Protection/PLCC</td>
<td>1-2C X 6 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>16</td>
<td>Main Lighting DB</td>
<td>Lighting Panels (indoor)</td>
<td>1-3½C X 35 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>17</td>
<td>Main Lighting DB</td>
<td>Lighting</td>
<td>1-3½C X 70 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>DB</td>
<td>Panels (outdoor)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Main Lighting DB</td>
<td>Receptacles (indoor)</td>
<td>1-3½C X 35 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>19</td>
<td>Main Lighting DB</td>
<td>Receptacles (outdoor)</td>
<td>1-3½C X 70 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>20</td>
<td>Lighting Panel</td>
<td>Sub-lighting panels</td>
<td>1-4C X 16 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>21</td>
<td>Lighting Panel/</td>
<td>Lighting fixtures</td>
<td>1-2C X 6 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td></td>
<td>Sub-lighting panels</td>
<td>(outdoor)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Bay MB</td>
<td>Equipments</td>
<td>1-4C X 16 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>/ 1-4C X 6 mm²</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>/ 1-2C X 6 mm²</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Air Conditioning Board</td>
<td>A/C unit panel</td>
<td>1-3½C X 70 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>24</td>
<td>Air Conditioning Board</td>
<td>AHU</td>
<td>1-3½C X 35 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>25</td>
<td>Air Conditioning Board</td>
<td>Heater</td>
<td>1-3½C X 35 mm²</td>
<td>PVC</td>
</tr>
<tr>
<td>26</td>
<td>Air Conditioning Board</td>
<td>Chiller Pump</td>
<td>1-3½C X 35 mm²</td>
<td>PVC</td>
</tr>
</tbody>
</table>

1.1.5 Bidder may offer sizes other than the sizes specified in clause 1.1.4. In such case and For other application where sizes of cables have not been indicated in the specification, sizing of power cables shall be done keeping in view continuous current, voltage drop & short-circuit consideration of the system. Relevant calculations shall be submitted by bidder during detailed engineering for purchaser’s approval.

1.1.6 Cables shall be laid conforming to IS: 1255.

1.1.7 While preparing cable schedules for control/protection purpose following shall be ensured:

1.1.7.1 Separate cables shall be used for AC & DC.

1.1.7.2 Separate cables shall be used for DC1 & DC2.

1.1.8 For different cores of CT & CVT separate cable shall be used

1.1.9 Atleast one (1) cores shall be kept as spare in each copper control cable of 4C, 5C or 7C size whereas minimum no. of spare cores shall be two (2) for control cables of 10 core or higher size.

1.1.10 For control cabling, including CT/VT circuits, 2.5 sq.mm. size copper cables shall be used per connection. However, if required from voltage drop/VA burden consideration additional cores shall be used. Further for potential circuits of energy meters separate connections by 2 cores of 2.5 sq.mm. size shall be provided.

1.2. TECHNICAL REQUIREMENTS

1.2.1. General

1.2.1.1. The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

1.2.1.2. They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions. The XLPE /PVC insulated L.T. power cables of sizes 240 sq. mm. and above shall withstand without damage a 3 phase fault
The current of at least 45 kA for at least 0.12 second, with an initial peak of 105 kA in one of the phases. The armour for these power cables shall be capable of carrying 45 kA for at least 0.12 seconds without exceeding the maximum allowable temperature of PVC outer sheath.

1.2.1.3. The XLPE insulated cables shall be capable of withstanding a conductor temperature of 250°C during a short circuit without any damage. The PVC insulated cables shall be capable of withstanding a conductor temperature of 160°C during a short circuit.

1.2.1.4. The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects. All aluminium used in the cables shall be of H2 grade.

1.2.1.5. The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable.

1.2.1.6. Progressive sequential marking of the length of cable in meters at every one meter shall be provided on the outer sheath of all cables.

1.2.1.7. Strip wire armouring method (a) mentioned in Table 5, Page-6 of IS: 1554 (Part-1) 1988 shall not be accepted for any of the cables. For control cables only round wire armouring shall be used.

1.2.1.8. The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.

1.2.1.9. All the cables shall pass fire resistance test as per IS: 1554 (Part-I)

1.2.1.10. The normal current rating of all PVC insulated cables shall be as per IS: 3961.

1.2.1.11. Repaired cables shall not be accepted.

1.2.1.12. Allowable tolerance on the overall diameter of the cables shall be plus or minus 2mm.

1.2.2. **XLPE Power Cables**

1.2.2.1. The XLPE insulated cables shall be of category “C2” and type ‘FR-LSH’ as per IS:1554 and its amendments read alongwith this specification. The conductor shall be stranded aluminium circular/sector shaped and compacted. In multicore cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multicore cables. For XLPE cables, the inner sheath shall be of extruded PVC to type ST-2 of IS:5831. When armouring is specified for single core cables, the same shall consist of aluminium wires/strips. The outer sheath shall be extruded PVC to Type ST-2 of IS:5831 for all XLPE cables.

1.2.3. **PVC Power Cables**

1.2.3.1. The PVC (70°C) insulated 1100V grade power cables shall be of category “C2” and type ‘FR-LSH’ as per IS:1554 and its amendments, read alongwith this specification and shall be suitable for a steady conductor temperature of 70°C. The conductor shall be stranded aluminium. The Insulation shall be extruded PVC to type-C of IS: 5831. A distinct inner sheath shall be provided in all multicore cables. For multicore armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-2 of IS: 5831 for all XLPE cables.

1.2.4. **PVC Control Cables**

1.2.4.1. The 1100V grade control cables shall be of category “C2” and type ‘FR-LSH’ as per IS:1554 and its amendments, read alongwith this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type C of IS 5831. A distinct
inner sheath shall be provided in all cables whether armoured or not. The over sheath shall be extruded PVC to type ST-2 of IS: 5831 and shall be grey in colour except where specifically advised by the Owner to be black.

1.2.4.2. Cores shall be identified as per IS:1554 (Part-1) for the cables up to five (5) cores and for cables with more than five (5) cores the identification of cores shall be done by printing legible Hindu Arabic Numerals on all cores as per clause 10.3 of IS 554 (Part-1).

2.0 HT CABLE FOR AUXILIARY POWER SUPPLY

2.1. The HT cable of 1Cx185 mm² (Aluminium Conductor) or 1Cx120 mm² (Copper Conductor) of voltage class as specified for 400 kVA LT transformer for interconnecting 400kVA LT transformer shall be, XLPE insulated, armoured cable conforming to IS: 7098 (Part-II) and IEC 60502-2 1998. Terminating accessories shall conform to IEC 61442 1997/IEC 60502-4 1998.

2.2. Only overhead connection has been foreseen for interconnecting 400 kVA, LT transformer to the tertiary of the Power Transformer. However, HT cable connections in place of overhead connection, if necessary shall also be in the scope of contractor. In this case contractor shall provide 1C x 185 mm² (Aluminium Conductor) or 1Cx120mm² (Copper Conductor), 38/66kV HT cable alongwith necessary terminating accessories. The construction of XLPE insulated, armoured HT cable shall be generally conforming to IS 7098 (Part-III). Terminating accessories shall conform to IEC 60840 1999.

2.3. Bidder may offer sizes other than the sizes specified in clause 2.1 and 2.2. In such case sizing of power cables shall be done keeping in view continuous current, voltage drop & short-circuit consideration of the system. Relevant calculations shall be submitted by bidder during detailed engineering for purchaser’s approval.

3.0 CABLE DRUMS

3.1. Cables shall be supplied non-returnable wooden or steel drums of heavy construction. Wooden drum shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum.

3.2. Standard lengths for each size of power and control cables shall be 500/1000 meters. The cable length per drum shall be subject to a tolerance of plus or minus 5% of the standard drum length. The owner shall have the option of rejecting cable drums with shorter lengths. However, the total quantity of cables after taking into consideration of all cable drums for each size shall be within the tolerance of ± 2%.

3.3. A layer of waterproof paper shall be applied to the surface of the drums and over the outer most cable layer.

3.4. A clear space of at least 40 mm shall be left between the cables and the lagging.

3.5. Each drums shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stencilled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

3.6. 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.
4.0  TYPE TESTS

4.1. All cables shall conform to all type, routine and acceptance tests listed in the relevant IS.

4.2. The type tests on cables shall be conducted on each type and size of cables offered.

4.3. Following type tests as per IS: 7098 (Part 1) – 1988 including its amendments and additional type tests shall be carried out on 1.1 KV grade XLPE insulated cables:
   a) Tests on conductor
      i) Annealing test (for Copper)
      ii) Tensile test (for aluminium)
      iii) Wrapping test (for aluminium)
      iv) Resistance test
   b) Test for armouring wires/strip
   c) Test for thickness of insulation and sheath
   d) Physical tests for insulation
      i) Tensile strength and elongation at break
      ii) Ageing in air oven
      iii) Hot set test
      iv) Shrinkage test
   e) Physical tests for outer sheath
      i) Tensile strength and elongation at break
      ii) Ageing in air oven
      iii) Loss of mass in air oven
      iv) Shrinkage test
      v) Hot deformation
      vi) Heat shock test
      vii) Thermal stability
   f) Insulation resistance (volume resistivity test)
   g) High voltage test
   h) Flammability test
   i) Oxygen index and temperature index test on outer sheath
   j) Short time current test on power cables of sizes 240 sq.mm and above.
      1) On conductor(s).
      2) On armours.

4.4.1 Following type tests as per IS: 1554(Part-1) including its amendments and additional type tests shall be carried out on 1.1 KV grade PVC insulated cables:
   1) Tests on conductor
      a) Annealing test
      b) Conductor resistance test
   2) Test for thickness of insulation and sheath.
   3) Physical tests for insulation and outer sheath:
      a) Tensile strength and elongation at break.
      b) Ageing in air oven.
      c) Shrinkage test.
      d) Hot deformation.
      e) Loss of mass in air oven.
      f) Heat shock test.
      g) Thermal stability
   4) Insulation resistance test.
   5) High voltage test (water immersion test)
   6) High voltage test at room temp
   7) Flammability test.
8) Tests for round steel wire armour:
   a) Dimensions
   b) Physical tests on round wire:
      i.) Tensile strength
      ii.) Elongation at break
      iii.) Torsion test for round wires
      iv.) Uniformity of zinc coating
      v.) Mass of zinc coating
      vi.) Resistivity

   a) Oxygen Index Test
   b) Flame Retardant Test on single cable.
   c) Flame Retardant Test on bunched cables.
   d) Test for halogen acid gas evolution
   e) Temperature Index

4.4.2 Following acceptance tests as per IS: 1554(Part-1) including its amendments and additional type tests shall be carried out on 1.1 KV grade PVC insulated cables.
   1) Annealing test
   2) Conductor resistance test
   3) Test for thickness of insulation and sheath
   4) Tensile strength and elongation at break of insulation and sheath
   5) Insulation resistance test
   6) High voltage test at room temp
   7) Oxygen Index Test
   8) Flame Retardant Test on single cable
   9) Test for halogen acid gas evolution

4.4.3 Following routine tests as per IS: 1554(Part-1) including its amendments and additional type tests shall be carried out on 1.1 KV grade PVC insulated cables.
   1) Conductor resistance test
   2) High voltage test at room temp

4.5. Following type tests as per IS: 7098 (Part 2) - 1988 including its amendments and additional type tests shall be carried out on XLPE insulated HT cable up to and including 220 KV

a) Tests on conductor
   i) Annealing test (for Copper)
   ii) Resistance test
   iii) Tensile test (for aluminium)
   iv) Wrapping test (for aluminium)

b) Physical tests for insulation
   i) Test for thickness and dimensions of insulation
   ii) Tensile strength and elongation at break
   iii) Thermal Ageing in air oven
   iv) Hot set test
   v) Shrinkage test

c) Resistivity test for semi-conducting layers

4) Test for concentric metallic screen:
   i) Test for concentric copper wire
   ii) Test for concentric copper tape

e) Thickness of metallic sheath
f) Test for armouring material:
g) Dimensions
h) Physical tests for outer sheath:
   1. Measurement of thickness
   2. PVC sheath
      i) Tensile strength and elongation at break
      ii) Ageing in air oven
      iii) Loss of mass in air oven only for PVC sheath
      iv) Heat shock test
      v) Hot deformation test
      vi) Shrinkage test
      vii) Thermal stability
   3. PE sheath
      i) Carbon black content
      ii) Tensile strength and elongation at break before and after ageing
      iii) Hot-deformation
   i) Flammability test (for PVC outer sheathed cables only)
j) Water tightness test
k) 1) Thermal ageing on complete cable sample
     2) Tensile strength and elongation at break for insulation and outer sheath
     3) Resistivity test for semi-conducting layer
l) Bending test followed by P.D. test
m) Dielectric power factor and capacitance measurement at ambient temperature
n) Dielectric power factor measurement at elevated temperature
o) Impulse withstand test followed by HV test
p) Oxygen index and temperature index test on outer sheath

4.6. Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for which test conducted once are acceptable (i.e. The requirement of test conducted within last five years shall not be applicable) for the following:

4.6.1. 1.1 kV grade PVC insulated cables
        High voltage test (water immersion d.c. test as per clause no. 16.3.2 of IS: 1554 (Part 1) - 1988)

4.6.2. 1.1 kV grade XLPE insulated cables
        Water absorption (gravimetric) test as per IS: 7098 (Part 1) –1988

4.6.3. XLPE insulated HT cable from 66kV up to and including 220KV
        Load cycle test followed by P.D. measurement as per IS: 7098(Part 3)

4.6.4. Terminating/jointing accessories as per IEC 60840:1999
        a) Partial discharge test at ambient temperature;
        b) Heating cycle voltage test
        c) Partial discharge tests
           -At ambient temperature
           -At high temperature
        d) Impulse voltage test followed by power frequency test
        e) Test of outer protection for buried joints
SECTION –II : TECHNICAL SPECIFICATIONS FOR UNARMORED U/G FIBER OPTIC CABLE

This section describes the functional requirements, major technical parameters, Type and Factory Acceptance Testing requirements for underground fiber optic cable. Marking, packaging and transportation requirements have also been described.

2.1 General

The underground fiber optic cable shall be unarmored and shall be suitable for underground installation in pipes. The cable should be of low weight, small volume and high flexibility. The mechanical design and construction of each unit shall be inherently robust and rigid under all condition of operation, adjustment, replacement, storage and transport.

2.2 Applicable Standards

The cable shall conform to the standards named below and the technical specifications described in the following sections.
ITU-T Recommendations G-652.

2.3 Fiber Type(s) and Counts

The cable shall contain 12 Dual Window Single Mode (DWSM) fibers conforming to G.652 as per the bill of the Quantity and the Technical parameters stipulated in the following sections. The BOQ for each type of cable has been provided in the appendices.

2.4 Optical Characteristics

The attenuation coefficient for wavelength between 1525nm and 1575nm shall not exceed the attenuation coefficient at 1550nm by more than 0.05dB/km. The attenuation coefficient between 1285nm and 1330nm shall not exceed the attenuation coefficient at 1310nm by more than 0.05dB/km. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.1dB. The fibre attenuation characteristics specified in table 2-1 shall be “guaranteed” fibre attenuation of any & every fibre reel. Further the average cabled fibre attenuation, averaged over 100kms of cabled fibre, (as measured during the factory acceptance testing) shall be as specified in 2-1.

DWSM fibres shall conform to the requirements specified in Table 2-1 below.

Table 2-1

<table>
<thead>
<tr>
<th>Fibre Description:</th>
<th>Dual Window Single-Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode Field Diameter:</td>
<td>8.6 to 9.5nm um (≤ 10% of the nominal value)</td>
</tr>
<tr>
<td>Cladding Diameter:</td>
<td>125.0 um ± 2um</td>
</tr>
<tr>
<td>Mode field Concentricity Error:</td>
<td>≤ 1.0 um</td>
</tr>
<tr>
<td>Cladding non-circularity</td>
<td>≤ 2%</td>
</tr>
<tr>
<td>Cable Cut off Wavelength</td>
<td>≤ 1260nm</td>
</tr>
<tr>
<td>1550 loss performance</td>
<td>As per G.652</td>
</tr>
<tr>
<td>Proof Test Level</td>
<td>≥ 0.35Gpa</td>
</tr>
<tr>
<td>Attenuation coefficient</td>
<td>@ 310nm ≤ 0.35 dB/Km</td>
</tr>
<tr>
<td></td>
<td>@ 1550nm ≤ 0.23 dB/Km</td>
</tr>
<tr>
<td>Chromatic Dispersion : Maximum:</td>
<td>20 ps/(nm x km) 1550 nm</td>
</tr>
<tr>
<td></td>
<td>3.5 ps/(nm x km) 1288-1339nm</td>
</tr>
<tr>
<td></td>
<td>5.3 ps/(nm x km) 1271-1360nm</td>
</tr>
<tr>
<td>Zero Dispersion Wavelength:</td>
<td>1300 to 1324 nm</td>
</tr>
<tr>
<td>Zero Dispersion Slope:</td>
<td>-0.093 ps/(nm² x km) maximum</td>
</tr>
<tr>
<td>Parameter</td>
<td>Specification</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Polarization mode dispersion coefficient</td>
<td>≤ 0.5 ps/km^1/2</td>
</tr>
<tr>
<td>Temperature Dependence:</td>
<td>Induced attenuation ≤0.05 dB (-60 °C + 85 °C)</td>
</tr>
<tr>
<td>Bend performance:</td>
<td>@1310nm(75±2nmdia Mandrel), 100 turns: Attenuation rise &lt;0.05 dB/km</td>
</tr>
<tr>
<td></td>
<td>@1550nm(75±2nmdia Mandrel), 100 turns: Attenuation rise &lt;0.10 dB/km</td>
</tr>
<tr>
<td></td>
<td>@1550nm(32±0.5 dia Mandrel), 1 turn: Attenuation rise &lt;0.50 dB/km</td>
</tr>
</tbody>
</table>

End of Table

### 2.5 General Construction

The optical cable shall consist of a central fibre optic unit protected by one or more layers of helically wound anti-hygrosopic tape or yarn. The central fibre optic unit shall be designed to house and protect the fibres from damage due to forces such as crushing, bending, twisting, tensile stress and moisture, wide temperature variations, hydrogen evolution etc. The fibre shall be of loose tube construction. The inner polyethylene jacket and outer sheath jackets shall be free from pinholes, joints, splits or any other defects. All fibre optic cable shall have a minimum service life span of 25 years.

#### 2.5.1 Colour Coding & Fibre Identification

Individual optical fibres within a fibre unit, and fibre units shall be identifiable in accordance with EIA/TIA598 or IEC 60304 or Bellcore GR-20 colour-coding scheme. The colour coding system shall be discernible throughout the design life of the cable. Colouring utilised for colour coding optical fibres shall be integrated into the fibre coating and shall be homogeneous. The colour shall not bleed from one fibre to another and shall not fade during fibre preparation for termination or splicing. Each cable shall have tracibility of each fibre back to the original fibre manufacturer’s fibre number and parameters of the fibre. If more than the specified number of fibres included in any cable, the spare fibres shall be tested by the cable manufacturer and any defective fibre shall be suitably bundled, tagged and identified at the factory by the vendor.

#### 2.5.2 Strength Members

The central fibre optic unit should include a central strength member of Fibre Reinforced Plastic (FRP) or other suitable material. Peripheral strength members and aramid yarns are also acceptable. The central FRP strength member may be of slotted type with SZ lay (reverse oscillation lay) of fibre units or it may be cylindrical type with helical lay of fibre units.

#### 2.5.3 Filling Compound

The interstices of the central fibre optic unit and cable shall be filled with a suitable compound to prohibit any moisture ingress or any longitudinal water migration within fibre optic unit or along the fibre optic cable. The water tightness of the cable shall meet or exceed the test performance criteria as per IEC60794-1-2-F5. The filling compound used shall be a non-toxic homogeneous water proofing compound that is free of dirt and foreign matter, anti-hygrosopic, electrically nonconductive and non-nutritive to fungus. The compound shall also be fully compatible with all cable components it may come in contact with and shall inhibit the generation of hydrogen within the cable. The filling compound shall remain stable for ambient temperature up to +70 °C and shall not drip, flow or leak with age or at change of temperatures. Reference method to measure drip point shall be as per IEC60811-5-1 and drip point shall not be less than 70 °C.

#### 2.5.4 The Sheath/Inner Jacket

The sheath shall be black, smooth, concentric, and shall be free from holes, splits, blisters and other surface flaws. The sheath shall be extruded directly over the central fibre optic unit and shall also be non-hygrosopic. The cable sheath design shall permit easy removal without damage to
the optical fibres or fibre units. The sheath shall be made from good quality of weather resistant polyethylene compound (Black High Density Polyethylene-HDPE) and thickness shall be ≥ 1.8mm.

2.5.5 The Outer Jacket/Termite protection

A circular jacket of not less than 0.65mm Polymide-12(Orange Nylone-12) material should be applied over the sheath as an outer jacket. The outer jacket shall have smooth finish and shall be termite resistant.

RIP Cord: Suitable rip cord(s) shall be provided to open the outer sheath of the cable. The rip cord(s) shall be properly waxed to prevent wicking action and shall not work as a water carrier.

2.6 Mechanical Parameters & Tests

(A) **Tensile Strength:** The cable shall be of sufficient strength to withstand a load of value \( T (N) = 9.81 \times 2.5 \times W \) Newton or 2670 N whichever is higher (where \( W \) is the mass in Kg of 1 Km cable). The load shall be sustained for 10 minutes and the strain of the fiber monitored. The load shall not produce a strain exceeding 0.25% in the fiber and shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the rated tensile load in accordance with IEC 60794-1-2-E1 procedure shall not exceed 0.05dB/Km both for 1310 nm and 1550 nm wavelength. The attenuation shall be noted before strain, and after release of strain for all the fibers.

(B) **Crush test** (Compressive Strength): The cable shall withstand a compressive force of at least 2000 N. applied for at least 60 seconds between two plates of 100mm x 100mm in accordance with IEC60 794-1-2-E3 procedure. This compressive load applied in accordance with IEC60794-1-2-E3 shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the compressive load shall not exceed 0.05dB/Km both 1310nm and 1550nm wavelength. The attenuation shall be noted before and after the test for all the fibers.

(C) **Bend Radius:** The cable bend radius under no load shall be less than or equal to 20 times the cable diameter. The test method shall be according to the IEC60794-1-2-E11 (procedure-I). The fibers and component parts of the cable shall not suffer permanent damage when the cable is repeatedly wrapped and unwrapped 4 complete turns of 10 complete cycles around a mandrel of 20 times to the cable diameter. The change in optical attenuation after the test shall not exceed 0.05dB/Km both for 1310nm and 1550nm wavelength. The attenuation shall be noted before and after the test for all the fibers. Outer Jacket shall not show any cracks visible to the naked eye when examined whilst still wrapped on the mandrel.

(D) **Cable Bending test** (Repeated bending): The cable shall withstand repeated bending when tested in accordance with EIA-455-104 and shall not cause any permanent damage to any constituent part of the cable. The cable sample shall be at least 5 meters or more. The change in optical attenuation during or after the application of the repeated bending test shall not exceed 0.05dB/Km for all the fibers. The attenuation shall be noted before and after the test for all the fibres. The test requirement shall be as mentioned below:-

<table>
<thead>
<tr>
<th>Weight</th>
<th>5Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum distance from pulley centre to holding device</td>
<td>216 mm</td>
</tr>
<tr>
<td>Minimum distance from weight to pulley centre</td>
<td>457mm</td>
</tr>
<tr>
<td>Pulley diameter</td>
<td>20 times to the cable dia</td>
</tr>
<tr>
<td>Angle of turning</td>
<td>90º</td>
</tr>
<tr>
<td>No. of cycles</td>
<td>30</td>
</tr>
<tr>
<td>Time required for 30 cycles</td>
<td>2 min.</td>
</tr>
</tbody>
</table>

(E) **Impact Test:** The cable shall withstand at least 10 impacts of 50N load from a 0.5 meter height with impacting surface radius of 300mm. This impact load applied at the same place in accordance with IEC60794-1-2-E4 shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the impact load shall not exceed 0.05dB/Km. The attenuation shall be noted before and after the test for all the fibres.
(F) **Torsion test:** The cable shall withstand 10 cycles of ±180º torsion with 100N load applied on a 2m sample. This load cycle applied in accordance with IEC60794-1-2-E7 shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the torsion load shall not exceed 0.05dB/km for all the fibres. The attenuation shall be noted before and after the test.

(G) **Kink test (Resistance):** When a cable of sample length 10 times the minimum bend radius as defined above is subjected to kinking, it shall not result in any fibre breakage and the kink shall disappear after normalizing the cable. The change in optical attenuation after the application of the kink in accordance with IEC60794-1-2-E10 shall not exceed 0.05dB/km for all the fibres.

(H) **Water penetration test (Resistance to water ingress):** The resistance to water ingress of the cable shall meet or exceed the test performance criteria as per IEC60794-1-2-F5 method F5B. Before applying the water tight sleeve at one end the outer jacket shall be stripped. A water soluble fluorescent dye shall be used for testing. The duration of test shall be 7 days. In addition after the test the cable shall be ripped open and distance up to which water has seeped shall be noted.

(I) **Drip Test (Seepage of Filling Compound):** For testing, a sample of 30cm length of the cable with one end sealed by the end cap will be taken and outer jacket, sheath, binder tapes shall be removed by 5cms from open end of the sample. The filling compound will be wiped thoroughly and the sample be kept vertically with open end downward in the oven for 24 hours at 70 ºC temperature with a filter paper under the sample. The filter paper should not indicate any sign of drip or oily impression. The reference test specification shall be as per IEC60811-5-1 to measure drip point.

(J) **Environmental Test:** Temperature cycling test shall be carried out on one drum length of the cable to ensure stability of attenuation parameter of the cable when subjected to temperature change which may occur during storage, transportation, and operation. The permissible temperature range for storage and operation will be from -20ºC to +70ºC. The rate of change of temperature during test shall be 1ºC per minute. The cable shall be kept for 12 hours at each of the following temperature and should follow the specification IEC60794-1-2-F1. Two cycles shall be performed.

<table>
<thead>
<tr>
<th>Temperature Code</th>
<th>Temperature (ºC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA2</td>
<td>-20ºC</td>
</tr>
<tr>
<td>TA1</td>
<td>-10.5ºC</td>
</tr>
<tr>
<td>TB1</td>
<td>+60ºC</td>
</tr>
<tr>
<td>TB2</td>
<td>+70ºC</td>
</tr>
</tbody>
</table>

The attenuation shall be measured at the end of each temperature range both at 1310nm & 1550nm. The change of attenuation of fibre used shall be 0.05 dB both for 1310 & 1550nm for entire range of temperature for all the fibres in each cycle.

(K) **Termite Resistance Test:** The outer jacket shall be demonstrated to be termite resistant. The exact procedure for the test shall be mutually agreed between the Contractor and the Purchaser and shall generally be in line with test procedures followed by reputed test laboratories.

(L) **Abrasion Test:** To be conducted as per IEC 60794-1-E2 or equivalent international test method.

(M) **Flexure Rigidity Test:** To be conducted as per ASTM D-790. The test shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation after the test shall not exceed 0.05 dB/km. The attenuation shall be noted before and after the test for all the fibres.

(N) **Figure of Eight Test:** 1000m of cable shall be uncoiled from the drum and arranged in figure of eight, each loop having a maximum, dimension of 2m. It shall be possible to arrange cable in figure of 8 with relative ease and the cable shall not show any visible damages.
**Cable Ageing Test:** After Environmental test the cable shall be subjected to a temperature of 85 ±2 °C for 168 hours. Cable shall then be brought to ambient temperature and stabilized for 24 hours. The change in optical attenuation after the test shall not exceed 0.05dB/km. For 1310 as well as 1550nm wavelengths. The attenuation shall be noted before and after the test for all the fibres.

**Embitterment Test of Loose tube:** The minimum length of the test sample depend on the outside diameter of the loose tube and should be 85mm for tubes up to 2.5mm outside dia. The length of the bigger tubes should be calculated by using the following equation:

\[ L_0 > 100 \times \left( \frac{D^2 + d^2}{4} \right)^{1/2} \]

Where

- \( L_0 \) = Length of tube under test
- \( D \) = Outside dia of loose tube
- \( d \) = Inside dia of loose tube

Both the ends of a buffer tube test sample may be mounted in a tool which is clamped in jaws of a tensile machine which exert a constant rate of movement. The movable jaw may move at a rate if 50mm per minute toward the fixed jaw. Under load the tube will bend, so that the tube is subjected to tensile and compressive stresses. The fixture for holding the tube should be designed in a manner that the tube might bend in all directions without further loading. The tube should not get embrittled. No ink should appear on the tube up to the safe bend dia of tube (20D) where D is the outside diameter of the loose tube. There should not be any physical damage or mark on the tube surface.

**Kink Resistance test on the loose tube:** A longer length of the loose tube is taken (with fibre and gel), a loop is made and loop is reduced to the minimum bend radius of loose tube i.e. 20D. Where D is the outside dia of the loose tube. This test is to be repeated 4 times on the same sample length of the loose tube. No damage or kink should appear on the surface of the tube.

**Drainage test for loose tube:** A tube length to 40cm shall be cut and filled with filling gel ensuring there are no air bubbles and the tube is completely full. The filled tube is placed in a horizontal position on a clean worktop and cut 5cm from each end so that the finished length of the sample is 30cm. The filled tube shall be left in a horizontal position at an ambient temperature for 24 hrs. The sample tube is then suspended vertically in an environment heat oven over a weighed beaker. It is left in the oven at a temperature of 70 °C for a period of 24 hrs. At the end of the 24hrs. period, the beaker is checked and weighed to see if there is any gel in beaker. There shall be no gel or oil in the beaker.

**Check of easy removal of sheath:** The sheath shall be cut in circular way using a sheath removal tool and the about 300mm length of the sheath should be removed in one operation. It should be observed during sheath removal process that no undue extra force is applied and no component part of the cable is damaged. It shall be possible to remove the sheath easily. Easy removal of both the outer jacket and the inner sheath shall be checked separately.

**Effect of aggressive media on the cable surface (Acidic and alkaline behaviour):** The test shall be conducted as per method no.ISO175. The two test samples of the finished cable each of 600mm in length are taken and the ends of the samples shall be sealed. These test samples are put in the PH4 and PH10 solutions separately. After 30 days these samples are taken out from the solutions and examined for any corrosion etc. on the sheath and other markings of the cables. The sample should not show any effect of these solution on the sheath and other marking of the cable.

### 2.7 Optical fibre cable marking

A suitable marking shall be applied in order to identify this cable from the other cables. Marking on the cable shall be indelible, of durable quality, shall last long and shall be applied at regular interval of one-meter length. Marking shall be imprinted and must clearly contrast with the surface and colors used must withstand the environmental influences experienced in the field.

The accuracy of the sequential marking must be within ±0.5% of the actual measured length. The sequential length marking must not rub off during normal installation. In case laser printing is used
the marking shall not exceed 0.15mm depth. The optical fibre cable shall have the following markings in every metre.

Type of Cable
Running metre length
No. of fibres
Type of fibre
Laser symbol & caution notice
Year of manufacture and batch no.
Manufacturer’s name
D T L

2.8 Operating Instructions

Complete technical literature in English with detailed cable construction diagram of various sub-component with dimensions and test data of the cable shall be provided. All aspects of installation shall also be covered in the handbook.

2.9 TEST AND INSPECTION:

The general conditions for Type and Factory Acceptance Testing shall be as follows:-

2.9.1 TYPE TEST

Type testing shall be carried out as per IEC for fiber optic cable & the tests listed in table 2-2 shall be carried out as type tests for fibers.

Table 2-2
Type test for Fibres

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Test Name</th>
<th>Acceptance Criteria</th>
<th>Test procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Attenuation</td>
<td>TS Table 2-1</td>
<td>EIA/TIA 455-78A</td>
</tr>
<tr>
<td>2.</td>
<td>Attenuation Variation with wavelength</td>
<td>TS Table 2-1</td>
<td>EIA/TIA 455-78A</td>
</tr>
<tr>
<td>3.</td>
<td>Attenuation at Water Peak</td>
<td>TS Table 2-1</td>
<td>EIA/TIA 455-78A</td>
</tr>
<tr>
<td>4.</td>
<td>Temp.Cycling (Temp. dependence of Attenuation)</td>
<td></td>
<td>EIA/TIA 455-3A,</td>
</tr>
<tr>
<td>5</td>
<td>Attenuation with Bending (Bend performance)</td>
<td></td>
<td>2 cycles</td>
</tr>
<tr>
<td>6.</td>
<td>Mode Field dia.</td>
<td></td>
<td>EIA/TIA 455-164A/167A/174</td>
</tr>
<tr>
<td>7.</td>
<td>Chromatic Dispersion</td>
<td></td>
<td>EIA/TIA455-168A/ 169A/175A</td>
</tr>
<tr>
<td>8.</td>
<td>Cladding Diameter</td>
<td></td>
<td>EIA/TIA 455-176</td>
</tr>
<tr>
<td>9.</td>
<td>Point Discontinuities of attenuation</td>
<td></td>
<td>EIA/TIA 455-59</td>
</tr>
<tr>
<td>10.</td>
<td>Core-Clad concentricity error</td>
<td></td>
<td>EIA/TIA 455-176</td>
</tr>
<tr>
<td></td>
<td>-- End of Table---</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.9.2 Factory Acceptance Testing

The tests listed in Table 2-3 shall be carried out as Factory Acceptance Test for Underground fibre optic cable.

Table 2-3
Factory Acceptance Tests on Underground Fibre Optic Cable

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Factory Acceptance Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Attenuation Co-efficient (1310,1550, and Water Peak)</td>
</tr>
<tr>
<td>2.</td>
<td>Point discontinuities of attenuation</td>
</tr>
<tr>
<td>3.</td>
<td>Chromatic Dispersion</td>
</tr>
<tr>
<td>4.</td>
<td>Visual Material verification and dimensional checks as per approved drawings</td>
</tr>
</tbody>
</table>
5. Resistance to Water Ingress test
6. Tensile strength test/Strain test
7. Impact test
8. Kink test

SECTION-III : QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of contract, whether manufactured or performed within the contractors work or at his sub contractors premises or at the owners site or at the other place of the work are in accordance with the specifications, the contractors shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programme shall be outlined by the contractor and finally accepted by the owner/authorize representative after discussion before the award of contract. The QA programme shall be in line with ISO 9001/IS-14001.

GENERAL REQUIREMENTS QUALITY ASSURANCE

All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all stages, as per comprehensive quality assurance programme. An indicated programme of the inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specifications. This is however, not intended to form a comprehensive programme as it is the contractor responsibility to draw up and implement such programme duly approved by the owner. The detailed quality plans for manufacturing and field activities should be drawn by the bidder and will be submitted to owner for approval. Schedule of finalization of such quality plans will be finalized before award.

Manufacturing quality plan will detail out for all the components and equipments, various tests/inspection, to be carried out as per the requirement of this specification and standards mentioned therein and quality practices and procedure followed by contractors quality control organization, the relevant reference document and standards, acceptance norms, inspection documents raised etc. during all stages of material procurement, manufacturer, assembly and final testing performance testing.

Field quality plans will detail out for all the equipment the quality practices and procedures etc. to be followed by the contractors site quality control organization, during various stages of site activities from receipt of materials/equipment at site.

The Contractor shall also furnish copies of the reference documents/plant standards/ acceptance norms/tests and inspection procedure etc., as referred in quality plans alongwith quality plans. These quality plans and reference documents/standards etc. will be subject to Owner’s approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans Owner shall identify Customer Hold Points (CHP), i.e. test/checks which shall be carried out in presence of the Owner’s engineer or his authorized representative and beyond which the work will not proceed without consent of Owner/authorized representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner alongwith technical justification for approval and disposition.

No material shall be dispatched from the manufacture’s work before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspection by Owner’s engineer/authorized representative, and duly authorized for dispatch issuance of MDCC.

All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
VOLUME-III

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SECTION-I

BID FORM
SECTION: I

BID FORMS

Bid Proposal Ref. No: ............................. Date: ......................

Name of Package: 220/66/33kV GIS Substation at R.K.Puram, New Delhi (India)

To,

Delhi Transco Limited
Shakti Sadan, Kotla Road
New Delhi – 110002

Ladies and Gentlemen,

1.0 Having examined the Bidding Documents, including Amendment Nos. ______________(Insert Numbers) dated ………………… the receipt of which is hereby acknowledged, we the undersigned, offer to design, test, deliver, install and commission (including carrying out Performance & Guarantee Test) the Facilities under the above-named package in full Conformity with the said Bidding Documents for the sum of :

(Amount of Indian Rupees in Words)

(Amount in Figures)

or such other sums as may be determined in accordance with the terms and conditions of the Bidding Documents.

“Note: Being a Two Part tender, bidders are required to submit the Bid Forms in Part –I as well as in Part-II. However, the prices shall be quoted only in the Bid Form to be submitted with Price Bid Part -II.”

2.0 ATTACHMENTS TO THE BID FORM

In line with the requirement of the Bidding Documents, we enclose herewith the following Attachments to the Bid Form :

(a) Attachment 1: Bid Security in the form of .......................* for a sum of ............................... (amount in INR in words and figures) initially valid for a period of two hundred twenty-five (225) days from the date set for opening of bids.

* Please fill in the alternative chosen in line with 12.2 Section-ITB, Vol.-I, of the Bidding Documents

(b) Attachment 2: A power of attorney duly authorized by a Notary Public indicating that the person(s) signing the bid have the authority to sign the bid and thus that the bid is binding upon us during the full period of its validity in accordance with the ITB Clause 13.

(c) Attachment 3 : The documentary evidence that we are eligible to bid in accordance with ITB Clause 1 and in Clause 8.3 (c) & (e) ITB are qualified to perform the contract if our bid is accepted. The qualification data has been furnished as per your format enclosed with the bidding documents. * Further, the required deed of Joint Venture Agreement signed by us and our Partners has also been furnished as per your format.

* Delete if not applicable
(d) Attachment 4&4A: The documentary evidence establishing in accordance with ITB Clause 1, Vol.-l of the Bidding Documents that the facility offered by us are eligible facilities and conform to the Bidding Documents has been furnished as Attachment 4. Moreover, a list of Special Tools & Tackles to be furnished by us, the cost of which is included in our Bid Price, is also enclosed as per your format as Attachment 4A.

(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, ITB and other commercial conditions. 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 6A: The variation and deviations from the requirements of the CC clauses mentioned in ITB Clause 21.4.1 in your format enclosed with the Bidding Documents, including, inter alia, the cost of withdrawal of the variations and deviations indicated therein.

(h) Attachment 7: The details of Alternative Bid made by us indicating the complete Technical Specifications, the Bid price for the Alternative Bid and the deviation to contractual and commercial conditions.

(i) Attachment 8: Not applicable.

(j) Attachment 9: Work Completion Schedule.

(k) Attachment 10: Guarantee Declaration.

(l) Attachment 11: Information regarding ex-employees of DTL in our firm.

(m) Attachment 12: Unequivocal consent of the proposed Assignee for the purpose of executing the 'Second Contract' and/ or "Third Contract' as an independent Contractor (Applicable to Foreign Bidders).

(n) Attachment 13: Capacity and Experience of Proposed Assignee (Applicable to Foreign Bidders).

3.0 PRICE SCHEDULES

3.1 In line with the requirements of the Bidding documents, we enclose herewith the following Price Schedules, duly filled - in as per your proforma:

Schedule 1  Price break-up Plant and Equipment (including Mandatory Spares Parts) to be supplied from Abroad including Type Test charges for Type Test to be conducted Abroad.

Schedule 2  Price break-up of Plant and Equipment (including Mandatory Spares Parts) to be supplied from India including Type Test charges for Type Test to be conducted in India.

Schedule 3  Break-up of Local Transportation, Insurance and other Incidental Services (including port clearance etc.)

Schedule 4  Price Breakup of Installation Charges

Schedule 5a Break-up of Type Test charges for Type Tests to be conducted abroad. (Total of this schedule is included in Schedule -1 above)

Schedule 5b Break-up of Type Test charges for Type Tests to be conducted in India. (Total of this schedule is included in Schedule - 2 above)
| Schedule 6a | Training Charges for Training to be imparted abroad (Training in the field of design, operation and maintenance of the GIS Installations including procedures for fault attending at manufacturer's / supplier's works (as per Technical Specifications)). (Shall be inclusive) |
| Schedule 6b | Training Charges for Training to be imparted in India (Training in the field of design, operation and maintenance of the GIS Installations including procedures for fault attending at manufacturer's / supplier's works (as per Technical Specifications)) (Shall be inclusive) |
| Schedule 7 | Grand summary of the quoted bid price. |
| Schedule 8 | Details of taxes & duties not included in the Bid Price (in line with clause CC 14.4, CC 14.5 & CC 14.6. |
| Schedule 9 | Minimum value of bought-out items for the purpose of sales tax declaration forms. |
| Schedule 10 | Details of recommended spare parts & recommended test equipments. (in line with Technical specifications) |

3.2 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 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. We agree that the entered rates and prices shall be deemed to include for the full scope as aforesaid, including overheads and profit.

3.3 We declare that as specified in the clause 11.2 CC of the Bidding Documents prices quoted by us in the Price Schedules shall be Fixed and Firm during the execution of Contract.

3.4 We understand that in the price schedules, where there are errors between the total of the amounts given under the column for the price Breakdown and the amount given under the Total Price, the former shall prevail and the latter will be corrected accordingly. We further understand that where there are discrepancies between amounts stated in figures and amounts stated in words, the amount stated in words shall prevail. Similarly, any discrepancy in the total bid price and that of the summation of Schedule price (price indicated in a Schedule indicating the total of that schedule), the total bid price shall be corrected to reflect the actual summation of the Schedule prices.

3.5 We declare that items left blank in the Schedules will be deemed to have been included in other items. The TOTAL for each Schedule and the TOTAL of Grand Summary shall be deemed to be the total price for executing the Facilities and sections thereof in complete accordance with the Contract, whether or not each individual item has been priced.

4.0 We confirm that except as otherwise specifically provided our Bid Prices 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 We understand that notwithstanding 4.0 above, in case of award on us, you shall bear and promptly pay/reimburse all custom and import duty imposed; on the Plant & Equipment including Mandatory Spare Parts specified in Schedule No.1 to be incorporated into the Facilities, by the Indian Laws. However, we understand that if we choose to ship the equipment in Shipper's Containers, then the custom duty levied on the cost of empty Containers shall not be borne by you and shall be payable by us.

100% of applicable Taxes and Duties, 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/our Assignee (applicable for Foreign Bidders), Sales Tax (but not the surcharge in lieu of Sales Tax), local tax and other levies in respect of direct transaction between you and us/our Assignee (applicable for Foreign Bidders), imposed on the Plant & Equipment
including Mandatory Spare Parts specified in Schedule No. 2 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/our Assignee (applicable for Foreign bidders) 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).

4.4 We confirm that we shall [or our Assignee (applicable for Foreign Bidders) as per para 5.0 below] 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 in any form shall be payable by you for the bought out items which shall be dispatched directly by us/our Assignee (applicable to Foreign Bidders) under the Second Contract (for foreign bidder)/ First Contract (for domestic bidder) (as referred in para 5.1) to the project site. However, you will issue requisite Sales Tax declaration forms in respect of such bought out items, on production of documentary evidence of registration with the concerned Sales Tax Authorities. The minimum value of bought-out items for the purpose of sales tax declaration forms is also indicated in Schedule No. 9.

4.6 We confirm that service tax and/or Works Contract Tax(WCT) levied, if any, shall be to our account and shall be deemed to be included in our total lump sum bid price. However, statutory deduction of tax at sources (TDS), if any, in this regard shall be done by the employer and certificate shall be issued

5.0 CONSTRUCTION OF THE CONTRACT

5.1* (Applicable to foreign bidders only) We declare that we have studied Clause CC 44 relating to mode of contracting for Foreign Bidders and we are making this proposal with a stipulation that you shall award us three separate Contracts viz 'First Contract' for all works to be performed in countries outside India covering, inter-alia, the Off-Shore Supply of equipment & materials including mandatory spares (CIF Supply); 'Second Contract' for Supply of equipment & materials including mandatory spares (Ex-works Supply) and testing to be conducted within India; and 'Third Contract' for providing all services i.e. port handling and custom clearance for delivery at site, unloading, storage, handling at site, installation, testing and commissioning including Performance Testing in respect of all equipment & materials supplied under both 'First Contract' and 'Second Contract' and any other services specified in the Bidding Documents. We declare that the award of three 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 all the three Contracts will have a cross-fall breach clause i.e. a breach in one Contract will automatically be classified as a breach of the remaining contracts which will confer on you the right to terminate the other contracts at our risk and cost and/or recover damages under any or all the Contracts.

Further, M/s............................................................... ...............................whose capacity, and experience are enclosed with our Bid as our Assignee for the purpose of executing the 'Second Contract' and / or the 'Third Contract' and written unequivocal consent of the above mentioned proposed Assignee to work as your independent Contractor, on the same terms and conditions as offered by us to you in this bid, is also enclosed with the Bid form. We shall, however, be overall responsible for the execution of all the three Contracts.

The above-mentioned proposed Assignee shall directly enter into the 'Second Contract' and/or 'Third Contract' with you and all the three contracts shall contain the aforesaid cross-fall breach clause.

In case the Assignee, despite his written consent fails to enter into the 'Second Contract' and/or 'Third Contract' with you, or if the Employer in his judgment does not find acceptance of the proposed Assignee as its Contractor, then we undertake to enter into and execute all the Contracts, inter alia, containing the aforesaid cross-fall breach clause. In such an event, the overall financial liability of the Employer, under the Contract shall, however, not exceed that envisaged in this bid.

5.1** (Applicable to Domestic Bidders only) We declare that we have studied Clause CC 44 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 ex-works and CIF (if any) supply...
of all equipment and materials including mandatory spares identifying separately the CIF and Ex-
works components of the supply and 'Second Contract' for providing all the services i.e. inland 
transportation for delivery at site, unloading, storage, handling at site, installation, testing and 
commissioning including Performance Testing 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 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:

(i) Appendix 2 to the Form of Contract Agreement (Price Adjustment): Clause No. 10.6 ITB
(ii) Bid Security: Clause No. 12.1, 12.2 ITB.
(iii) Performance Security: Clause 13.3 CC
(iv) Liquidated Damages & (Functional Guarantee): Clause 28 & 28.5 CC
(v) Defect Liability: Clause No. 27 CC
(vi) Payment: Clause No.12 CC
(vii) Time Schedule: Appendix-4

OR

@ We have read the provisions of following clauses and confirm that the specified stipulations of 
these clauses are acceptable to us except for the deviations, along with the cost of withdrawal of 
such deviations as listed in Attachment 6A:

(i) Appendix 2 to the Form of Contract Agreement (Price Adjustment): Clause No. 10.6 ITB
(ii) Bid Security: Clause No. 12.1, 12.2 ITB.
(iii) Performance Security: Clause 13.3 CC
(iv) Liquidated Damages & (Functional Guarantee): Clause 28 & 28.5 CC
(v) Defect Liability: Clause No. 27 CC
(vi) Payment: Clause No.12 CC
(vii) Time Schedule: Appendix-4

@ Bidders to strike off whichever is not applicable

6.1 We further declare that additional conditions, variations, deviations, if any, found in the proposal 
other than those listed in Attachment 6 and/or Attachment 6A, save those pertaining to any rebates 
ofered, shall not be given effect to.

7.0 We undertake, if our bid is accepted, to commence the work on Facilities immediately upon your 
Notification of Award to us, and to achieve Completion within the time stated in the Bidding 
Documents.

We agree to abide by this bid for a period of 180 days from the date fixed for submission 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.

8.0 We undertake that, in competing for (and, if the award is made to us, in executing) the above 
contract, we will strictly observe the laws against fraud and corruption in force in India namely 
"Prevention of Corruption Act 1988".
9.0 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.

10.0 We understand that you are not bound to accept the lowest or any bid you may receive.

We confirm that we (including all members of our Joint Venture*) are not associated and nor have been associated in the past, with the Consultant or any other entity, including the Employer, that has prepared the design, specifications and other prequalification and bidding documents for the project, or that was proposed as Engineer for the Contract, over the last five years.

(* Delete, if bid is not from a JV)

We confirm that we have filled-in the data required to be furnished by us in the Conditions of Contract and Appendix-2 and Appendix-3 to the form of Contract Agreement.

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 faithfully,

(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:

* In para 5.1, Indian Bidder to strike-off this provision.

** In para 5.1, Foreign Bidder to strike-off this provision.

Note: Bidders may note that no prescribed proforma has been enclosed for:

(a) Attachment 2: Power of Attorney.
(b) Attachment 7: The details of Alternative Bid
(c) Attachment 8: Deleted
(c) Attachment 12: Unequivocal consent of the proposed Assignee for the purpose of executing the 'Second Contract' and/or 'Third Contract' as an independent Contractor (Applicable to Foreign Bidders).
(d) Attachment 13: Capacity and Experience of Proposed Assignee (Applicable to Foreign Bidders).

(For Attachments 2, 7, 12 and 13, Bidders may use their own Performa for furnishing the required information with the bid).
SECTION-II

ATTACHMENTS
ATTACHMENT - 1

220/66/33KV GIS SUBSTATION PACKAGE
R.K.PURAM, NEW DELHI

(Bid Security Form)

Please Refer Volume I (Conditions of Contract), Section : Forms & Procedures
220/66/33KV GIS SUBSTATION PACKAGE
R.K.PURAM, NEW DELHI

(Power of Attorney)

Please Refer Volume I (Conditions of Contract), Section : Forms & Procedures.

or

Bidders may use their own performa for furnishing the required information with bid.
220/66/33KV GIS SUBSTATION PACKAGE
R.K.PURAM, NEW DELHI
(QUALIFYING REQUIREMENT (QR) DATA)

Bidder’s Name and Address: To: Delhi Transco Ltd.
Shakti Sadan, Kotla Road
New Delhi – 110002

Name of Tender:

*We have submitted bid as individual firm/

*We have submitted bid as joint venture of following firms:
(*Strike-off whichever is not applicable)

(i) .................................................................
(ii) .................................................................
(iii) .................................................................

In accordance with the QR Annexure-A (ITB) of Volume I (relevant /clause nos. extracts have been brought out herein, however, in case of any discrepancy, Annexure-A (ITB) shall prevail), we are furnishing the following details/document in support of meeting the QR for 220/66/33kV GIS Substation.

1.0 General Information

Qualification of bidder will be based on meeting the minimum pass/fail criteria specified in Part-A, Annexure-A (ITB) Volume-I, regarding the Bidder’s technical experience and financial position as demonstrated by the Bidder’s responses in the corresponding Bid Schedules. The bidder shall also be required to furnish the information specified in Part-B Annexure-A (ITB) Volume-I in their Bid.

Technical experience and financial resources of any proposed subcontractor(s) (except as specified in Part-A, Annexure-A (ITB) Volume-I) shall not be taken into account in determining the Bidder's compliance with the qualifying criteria.

The bid can be submitted by an individual firm or a Joint Venture of two or more firms or by a firm having foreign collaboration.

2.0 The details and documents as listed in clause 2.0 of Part-B Annex-A ITB are furnished in the bid for individual firm / each partner of the joint venture:

a. Copies of original documents defining the constitution or legal status, place of Registration and principal place of business; written power of attorney of the Signatory of the bid to commit the bidder;
b. The qualification and experience of key personnel, proposed for carrying out the work:

<table>
<thead>
<tr>
<th>Name of Person</th>
<th>Professional Qualification</th>
<th>Experience</th>
<th>Designation</th>
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c. Proposal for subcontracting elements of the supply of materials amounting to more than 10% of the Bid Price for each element:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>In case of Joint Venture</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>For Lead Partner</td>
</tr>
<tr>
<td>1.</td>
<td>Name of Firm</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Head Office / Registered Office Address</td>
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<tr>
<td>3.</td>
<td>Telephone</td>
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<tr>
<td>4.</td>
<td>Fax</td>
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</tr>
<tr>
<td>5.</td>
<td>Contact Person</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Place of Incorporation/ Registration</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Year of Incorporation/ Registration</td>
<td></td>
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<tr>
<td>8.</td>
<td>subcontracting elements of the supply</td>
<td></td>
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</tbody>
</table>

d. Litigation History: Information regarding any current litigation in which the bidder is involved, the parties concerned and disputed amount. As per Cl. 3.0 (a) of Part-B Annex-A ITB, the information is to be completed for individual bidder and each Partner of a Joint Venture.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of Parties concerned</th>
<th>Cause of litigation and matter in dispute</th>
<th>Disputed amount</th>
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</thead>
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</table>

3.0 Eligible bidder to submit relevant documentary evidence in support of clause 1.1, Part-A, Annexure-A (ITB) Volume-I.

3.1.1 Experience for GIS Manufacturer(s): Refer QR specified in clause 1.1.1, Part-A, Annexure-A (ITB) Volume-I. The GIS Manufacturer shall furnish details/documents that it has adequate 220kV, 66kV as well as 33kV GIS substation Design infrastructure & capacity and procedures including quality control.

3.1.2 Experience for Erection, Testing & Commissioning: Refer QR specified in clause 1.1.2, Part-A, Annexure-A (ITB) Volume-I. Erector shall furnish details/documents that it has adequate erection facilities and capacity and procedures including quality control.

3.1.3 Techno- Commercial Experience and Legal Arrangement of Joint Venture: Refer QR

3.1.4 Techno-Commercial and Legal Arrangement For Indian Manufacturer with Foreign firm for Foreign Collaboration and for Foreign Firm establishing plant in India with their Parent Company: Refer QR specified in clause 1.1.4, Part-A, Annexure-A (ITB) Volume-I.

3.1.5 General Requirements: Refer QR specified in clause 1.1.1, Part-A, Annexure-A (ITB) Volume-I.

3.1.6 Bidder is requested to furnish the details of the Technical Experience in Formats A, B & C (manufacturing experience / engineering and project execution experience, installation experience, testing and commissioning experience) on the basis of which the Bidder wishes to qualify, as detailed at para 3.0 above. in case of Joint Venture, formats shall be filled for each of the partners each of the partners shall submit the respective formats separately.

**FORMAT A**:
Format for the Bidder in support of meeting the Qualifying Requirements as per para 3.0 above for GIS.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Name of Bidder/Lead Partner/JV Partner/sub-contractor</th>
<th>Contract/Order No. &amp; Date</th>
<th>Customer</th>
<th>Rating &amp; Type of GIS</th>
<th>Qty</th>
<th>Date of Supply</th>
<th>Date of Commissioning</th>
<th>Scope of Work performed</th>
<th>Period of satisfactory operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manufacturing and supplying of 220kV or higher voltage class</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>2</td>
<td>Design, Manufacture, Supply, erection, testing and commissioning not less than two (2) GIS installations having cumulatively at least 14(fourteen) 220 kV or higher voltage Circuit Breaker bays of 40kA or higher short circuit level</td>
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Note : 1. Documentary evidence viz Customer’s Certificate etc. to be enclosed by the bidder in support of above details.
2. Consent Letter of Sub-Contractor is to be enclosed.
3. Details in respect of availability of design and manufacturing infrastructure, capacity and procedures including quality control are to be enclosed.
4. Continuation sheets, of like size and format, may be used as per bidders requirement & shall be annexed to this schedule.

**Format-B**
Format for the Bidder for indicating its technical experience of Manufacturer(s)@ for offered Power Transformer @ Please provide details of all the manufacturers from whom 220kV class Power Transformer is proposed to be offered.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Name of Manufacturer</th>
<th>Contract/Order No. &amp; Date</th>
<th>Customer</th>
<th>Rating of Transformer</th>
<th>Qty</th>
<th>Date of Supply</th>
<th>Date of Commissioning</th>
<th>Scope of Work performed</th>
<th>Period of satisfactory operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Details of manufacturer @ from whom 220kV class Power Transformer (s) is being offered :</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name and Address of the manufacturer</td>
<td>e-mail ID</td>
<td>Telephone No.</td>
<td>Fax No.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

2  No. of years for which the manufacturer has been manufacturin g 220kV class Power Transformers

3  Documentary evidence enclosed herewith in support of being manufacturer of 220kV class Power Transformers for no. of years as stated in S.No. 2 above.

4  Scope of manufacturin g covered for 220kV or above class equipment

Documentary evidence viz Customer’s Certificate etc. to be enclosed by the bidder in support of above details.

---

**FORMAT C**

Format for the Bidder in support of meeting the requirement as per para 3.1.2 above for Experience for Erection, Testing & Commissioning:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Name of the Bidder</td>
</tr>
<tr>
<td>2.</td>
<td>Name of Contract:</td>
</tr>
<tr>
<td>3.</td>
<td>Contract Reference No. &amp; Date of Award</td>
</tr>
<tr>
<td>4.</td>
<td>Name and Address of the Employer/Utility by whom the Contract was awarded:</td>
</tr>
<tr>
<td></td>
<td>e-mail ID</td>
</tr>
<tr>
<td></td>
<td>Telephone No.</td>
</tr>
<tr>
<td></td>
<td>Fax No.</td>
</tr>
<tr>
<td>5.</td>
<td>i) Name of sub-station or switchyard executed under the Contract.</td>
</tr>
<tr>
<td></td>
<td>ii) Type of Switchgear – GIS/AIS</td>
</tr>
<tr>
<td></td>
<td>iii) Voltage level of sub-station or switchyard</td>
</tr>
<tr>
<td></td>
<td>iv) No. of Circuit Breaker bays in the sub-station or Switchyard</td>
</tr>
</tbody>
</table>
6. i) Date of successful execution of the Contract.
   ii) No. of years the above referred sub-station is in successful operation as on the date of bid opening.

7. Scope of work executed under the above contract.

8. Capacity in which the Contract was undertaken (Check one)
   O Prime Contractor
   O Sub Contractor
   O Partner of JV
   (Tick whichever is applicable)


10. Details/ documentary evidence submitted in support of erection facilities and capacity and procedures including quality control.
    a) Name of the GIS manufacturer from whom the GIS is to be supplied.
       [The credentials of said GIS manufacturer as given at Format - A]
    b) Enclosed the equisite consent letters (as per enclosed formats) from the above supplier(s) for supply of GIS & supervision of erection, testing & commissioning of GIS (yes/No).

4.0 Financial Requirement

A Individual Firms:
Refer cl. 1.2.1 of Part A, Annexure A Section ITB:

In support of meeting the QR the Bidder must provide the relevant information, along with documentary evidence, in the following format.

<table>
<thead>
<tr>
<th>DATA IN SUPPORT OF 4.0A (a) (MAAT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the Bidder / Partner of a Joint Venture (As Applicable):</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S. No</th>
<th>Financial Year</th>
<th>Turnover (in Million)</th>
<th>Annual Turnover in equivalent US Dollars</th>
<th>Annual Turnover in equivalent Rupees</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>4.*</td>
<td>5.*</td>
</tr>
<tr>
<td>1.</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
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<tr>
<td>3.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.
6.
"Details in column 5 are to be filled in if currency in column 3 is different from Indian Rupees, considering rate of exchange at the end of reported period."

Average annual turnover for best three years.
Rs. ____________________ million

---

DATA IN SUPPORT OF 4.0A (b) (Liquid Assets)

Details of evidence of having Liquid assets (LA)

Or

Details of evidence of access to or availability of credit facilities

---

**B Joint Venture Firms:** Refer cl. 1.2.2 of Part A, Annexure A Section ITB.

The information as per format for cl. 4.0A above is to be provided in respect of all partners (Lead Partner and Other Partners) of Joint Venture Bidder. Use a separate sheet in each case.

**C Indian Manufacturers with Foreign Collaboration:** Refer cl. 1.2.3 of Part A, Annexure A Section ITB.

The information as per format for cl. 4.0A above is to be provided in respect of all partners (Lead Partner and Other Partners) of Joint Venture Bidder. Use a separate sheet in each case.

5.0 The bidder shall have a project manager with 15 years experience in executing such contract of comparable nature including not less than five years as manager.

---

<table>
<thead>
<tr>
<th>Name of the Bidder / Partner of Joint Venture</th>
<th>Candidate Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Title or position</td>
<td>Project Manager</td>
</tr>
<tr>
<td>(i) Name of Candidate</td>
<td></td>
</tr>
<tr>
<td>(ii) Professional Qualification</td>
<td></td>
</tr>
<tr>
<td>2 Present Employment</td>
<td></td>
</tr>
<tr>
<td>(i) Name of the Employer</td>
<td></td>
</tr>
<tr>
<td>(ii) Address of the Employer with E-mail ID, Fax &amp; Telephone Nos.</td>
<td></td>
</tr>
</tbody>
</table>
6.0 **Financial & Capacity Requirements**: Refer Cl. 1.1 of Part B, Annexure A, Section ITB.

(A) **Details of Banker:**

<table>
<thead>
<tr>
<th>Name of Banker</th>
<th>Address of Banker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telephone No.</td>
<td>Contact Name and Title</td>
</tr>
<tr>
<td>Fax No.</td>
<td>E-mail ID</td>
</tr>
</tbody>
</table>

(B) **Certificate from Banker**, enclosed in the bid, in accordance with para 1.1(i), Part-B, Annexure-A (ITB), Volume-I of the bidding documents:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of Bank</th>
<th>Date of Issue of Certificate</th>
</tr>
</thead>
</table>

(C) **The monthly cash flow projection for execution of the contract having regard to implementation schedule along with proposed means to meet funding gap in each month, if any, is given below:**

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Company</th>
<th>Relevant experience in executing such contracts of comparable nature (in years)</th>
<th>Relevant experience as Manager in executing such contracts of comparable nature (in years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>S. No</td>
<td>Month</td>
<td>Anticipated Cash Flow</td>
<td>Source</td>
<td>Funding Gap</td>
</tr>
<tr>
<td>-------</td>
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<td>23)</td>
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<tr>
<td>24)</td>
<td></td>
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</tr>
</tbody>
</table>

(D) Summarized actual assets and liabilities in Indian Rupees or equivalent (at the rates of exchange current at the end of each year to be indicated) for the last five years and, based upon known commitments, summarized projected assets and liabilities in Indian Rupees equivalent for the next three years.

<table>
<thead>
<tr>
<th>Financial Information in Indian Rupees</th>
<th>Details for last five years preceding to the date of Bid Opening</th>
<th>Projection for the next three years</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total Assets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Current Assets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Total Liabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Current Liabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Profit before Taxes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Profit after Taxes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(* Indicate the rate of exchange used in calculating the equivalent Indian Rupees amount)

6.1 Refer Cl. 1.1.2 of Part B, Annexure A, Section ITB.

Audited balance sheet and income statements for the last five years (for the individual bidder or each partner of a Joint Venture), as stated below are attached:

<table>
<thead>
<tr>
<th>Years preceding to the bid opening</th>
<th>Audited Balance Sheet and Income Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; Year</td>
<td>Yes</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Year</td>
<td>Yes</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Year</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Attachment 3 (Vol. III)
6.2 Refer cl. 1.1.3 of Part-B. Annexure A, ITB. To be filled up in line with the formats available in 6.1 and 6.2 above for respective case.

7.0 The bid submitted by Joint Venture, and in case of successful bid, the Form of Agreement shall be signed, so as to be legally binding on all partners.

8.0 Public Sector Companies: Refer cl. 5.0 of Annexure A Section ITB.

(If the bidder is a Majority publicly-owned enterprise domiciled in India, they are required to demonstrate that they meet the above mentioned criteria and submit documents in support the same.)

Details in above regard are furnished as follows:

............... 
............... 

Date :.....................   Signature ..............................
Place :.....................   (Printed Name) ......................
                        (Designation) ......................
                        (Common Seal) ......................
220/66/33KV GIS SUBSTATION PACKAGE
R.K.PURAM, NEW DELHI

(Format of Certificate of Origin and Eligibility)

Bidder’s Name and Address: To: Delhi Transco Ltd.
Shakti Sadan, Kotla Road
New Delhi – 110002

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) ...............
Dear Sir,

We are furnishing below the list of special maintenance tools & tackles for various equipment under the subject package. The prices for these tools & tackles are already included in the lump sum 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)

Notwithstanding what is stated above, we further confirm that any additional special maintenance tools and tackles, required for the equipment under this package shall be furnished by us at no extra cost to the employer.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>For Equipment</th>
<th>Item Description</th>
<th>Unit</th>
<th>Quantity</th>
</tr>
</thead>
</table>

Date:...
(Signature)...
Place:...
(Printed Name)...
(Designation)...
(Common Seal)...

Place:...
(Signature)...
Printed Name:...
Designation:...

Date:...
(Signature)...
Place:...
(Printed Name)...
(Designation)...
(Common Seal)...

Delhi Transco Ltd.
Shakti Sadan, Kotla Road
New Delhi – 110002
Dear Sirs,

We hereby furnish the details of the items/sub-assemblies, we propose to buy for the purpose of furnishing and installation of the subject Package:

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Item Description</th>
<th>Quantity proposed to be bought/sub contracted</th>
<th>Detail of the proposed sub contractor/sub vendor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Name</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nationality</td>
</tr>
</tbody>
</table>

Date:...

(Signature) .............

Place:...

(Printed Name) .............

(Designation) .............

(Common Seal) .............
220/66/33KV GIS SUBSTATION PACKAGE  
R.K.PURAM, NEW DELHI  
(Deviations)

Bidder’s Name and Address:  To:  Delhi Transco Ltd.  
Shakti Sadan, Kotla Road  
New Delhi – 110002

The bidder shall itemise 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:

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Reference Clause in the specification</th>
<th>Deviation</th>
<th>Reason for change</th>
<th>The change in Bid price if the deviation is withdrawn and bidder conforms to the specification</th>
</tr>
</thead>
</table>

Any proposed deviation will be applicable only for the bidder whose bid is substantially responsive in accordance with clause 21, Section ITB, Vol. I of the bidding documents. If a bid is not substantially responsive, it will be rejected and may not subsequently be made responsive by the bidder by correction of the non conformity.

Date:...

(Signature)...  
(Signature)...

Place:...

(Printed Name)...  
(Printed Name)...

(Designation)...  
(Designation)...

(Common Seal)  
(Common Seal)

.................

.................

.................

.................
220/66/33KV GIS SUBSTATION PACKAGE
R.K.PURAM, NEW DELHI

(Cost of withdrawal of deviations from critical provisions as per ITB clause 21.4.1)

Bidder’s Name and Address:                             To : Delhi Transco Ltd.
                                                              Shakti Sadan, Kotla Road
                                                              New Delhi – 110002

Dear Sir,

Following are the deviations proposed by us to critical provisions relating to clauses listed in ITB clause 21.4.1. We are also furnishing below the cost of withdrawal for the deviations proposed by us. 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.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Clause No.</th>
<th>Deviation</th>
<th>Cost of withdrawal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Date:...

(Signature)...  ..................

Place:...

(Printed Name)...  ..................

(Designation)...  ..................

(Common Seal)  ..................

Note: Bidder may note that bids containing deviations without the cost of withdrawal shall be rejected.
Dear Sirs,

We hereby declare that the following Work Completion Schedule shall be followed by us in furnishing and installation of the subject Package i.e., 220/66/33 kV GIS SUBSTATION PACKAGE at NEW DELHI for the period commencing from the effective date of Contract to us:

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description Work</th>
<th>Period in months from the effective date of Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Completion of detailed Engineering and drawing submission</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) commencement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) completion</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Procurement of equipment/components &amp; assembly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) commencement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) completion</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Manufacturing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) commencement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) completion</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Type Tests</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) commencement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) completion</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Shipments &amp; Delivery</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) commencement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) completion</td>
<td></td>
</tr>
<tr>
<td>Sl.No.</td>
<td>Description Work</td>
<td>Period in months from the effective date of Contract</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>6.</td>
<td>Establishment of site office</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Erection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) commencement</td>
<td></td>
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<tr>
<td></td>
<td>b) completion</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Testing &amp; Commissioning</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) commencement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) completion</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Commissioning</td>
<td></td>
</tr>
</tbody>
</table>

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.
220/66/33KV GIS SUBSTATION PACKAGE
R.K.PURAM, NEW DELHI

(Guarantee Declaration)

Bidder’s Name and Address:                             To :    Delhi Transco Ltd.
                                                          Shakti Sadan, Kotla Road
                                                          New Delhi – 110002

Dear Sirs,

We declare that the ratings and performance figures of 160MVA, 220/66/11kV three
phase Power Transformer; 100MVA, 220/33/11kV three phase Power Transformer,
400KVA, 11/0.433 kV Auxiliary three phase LT Transformer furnished by us for
subject Package covered under this specification are guaranteed. 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.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Guaranteed Losses at rated output (kW) per unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Copper Loss at 75°C</td>
</tr>
<tr>
<td>Power Transformer</td>
<td></td>
</tr>
<tr>
<td>Auxiliary LT Transformer</td>
<td></td>
</tr>
</tbody>
</table>

Date:...

(Signature)... ................................

Place:...

(Printed Name)... ................................

(Designation)... ................................

(Common Seal) .................................
Dear Sirs,

We hereby furnish the details of ex-employees of DTL who had retired/ resigned at the level of General Manager and above from DTL and subsequently have been employed by us:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of person with designation in DTL</th>
<th>Date of retirement/resignation from DTL</th>
<th>Date of joining and resignation in our organization</th>
</tr>
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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.
SECTION-III

GUARANTEED TECHNICAL PARTICULARS
BATTERIES AND BATTERY CHARGERS

GUARANTEED TECHNICAL PARTICULARS

1.0  GENERAL

1.1  Name of the bidder

1.2  Specification & Standards

1.3  Location

1.4  Design ambient temp

1.5  System

1.6  Input supply to battery

1.7  Control supply

1.8  Supply for charger panel
   Space heater and illumination

2.0  BATTERIES

2.1  Manufacturer’s type designation

2.2  Type designation of cells as per IS.

2.3  Ampere-hour capacity at Ten (10) hour rate of discharge and twenty seven (27) degrees centigrade electrolyte temperature.

2.4  Rated voltage

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<th>2.4.1 Nominal</th>
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<th>............v</th>
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<td>2.4.2 Maximum</td>
<td>:</td>
<td>............v</td>
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<tr>
<td>2.4.3 Minimum</td>
<td>:</td>
<td>............v</td>
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2.5  Number of positive plates per cell.

2.6  Total number of plates per cell.

2.7  Discharge current of cell and end voltage of battery for

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<th>2.7.1 One(1) minute load</th>
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<th>_______A</th>
<th>_______V</th>
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2.7.2 Half(1/2) hour load : _______A ________V 
2.7.3 Two(2) hour load : _______A ________V 
2.7.4 Three(3) hour load : _______A ________V 
2.7.5 Five(5) hour load : _______A ________V 
2.7.6 Eight(8) hour load : _______A ________V 
2.7.7 Ten(10) hour load : _______A ________V 
2.7.8 Twelve(12) hour load : _______A ________V 
2.7.9 Current versus time characteristic curve 
(attach curve and state curve reference No.) 
2.8 Recommended charging rate : 
i) Initial : _______A 
ii) Finish : _______A 
2.9 Nominal cell voltage : _______V 
2.10 Internal resistance of each cell 
i) Fully charge : _______micro ohms. 
ii) Fully discharge : _______micro ohms. 
iii) Floating : _______micro ohms. 
2.12 Resistance of the battery : _______ohms. 
2.13 Short circuit current : _______KA 
2.14 Container 
2.14.1 Material 
2.14.2 Thickness : _______mm 
2.15 Terminal Connector 
2.15.1 Type 
2.15.2 Material 
2.16 Separator : _______mm 
2.16.1 Type 
2.16.2 Material 
2.16.3 Thickness : _______mm 
2.17 Electrolyte
2.17.1 Quantity for first : _______Ltrs.
2.17.1 Quantity for first : _______Ltrs.
Filling : Plus ten (10)
Per cent extra.

2.17.2 Specific gravity at twenty seven (27) degrees centigrade

i) with all cells fully charged.

ii) At the end of discharge at ten (10) hour rate.

2.18 Max. electrolyte temp. that the cell will withstand without injurious effect.

i) Continuously

ii) For a short period.

2.19 Positive plates :

2.19.1 Type :

2.19.2 Construction :

2.19.3 Dimensions :_____mmLx_____mmWx____mmTH

2.19.4 Surface :____________mm2

2.20 Method of connections :

i) Bolted

ii) Burnt

2.21 Negative Plates

2.21.1 Type

2.21.2 Construction details

2.21.3 Dimensions :_____mmLx_____mmWx____mmTH

2.21.4 Surface Area : ___________mm2

2.22 Method of Supporting elements :

2.23 Clearance between

2.23.1 Edges of plates and inner surface of container : ____________mm

2.23.2 Bottom of negative plates : ____________mm
2.23.3 Top of plates and top of container: ______________mm

2.24 Sediment space (depth): ______________mm

2.25 Dimensions of each cell:

2.25.1 Length: ______________mm

2.25.2 Width: ______________mm

2.25.3 Height: ______________mm

2.26 Distance between centres of cells when erected: ______________mm

2.27 Net weight of each cell: ______________kg.

2.27.1 With electrolyte: ______________kg.

2.27.2 Without electrolyte: ______________kg.

2.28 Recommended max. period of storage before first charge

2.29 Whether explosion-proof vent plugs are provided (in case of sealed container): Yes/No

2.30 Expected life span of battery

2.31 Rack details

2.31.1 Description

2.31.2 Number of units

2.31.3 Unit length: ______________mm

2.31.4 Unit width: ______________mm

2.31.5 Unit Height: ______________mm

2.31.6 Unit shipping weight: ______________kg.

2.31.7 Material of supporting stand

2.31.8 Arrangement and foundation Details of supporting stands

2.31.9 Weight of one complete Set of supporting stand.

2.31.10 Details of painting.

2.31.11 Details of insulators
2.32 Proposed layout (attach) layout drawing & state drawing no.)

2.33 Ventilation required in battery room : _____________cu.mm./minute

2.34 Ampere hour efficiency : _____________percent

2.35 Watt hour efficiency : _____________percent

2.36 Recommended float charge : 

2.36.1 Current : _____________A

2.36.2 Voltage : _____________V

2.37 Recommended boost charge : 

2.37.1 Current : _____________A

2.37.2 Voltage : _____________V

2.37.3 Time required for boost charging from discharge conditions : _____________hours

3.0 BATTERY CHARGERS

3.1 Name of manufacturer : 

3.2 Manufacturer’s type designation : 

3.3 Degree of protection : 

3.4 Type of rectifier : 

3.5 AC Input : 

3.5.1 Voltage : _____________V

3.5.2 Voltage Variation : _____________percent

3.5.3 Number of phases : 

3.5.4 Frequency : _____________Hz.

3.5.5 Frequency variation : _____________percent

3.5.6 Combined voltage and frequency variation : _____________percent

3.5.7 Current : _____________A

3.5.8 Power factor : 

3.5.9 Power factor : 

3.6 AC Supply : 

3.6.1 Voltage : _____________V

3.6.2 Voltage Variation : _____________percent

3.6.3 Frequency : _____________Hz.

3.6.4 Frequency variation : _____________percent

3.6.5 Combined voltage and frequency variation : _____________percent

3.6.6 Current : _____________A

3.6.7 Power factor : 

3.6.8 Power factor : 

3.7 Battery Storage Room : 

3.7.1 Area required : _____________sq.ft.

3.7.2 Height required : _____________ft.

3.7.3 Accessories required : 

3.7.4 Ventilation required : _____________cu.mm./minute

3.7.5 Recommended float charge : 

3.7.6 Recommended boost charge : 

3.7.6.1 Current : _____________A

3.7.6.2 Voltage : _____________V

3.7.7 Time required for boost charging from discharge conditions : _____________hours

3.8 Battery control panel : 

3.8.1 Type of panel : 

3.8.2 Number of batteries : 

3.8.3 Number of charge circuits : 

GTP (Battery and Battery Charger)
3.6 Percentage of taps provided on transformer

3.6.1 Primary winding

3.6.2 Secondary winding

3.7 DC output ratings:

3.7.1 Boost Charger

i) Power output : ____________ KW

ii) Voltage : ____________ V

iii) Current : ____________ A

iii) Range of current control :

3.7.2 Float charger

i) Power output : ____________ KW

ii) Voltage : ____________ V

iii) Current : ____________ A

iv) Range of current control :

3.8 DC output voltage regulation from no load to full load

3.9 Maximum ripple current : ____________ percent

3.10 Maximum permissible temp. rise over an ambient temp. of fifty (50) degrees centigrade: ____________ C

3.11 Overall efficiency : ____________ percent

3.12 Load limiting feature (attach characteristic curve showing variation of voltage with increase in load).

3.13 List of major accessories provided

3.14 Battery charger panel

3.14.1 Thickness of sheet steel : ____________ mm

3.14.2 Dimensions : ____________ mmLx__mmWx__mmD

3.14.3 Total weight : ____________ kg.
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<td>3.15</td>
<td><strong>Rectifier</strong></td>
<td>:</td>
<td>Trickle charge</td>
<td>Quick charge</td>
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<td>3.15.1</td>
<td>Name of manufacturer</td>
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<td>3.15.2</td>
<td>Address :</td>
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<td>3.15.3</td>
<td>Type of semi conducting Material</td>
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<td>3.15.4</td>
<td>Continuous rating in Amps.</td>
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<td>3.15.5</td>
<td>Short time rating in Amp. and time.</td>
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<td>3.15.6</td>
<td>Rated AC input voltage</td>
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<td>3.15.7</td>
<td>Rated DC output voltage</td>
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<td>3.15.8</td>
<td>Ripple factor</td>
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<td>3.15.9</td>
<td>Voltage factor</td>
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<td>3.15.10</td>
<td>Current factor</td>
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</table>

**4.0 D.C. PANELS**

4.1 Name of manufacturers

4.2 Address

4.3 Continuous current of Amp.

   i) Main circuit breaker

   ii) Bus bar

4.4 Short time rating in Amp. and time

4.5 Rated DC output voltage

4.6 Material of Bus Bar

4.7 Type & Manufacturer of HRC Cartridge fuse

**5.0 INSTRUMENT & INDICATING DEVICES**

5.1 Type

5.2 Name of Manufacturer

5.3 Accuracy class
I. RELAY & PROTECTION PANELS:
1. Name & Address of Manufacturer of panels
2. Manufacturer's type and designation
3. Type of construction (simplex / duplex)
4. Dimensions of the panels.
5. Dimensions of supporting channel.
6. Thickness of the steel plates proposed for use on panels.
   (a) Front
   (b) Rear
   (c) Sides, top and bottom
7. Degree of protection
8. Confirm whether offered manufacturer of relay & Protection panels and protective relays have tested commissioned and they are in successful operation for at least two years in 220 KV system.

II. CONTROL SWITCHES FOR CIRCUIT BREAKERS:
1. Name & Address of Manufacturer of panels
2. Manufacturer's type and designation
3. Type of handle provided.
4. No. of Positions.
5. No. of contracts.
   (i) Normally closed
   (ii) Normally open.
6. Rating of contacts
   (i) Make and carry continuously.
   (ii) Make and carry for 0.5sec.
   (iii) Break resistive load in amps (DC).
   (iv) Break inductive load in amps (DC).
7. Life of switch in terms of million mechanical Operation.

III. POSITION INDICATORS
1. Name & Address of Manufacturer of panels
2. Manufacturer's type and designation
3. Diameter of the disc. mm mm
4. Operating voltage          Volts                   Volts
5. Burden Watts (DC)            Watts (DC)            Watts (DC)

IV. INDICATING LAMPS:
1. Name & Address of Manufacturer of panels
2. Manufacturer’s type and designation
3. Rating
   (i) Operating Voltage
   (ii) Operating Current
   (iii) Wattage of lamp
4. Size of Lamp
5. Whether series resistors provided?
6. If series resistors provided, give
   (i) Ohmic value
   (ii) Wattage
7. Colour of lamp.
8. Life of lamp in burning hours.

V. SWITCH BOARD WIRING:
1. Insulation of wiring.
2. Size of wiring conductor of following :
   i) P.T. Circuits
   ii) C.T. Circuits.
   iii) DC Supply circuits
   iv) Other circuits
3. Size of earthing bar of safety earthing.
4. Type of terminals provided on wiring.
5. Wiring conductor aluminium / corner.

VI. DIGITAL MULTI FUNCTION METER
1. Maker’s Name and country.
2. Type of Instrument
3. Size
4. Whether magnetically shielded or not
5. Limits of error in the effective range.
6. V.A. Burden (VA)
(i) Current coil (VA)
(ii) Potential coil (VA)

7. Power Consumption
i) Current coil (Watts)
ii) Potential coil (Watts)

8. Temperature at which the instruments are calibrated.


10. Range.

11. Ratings
   i) CT Secondary
   ii) VT Secondary
   iii) DC auxiliary
   iv) Frequency range
   v) Operating principal
   vi) Thermal rating

12. Accuracy class

13. Display of (YES / NO)
   (a) Real time rms value of amp.
   (b) Real time rms value of voltage
   (c) Real time average pf
   (d) Real time frequency
   (e) Real time average power in MW, MVAr (Ig),(Id) and MVA

14. Type of connection

VII. ENERGY METER

1. Maker's Name and country.

2. Type of Instrument

3. Size

4. Whether magnetically shielded or not

5. Limits of error in the effective range.

6. V.A. Burden (VA)
   i) Current coil (VA)
   ii) Potential coil (VA)

7. Power Consumption
   i) Current coil (Watts)
   ii) Potential coil (Watts)

8. Temperature at which the instruments are calibrated.

10. Range

11. Ratings
   i) CT Secondary
   ii) VT Secondary
   iii) Frequency range
   iv) Thermal rating

12. Accuracy class

13. Display of (YES/ NO)
   (a) LCD test
   (b) Real time with date
   (c) Inst. Line current
   (d) Inst. phase voltage
   (e) Inst. Average power factor
   (f) maximum demand in MW/ MVA
   (g) Cumulative energy parameters in different resistors for
      i) MWh
      ii) MVArh
      iii) MVArh(Id)
      iv) MVAh

14. Type of connection

VIII  ANNUNCIATOR:

1. Maker’s name and country.

2. Type of selector switch.

3. Type of annunciator.

4. Type and particulars of window.

5. No. of lamps per window.

6. Lamps
   (i) Voltage
   (ii) Wattage

7. Particulars of wiring.

8. Rated voltage Volts.


10. Instantaneous making capacity contacts.


12. Type of reset Manual / Self

13. Overall dimensions of annunciator.

14. Descriptive leaflets No.

IX. TRANSMISSION LINE PROTECTION
**IX. (A) NUMERICAL DISTANCE PROTECTION RELAYS:**

1. Name & Address of Manufacturer
2. Manufacturer's type and designation
3. Switched or non switched type (is it with separate measurements for single/ three phase faults)
4. Setting range of offset feature
5. Whether the relay is having self monitoring feature
6. Whether relay is compatible for SCADA Equipments and can be used for Permissive Under reach/Over reach/Blocking scheme etc.
7. Suitable for single and three phase trip
8. Type of shaped characteristic
9. IDMT earth fault relay meeting Normal Inverse Characteristic as per IEC 60253 is Being offered as built in feature for lines
10. If No, Type of IDMT being offered.
11. Built in feature offered with the relay(Yes/No)
   i) Disturbance Recorder
   ii) Over-Voltage(One stage only)
   iii) Auto reclose along with deadline charging and check synchronizing.

**IX. (B) Backup Directional over current and earth fault relay :**

1. Name & Address of Manufacturer
2. Manufacturer’s type and designation
3. Whether characteristic will confirm to IEC 255-3
4. Two O/C and one E/F elements Are whether independent or composite unit?
5. Polarisation
   a. Current
   b. Potential
6. Current coil rating
7. Tap range
8. Potential rating
9. VA burden
a. Current coil
b. Highest tap
c. Lowest tap.

10. Directional sensitivity

11. VT fuse failure relay/feature included
   For alarm.

12. Unit setting range
   (i) Inverse time
   (ii) High set

13. Time of operation at maximum time dial wetting at:
   (i) 10 times tap setting.

14. Trip contact rating (Amps.)

15. Whether seal in contact provided or not

16. Descriptive leaflets ref.

IX(C)  DISTURBANCE RECORDER

(a) Acquisition unit
1. Name & Address of Manufacturer
2. Manufacturer’s type and designation
3. Number of analogue channels
4. Number of digital recording channels
5. Built in feature of main-1 distance relay is offered
6. Pre-fault memory(msec.)
7. Post-fault memory(msec.)
8. Total storage memory in sec.
9. Sampling Frequency
10. resolution of the event channels(ms)
11. Time display present?
12. data output in COMTRADE is available

(b) Evaluation unit
1. Name & Address of Manufacturer
2. Manufacturer’s type and designation
3. Number of acquisition unit that can be connected
to one evaluation unit

4. Technical parameter of evaluation unit
   a. processor and speed
   b. RAM and hard disk capacity
   c. additional facility
   d. details of printer

5. Details of power supply arrangement for acquisition unit (including printer)

IX(d) AUTO RECLOSE RELAY

1. Name & Address of Manufacturer

2. Manufacturer’s type and designation

3. Electromechanical/ststic/numerical

4. Auto reclose relay along with deadline charging and check synchronizing relay for line offered as a part of distance relay

5. Suitable for single and three phase?

6. Single phase dead time setting range

7. Three phase dead time setting range

8. Reclaim time setting range

X. TRANSFORMER PROTECTION

X(A) DIFFERENTIAL RELAYS:

1. Name & Address of Manufacturer

2. Manufacturer’s type and designation

3. Current coil rating

4. Tap range (Bias setting range)
   
   Coil 1
   
   Coil 2
   
   Coil 3

5. Maximum VA Burden
   
   (i) Operating Coil
   
   (ii) Restraining Coil

6. Power consumption
   
   (i) Operating Coil
   
   (ii) Restraining Coil

7. Whether three instantaneous units provided? Yes / No

8. Second Harmonic restraint provided or not.
9. Range of H.T.L.T. ratios over which the relay can be used.
10. Operating time.
11. Trip contact rating.
12. Whether seal in contacts provided or not.
13. How ratio/phase angle correction are being done (interposing transformer/internal feature in the relay)
14. Descriptive leaflet No.

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<th>Over current relay</th>
<th>Earth Fault relay</th>
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<td><strong>Over current and earth fault relay:</strong></td>
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<td>2. Manufacturer’s type and designation</td>
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<td>3. Whether the relay is having self monitoring feature</td>
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<td>4. Directional sensitivity</td>
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<td>5. Unit setting range</td>
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<tr>
<td></td>
<td>a) Inverse time</td>
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<td>b) High set</td>
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<th>Earth Fault relay</th>
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<td>1. Name and Address of Manufacturer</td>
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<td>2. Manufacturer’s type and designation</td>
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<td>3. Type of relay</td>
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<td>4. Principle of operation</td>
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<td>5. Current coil rating</td>
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<td>6. Max VA Burden</td>
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<td>7. Setting Ranges</td>
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<td>i) Current</td>
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<td>ii) Time</td>
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<td>8. Power consumption</td>
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<td>9. Operating time</td>
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<td>10. Trip contact rating</td>
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<td>11. Descriptive leaflet No.</td>
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GTP OF CABLE

1. Name of Manufacturer:

2. Country of Manufacturer:

3. Type of Cable : XLPE

4. Standard according to which cable is manufactured

5. Rated voltage


7. Conductor material

8. Impulse withstand voltage 1.2/50 micro Second wave KVp

9. Power frequency withstand voltage KV rms

10. Maximum dielectric stress at the Conductor KV/cm

11. Maximum dielectric stress at the conductor KV/cm

12. Minimum radial thickness of insulation between conductor & screen.

13. Conductor screen
   a) Material
   b) Nominal thickness

14. Metal sheath:
   a) Minimum radial thickness
   b) Composition
   c) Maximum working stress

15. Nominal diameter over metal sheath

16. Nominal radial clearance allowed under Metal sheath.

17. Protective outer serving
   a) Type and composition
   b) Nominal thickness
   c) Test voltage at works.

18. Nominal overall diameter of completed Single core cable.

19. Nominal weight per meter of complete Cable.

20. Short circuit capacities
    With a conductor temperature of 90 degree C at the commencement:
    a) 0.5 Second duration.
    b) 1 Second duration.
c) 2 Second duration.
d) 3 Second duration.

21. Minimum radius of bend round which Cable can be laid.
   a) Direct burial in ground
   b) In ducts

22. Maximum D.C. resistance of conductor
    Per Km. at 20 degree C.

23. Maximum A.C. resistance of conductor
    Per km. At 90 degree C.

24. Equivalent star reactance per km. Of 3-phase Circuit at 50 Hz.

25. Maximum electrostatic capacitance per km. of cable.

26. Maximum continuous current carrying capacity per cable when laid in ground
    at a depth of 1.5 metres (Ground temp. 35 degree C soil thermal resistivity 150 degree C/watt/Cm.
    Maximum conductor temperature 90 degree C).
    a) Only one 3-phase ckt. loaded.
    b) Both the three phase ckts. Loaded.

27. Maximum continuous current carrying capacity
    per cable when drawn into pipes (conditions as in item 26 above).
    a) Only one 3 phase ckt. loaded
    b) Two 3 phase ckt. loaded.

28. Continuous current carrying capacity which will permit a further 10% overload for two
    hours without exceeding a maximum conductor temp. of 90 degree C laid as in item 26 above.
    a) Only one 3 phase ckt. loaded.
    b) Two 3 phase ckts. Loaded.

29. Continuous current carrying capacity which will permit a further 10% overload for two
    hours as in item no.28 above, but with cables drawn into pipes.
    a) Only one 3 phase ckt. loaded.
    b) Two 3 phase ckt. loaded.

30. Maximum dielectric power factor of cable when laid direct in the ground, at normal
    voltage, frequency at conductor temperature of 15, 30, 45, 65, 90 degree C.

31. Maximum dielectric power loss of cable per Km. Of 3 phase ckt., laid direct in
    ground, at normal voltage, frequency and maximum conductor temperature.

32. Maximum dielectric power factor of cable at normal frequency and at a conductor temperature of 20 degree C and at
0.5, 1.0, 1.5, 2.0 times nominal voltage.

33. Sheath loss of cable per km. Of 3 phase ckt. at normal voltage, frequency, at maximum continuous current rating.
   a) laid direct in ground (item 26 above)
   b) drawn into ducts (item 27 above)

34. Impedance per km. Of 3 phase ckt. at 50 C/s and maximum conductor temperature.
   a) positive and negative sequence
   b) zero sequence

35. Attenuation to carrier current signals operating over a frequency range of 50 to 200 Kc/s.

36. a) Phase to ground characteristic impedance at 50 to 200 Kc/s.
   b) Screening factor.

37. Maximum drum length of cable.

38. Appxm. Shipping weight & size of drums

39. For 1-core cables please recommend with reasons:
   a) Method of laying (trefoil, horizontal)
   b) Whether sheaths are to be bounded and Earthed at one end or both ends.
   c) Transposed.

40. Straight through joint.
   a) Make
   b) Type

41. End Terminations
   a) Make
   b) Type

42. Warning tape
   a) Material
   b) Width
   c) Thickness
   d) Tensile strength
   e) Breaking load

43. Cable covers
   a) Dimension
   b) Design.
   c) Drawing

44. Cable Marker
   a) Size
   b) Drawing.
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>01.</td>
<td>Name of manufacturer :</td>
</tr>
<tr>
<td>02. a)</td>
<td>Type of circuit breaker :</td>
</tr>
<tr>
<td>02. b)</td>
<td>Type of tank (Live/Dead) :</td>
</tr>
<tr>
<td>03.</td>
<td>Manufacturer’s type and designation :</td>
</tr>
<tr>
<td>04.</td>
<td>Standards applicable :</td>
</tr>
<tr>
<td>05.</td>
<td>Rated voltage (KV) :</td>
</tr>
<tr>
<td>06.</td>
<td>Rated insulation level :</td>
</tr>
<tr>
<td>07.</td>
<td>Rated Frequency (Hz) :</td>
</tr>
<tr>
<td>08.</td>
<td>Class :</td>
</tr>
<tr>
<td>09.</td>
<td>Number of poles :</td>
</tr>
<tr>
<td>10.</td>
<td>Whether 3 pole or single pole unit :</td>
</tr>
<tr>
<td>11.</td>
<td>No. of breaks per pole :</td>
</tr>
<tr>
<td>12.</td>
<td>Normal current rating (amps)</td>
</tr>
<tr>
<td></td>
<td>(a) Under standard conditions :</td>
</tr>
<tr>
<td></td>
<td>(b) Under site conditions :</td>
</tr>
<tr>
<td></td>
<td>(c) De-rating factor, if any :</td>
</tr>
<tr>
<td></td>
<td>for site conditions</td>
</tr>
<tr>
<td></td>
<td>(d) Temperature rise at 150%</td>
</tr>
<tr>
<td></td>
<td>rating for 3 hours :</td>
</tr>
<tr>
<td>13.</td>
<td>Short time current rating (KA) :</td>
</tr>
<tr>
<td></td>
<td>for 1 second</td>
</tr>
<tr>
<td>14.</td>
<td>Maximum temperature rise over</td>
</tr>
<tr>
<td></td>
<td>ambient (C ) due to rated current</td>
</tr>
<tr>
<td></td>
<td>in main contacts, measured</td>
</tr>
<tr>
<td></td>
<td>after breaking test</td>
</tr>
<tr>
<td>15.</td>
<td>Rated short circuit breaking current</td>
</tr>
<tr>
<td></td>
<td>a. Rated short circuit current :</td>
</tr>
<tr>
<td></td>
<td>(Symmetrical AC component) KA (rms)</td>
</tr>
<tr>
<td></td>
<td>b. Percentage DC component :</td>
</tr>
<tr>
<td></td>
<td>c. Asymmetrical breaking Current :</td>
</tr>
<tr>
<td></td>
<td>(including DC component) KA (rms)</td>
</tr>
<tr>
<td>16.</td>
<td>Making capacity (KA peak) :</td>
</tr>
<tr>
<td>17.</td>
<td>Total break time (Milli-seconds)</td>
</tr>
<tr>
<td></td>
<td>(a) For interruption of 10% :</td>
</tr>
<tr>
<td></td>
<td>of the rated capacity</td>
</tr>
<tr>
<td></td>
<td>(b) For interruption of 30% :</td>
</tr>
</tbody>
</table>
of the rated capacity
(c) For interruption of 60% of the rated capacity
(d) For interruption of the full rated capacity

18. Arcing time (Milli-seconds)
19. Opening time & break time
20. Closing time (Milli-second)
21. Rated Operating Sequence
22. Minimum re-closing time at rated interrupted capacity from the instant of the trip coil energisation (Milli-seconds)

23. Minimum dead time
   (a) 3 phase re-closing (Milli seconds)
   (b) Limit of adjustment of dead Time for 3 phase re-closing
   (c) 1 phase re-closing (Milli seconds)

24. Data on re-striking voltage for 100%, 50% or 30% rated capacity
   (a) Amplitude factor
   (b) Phase factor
   (c) Natural frequency (Hz)
   (d) Rate of rise of re-striking Voltage (V/Micro sec.)

25. Rated out of phase breaking current
26. Rated line charging breaking current
27. Maximum line charging current breaking capacity and corresponding over voltage recorded in test
   (a) On supply side
   (b) On line side

28. Maximum cable charging current breaking capacity and corresponding over voltage recorded in test
   (a) On supply side
   (b) On line side

29. Rated single capacitor bank
   (a) Capacitive in rush current Handling capability
   (b) Capacitive breaking current
40. **Capability**

30. Rated small inductive breaking current and the corresponding over voltage.

31. First pole to clear factor

32. Rated transient recovery voltage for terminal faults

33. Rated characteristic for short line faults i.e. rate of rise.

34. Dry-1 minute power frequency test withstand voltage for complete circuit breaker
   
   (a) Between line terminal and grounded Parts (KV rms.)
   
   (b) Between terminals with breakers Contacts open (KV rms.)
   
   (c) Between poles.

35. Wet-1 minute power frequency test withstand voltage
   
   (a) Between line terminal and grounded parts (KV rms)
   
   (b) Between terminals with breakers contacts open (KV rms)

36. 1.2/50 microsecond wave impulse withstand test voltage for complete circuit breaker
   
   (a) Between line terminals and ground (KV peak)
   
   (b) Between terminals with circuit Breaker contacts
   
   (c) Between poles

37. Minimum clearance
   
   (a) Between phases (mm)
   
   (b) Live parts and earth (mm)
   
   (c) Live parts to ground level (mm)

38. Number of operation possible without maintenance
   
   (a) At full rated interrupting capacity
   
   (b) At 150% of rated current
   
   (c) At 100% of rated current
   
   (d) At 50% of rated current
39. **SUPPORTING INSULATORS**
   (a) Make and type
   (b) Weight
   (c) Transport dimensions
   (d) Insulation class
   (e) Visible corona discharge voltage
   (f) Dry-1 minute power frequency
       Flash over / voltage
   (g) Wet one minute power frequency
       Flash over / withstand voltage.
   (h) 1.2/50 microsecond impulse
       Flashover / withstand voltage.
   (i) Creepage distance to ground (mm) for
       heavily polluted atmosphere :
       (i) Total
       (ii) Protected

40. No. of poles per circuit breaker :
41. No. of breaks per pole
42. Total length of breaks per phase (mm)
43. Type of main contacts
44. Material of main contacts
45. Whether main contacts silver plated (Yes/No)
46. Thickness of silver coating on main contacts (mm)
47. Contact pressure on arcing contacts (Kg/m2)
48. Type of arcing contacts.
49. Contact pressure on main contacts (Kg/m2)
50. Type of auxiliary switches
51. Whether contacts of auxiliary switches silver plated (Yes/No)
52. No. of auxiliary switch contacts
    operating with all three poles of breaker
    (a) Which are closed when breaker is closed :
    (b) Which are open when breaker is closed :
    (c) Those adjustable with respect to the position of main contacts.
53. No. of spare auxiliary switch contacts
    operation with all three poles of breaker
    (a) Which are closed when Breaker is closed.
    (b) Which are open when breaker is closed.
(c) Those adjustable with respect to the position of main contacts

54. Number of spare terminal block :
55. Tripping and closing circuit voltage(V) :
56. Power required for trip coil :
57. Power required for closing coil :
58. Contingencies for which alarm provided :
59. Design data for supporting structure :
60. Weight of supporting steel structure for breaker :
61. Whether descriptive leaflets enclosed (Yes/No) :

**FOR SF6 GAS CIRCUIT BREAKER:**

62. Rated pressure of SF6 Gas in the gas cylinder (Kg/cm²) :
63. Quantity of SF6 gas required per single pole unit (Kg.) :
64. a) Quantity of SF6 gas per cylinder (Kg.) :
   b) Guaranteed maximum leakage rate per year (kg / sq. cm) :
65. Weight of empty cylinder (Kg.) :
66. Quantity of absorbent required per pole (Kg) :
67. Recommended interval for renewal of absorbent in case of outdoor Circuit breaker operating in tropical conditions :
68. Chemical composition of the absorbent :
69. Quantity of absorbent covered in the scope of supply (including spare qty (Kg)) :
70. Limit of gas pressure for proper operation of circuit breaker :
71. Pressure at which the temperature compensated gas pressure switch will
   (a) Give alarm :
   (b) Cut off :
72. Name of SF₆ supplier and country of origin :
73. Quantity of SF₆ gas supplied for
   (a) Actual use in breakers (Kg.) :
   (b) As spare (Kg.) :
74. Chemical composition of gas
   (a) Qty. of air by weight (ppm) :
   (b) Qty of H₂O by weight (ppm) :
(c) Qty of CF4 by weight (ppm) : 

75. Type of operating mechanism offered : 

76. Dimension of the control cabinets : 

78. Weight of control cabinet : 

79. Seismic level for which Breaker is designed (g) : 

80. Compliance to technical specification : 
   w.r.t parameters specified for 
   i) Control Cabinet i) YES / NO 
   ii) Bushing/support Insulator ii) YES / NO 
   iii) Terminal connector. iii) YES / NO 
   iv) SF6 Gas iv) YES / NO 

81. Detailed Literature 
   a) Whether similar equipment are type 
      tested as per IEC/IS and are in successful 
      operation for atleast 2 (two) years 
      (If yes, furnish type test reports) 
   b) Furnish data on capabilities of circuit 
      breaker in terms of time and number of 
      operations at duties ranging from 100 % 
      fault currents to load currents of the lowest 
      possible value without requiring any 
      maintenance or checks 
   c) Furnish details of effect of non simultaneity 
      between contacts within a pole or between 
      poles and also show how it is covered 
      in the guaranteed rated break time. 
   d) Overall General Arrangement drawing of 
      circuit breaker is to be enclosed. 

WEIGHT AND SPACE REQUIREMENT: 

82. Weight of 3-phase breaker complete with operating mechanism, insulating supports frame work etc. 

83. Impact loading for foundation design to include dead load plus impact value on opening at maximum 
    interrupting rating in terms of equivalent of static load. 

84. Weight of heaviest package.
**TECHNICAL DATA REQUIREMENT**

(Bidder’s Name)

**CURRENT TRANSFORMERS**

1. Name and address of manufacturer ..............................................................
2. Manufacturer’s type designation ..............................................................
3. Standards applicable ..............................................................
4. Type of CT (Live or Dead Tank Type) ..............................................................
5. Rated frequency (Hz) ..............................................................
6. Rated voltage Ur (kV) ..............................................................
7. Rated current  
   i) Rated continuous current (Amps) ..............................................................  
   ii) Rated extended primary current (Amps) ..............................................................
8. Short time thermal current withstand for 1 sec(kA) ..............................................................
9. Dynamic current withstand (kAp) ..............................................................
10. 1.2/50 micros impulse withstand voltage (kVp) ..............................................................
11. 250/2500 micro sec switching surge  
    withstand voltage (dry and wet) (kVp) ..............................................................
12. One minute dry and wet power frequency  
    withstand voltage (kV rms) ..............................................................
13. No. of primary winding ..............................................................
14. No. cores per CT ..............................................................
15. Current ratio (for all cores) ..............................................................
16. Output Burden (for all cores) ..............................................................
17. Accuracy class (for all cores) ..............................................................
18. Knee point voltage at different taps (v)  
    (for all cores) ..............................................................
19. Instrument security factor at different ratios  
    for meeting cores ..............................................................
20. Radio interference voltage at 1.1 Ur/3  
    at 1.0 MHz (Micro Volts) ..............................................................
21. Corona extinction voltage (kV rms) ..............................................................
22. Partial discharge level (PC) ..............................................................
23. Standard to which oil conforms generally ..............................................................
24. Total weight (kg) ..............................................................
25. Whether similar equipment are type tested YES / NO
and in successful operation for at least 2 years.

26. Maximum exciting current at knee point voltage at different ratios (for all cores) (mA) ..................................................

27. Secondary winding resistance at all different ratios (for all cores) (Ohms) ..................................................

28. Overall General arrangement drawing of CT is to be enclosed ..................................................
TECHNICAL DATA REQUIREMENT

INSULATOR, HARDWARES & ACCESSORIES

………………………….(Bidder’s Name)

A. INSULATOR STRINGS

1. Manufacturer’s name and address .................................................................

2. Applicable Standards ..............................................................................

3. No. of Units per String .............................................................................

4. Weight
   a) Each Disc (Kg) ......................................................................................
   b) Complete String (kg) ..............................................................................

5. Creepage Distance
   a) Each Disc. (Kg) ......................................................................................
   b) Complete String (mm0 ..........................................................................

6. Power Frequency Withstand Voltage of the complete String with corona control ring
   i) Dry (KV rms) ....................................................................................... 
   ii) Wet (KV rms) ....................................................................................... 

7. Lightning Impulse (dry) Withstand Voltage of the Complete string for Both positive and negative peaks (kVp).

8. Switching Surge withstand Voltage of the Complete string With corona control (Wet) (kVp)

9. Power Frequency Puncture Withstand Voltage (Dry & Wet) Of each Disc (KV rms)

10. Electro Mechanical Strength of each Disc (Kg)

11. Minimum Corona extinction (kVrms) voltage level of the complete string with corona control ring (Dry Condition)

12. RIV level of the complete (micro-volts) String with corona control ring at 1 MHz When subjected to a test voltage.

13. Confirm whether string type tested with offered disc insulator as per IS
B. INSULATOR

1. Manufacturer’s Name and Address ..........................................................
2. Applicable Standards ..............................................................................
3. Ultimate Strength
   a. Complete assembly (kg) .................................................................
   b. Suspension/drop clamp (kg) ............................................................

C. TUBULAR BUS CONDUCTOR

1. Manufacturer’s name and address ..........................................................
2. Applicable Standards ..............................................................................
3. Material ................................................................................................
4. Size of Tubular Bus ...............................................................................
   i) Standard pipe size-IPS (mm) ..............................................................
   ii) Outside diameter (mm) ....................................................................
   iii) Tolerance on outside ......................................................................
   iv) Thickness (mm) ..............................................................................
   v) Tolerance on Thickness ....................................................................
5. D.C. Resistance of 20 deg. C. .................................................................
6. Current rating at ambient temperature of 50 deg. C. ............................
7. Short circuit current rating for 1 sec. Duration (kA) ..............................
8. Radio Interference at rated voltage (micro volts) .................................
9. Weight (kg/m) ......................................................................................
10. Final allowable tubular bus conductor temperature due to short circuit.

D. MARSHALLING KIOSK

1. Manufacturer’s Name and Address ..........................................................
2. Thickness of sheet steel (mm) ............................................................... 
3. Degree of protection provided .............................................................

E. BUS POST INSULATIONS

1. Manufacturer’s name and address ..........................................................
2. Applicable Standards ..............................................................................
3. No. of Units per Stack ..........................................................................
4. Whether corona ring provided or not ....................................................
5. Diameter (mm) .................................................................

6. Creepage Distance ..............................................................
   a. Total (mm) .................................................................
   b. Protected (mm) ..............................................................

7. Power Frequency withstand Voltage of Insulator
   a. One Complete stack ..........................................................
   i. Dry (kV rms) ...............................................................
   ii) Wet (kV rms) ..............................................................

8. 1.2/50 micro sec. Impulse withstand Voltage on complete stack (kVp) ..........................................................

9. 250/2500 micro second switching Surge withstand voltage
   i) One complete stack ..........................................................
   ii) We (kV peak) ..............................................................

10. Radio interference Voltage of complete stack
    i) Test Voltage (kV rms) ......................................................
    ii) Radio interference voltage (micro volt) ................................

11. Weight of complete stack (Kg) ..................................................

12. Cantilever Strength of Complete Stack ..........................................

13. Torsional Strength (Kg.m) ....................................................

14. Compression Strength (Kg) ....................................................

15. Confirm whether type tested as per IS/IEC and are in successful operation for at least 2 (Two) years.

E. **ACSR CONDUCTOR**

1. Name and address of manufacturer ..............................................

2. Standards Applicable .................................................................

3. Name & Type of Conductor .......................................................
F. GALVANISED STEEL EARTHWIRE

1. Name and Address of the Manufacture

2. Standards Applicable

3.1 UTS of the Earthwire (kN)

3.2 Lay length of outer steel layer (mm)

3.3 DC Resistance of earthwire at 20 deg. C (ohms)

3.4 Standard length of earthwire in the drum (metres)

3.5 Diameter of earthwire
GUARANTEED TECHNICAL PARTICULARS FOR D.G. SET.

1.00.0 General
1.01.0 Contract’s Name & Address
1.02.0 Manufacturer’s, type and address
   a. Diesel Engine.
   b. Alternator
   c. Exciter
   d. Battery

2.00 Engine
2.01 Rating
2.02 Revolutions per min.
2.03 Number and arrangement of cylinder.
2.04 No. of strokes.
2.05 Method of starting.
2.06 Time required for starting
2.07 Auxiliary Power consumption
2.08 Type of Governor
2.09 Sensitivity of Governor
2.10 Guaranteed limits of Governing
   a. Permanent variation
   b. Full Load thrown off
   c. Full load put on.
2.11 Total speed variation
2.12 Specification of fuel oil.
2.13 Specification of Lub oil
2.14 Guaranteed fuel consumption
   a. At full load
   b. At $\frac{3}{4}$ load
   c. At $\frac{1}{2}$ load
   d. At $\frac{1}{4}$ load
2.15 Lub. oil consumption
2.16 Mechanical efficiency
2.17 Thermal efficiency
2.18 Method of aspiration
2.19 Method of cooling of engine and lub. oil.
2.20 Amount of water required for cooling system.
2.21 Total weight.
2.22 Space requirement including clearances
2.23 Maker’s name, type and technical literature for the following:
   a. Air filter & silencer.
b. Thermometer.
c. Pressure Gauges.
d. Level indicator
e. Tachometer.
f. Fuel oil pump.

2.24 Mechanical auxiliaries loads connected on Radiator fans 5 HP Main shaft with wiring.
2.25 Rated engine power and the ambient conditions at which rated power is defined.

2.26 Direction of rotation.

3.00 Storage Tank. (Outside)
   a. Type and shade.
   b. Capacity
c. Number Specifies.
d. Material of construction.
e. Overall dimensions.
f. Plate thickness.
g. Installation paint.

4.00 Alternator.
4.01 Rated KW capacity.
4.02 Rated KVA capacity.
4.03 Rated Terminal Voltage.
4.04 Rated Power Factor.
4.05 Rated Stator Current.
4.06 Rated Speed.
4.07 Rated Frequency
4.08 No. of phases/ Terminals brought outside
4.09 Excitation current and voltage at rated 3 Amp DC power output and power factor.
4.10 Efficiencies at 0.8 power factor at
   a. 100% load
   b. 75% load.
c. 50% load.
d. 25% load.
4.11 Inherent regulation (%)
4.12 Impedance
   a. $X_a$ dir axis synchronous.
   b. $X'd$ dir axis transient.
c. $X^n$ dir axis sub transient.
d. $X_q$ quad axis reactance.
e. $X'^n_q$ quad axis sub transient.
4.13 Type of exciter used; capacity &rating of exciter
4.14 Class of Insulation.
   a. Armature winding.
   b. Field winding.
   c. Bearing
4.16 Short circuit ratio
4.17 Rotor air gap
4.18 Overload capacity
4.19 Insulation level test voltage
4.20 Total weight & dimensions.
4.21 Applicable standard.
4.22 Automotive voltage regulator type, technical specifications and characteristics curves.
4.23 Electrical auxiliaries load connected to generator terminals with rating.

5.00 Engine Alternator Set.
5.01 Starting time.
5.02 Interval between staring impulse.
5.03 No. of starting impulse.
5.04 Time for picking up the load.
5.05 Voltage variation
5.06 Frequency variation
5.07 Duration of continuous full load operation.
5.08 Noise level.

6.00 Battery.
6.01 Type
6.02 Name of manufacturer and address
6.03 No. of Cells
6.04 Capacity in AH
6.05 Capacity current of
   a. Full charged battery.
   b. Fully discharged battery.
6.06 Average life in years.
6.07 Applicable standard.
6.08 Weight of the battery.
GUARANTEED TECHNICAL PARTICULARS

ISOLATORS

01. Name and address of the manufacturer
02. Manufacturer’s type designation
03. Standard applicable
04. Type and catalogue No. of Isolators.
05. Rated current under site conditions at 50 deg. C ambient. (Amps)
06. System voltage.
07. Rated voltage
08. Rated frequency (Hz)
09. Number of poles
10. Whether all 3 poles are ganged mechanically YES / NO
11. Pole to pole spacing (mm)
12. Rated short time current of isolator and earth switch for 1(one) second and dynamic current
13. Opening time of isolator and earth switch
14. Closing time of isolator and earth switch
15. Rated mechanical terminal load
16. Dielectric withstand capacity of completely assembled isolator/ earth switch
17. One minute dry power frequency withstand test voltage i) against ground (kVrms) ii) across isolating distance (kVrms)
18. 1.2/50 micro sec impulse withstand test voltage i) against ground (kVp) ii) across isolating distance (kVp)
20. Earthing switch making capacity for discharging line charge.
21. Construction Rate:
   a) Number of break per circuit per pole.
   b) No. of Isolators pedestals on one phase.
   c) Type of contacts
   d) Contact Area (sq.cm)
   e) Type of hearing or rotating insulator.
   f) Material for rotating blade.
   g) Material for contact.
   h) Max. Current density
   i) Thickness of silver plating (Microns)
22. Minimum clearance in air:
   a) Between poles
   b) Between live parts and earth
23. Number of auxiliary switches in operating mechanism:
   a) Normally close
   b) Normally open.
24. Earthing device:
   a) Short time current rating.
   b) One second.
25. Total weight of one complete triple pole isolator.
26. Mounting structure weight.
27. Terminal connectors.
28. Operating device details.
29. Operating Mechanism
   i) For main blades
   ii) For earth switches
30. Controls
   i) Rated DC control voltage (V)
   ii) Limits of voltage
31. Rated Insulation level.
32. Radio interference level at 1.1 Ur/
    root 3 (in micro volts) at 1 MHz
33. Corona Extinction voltage (kV rms)
34. Compliance to Technical specification w.r.t
    i) MOM Box
    ii) Support insulators
    iii) Terminal Connectors
35. Whether similar equipment are type tested
    as per IEC / IS and are in successful operation
    for at least 2 (two) years
36. Overall General Arrangement drawing of
    Isolator/ Earthswitch is to be enclosed.
VOLTAGE / POTENTIAL TRANSFORMERS

GUARANTEED TECHNICAL PARTICULARS

1. Type
2. Manufacturer’s Type
3. Designation
4. Rated Voltage
5. Rated Primary Voltage
6. Rated Secondary Voltage
7. Number of cores

<table>
<thead>
<tr>
<th></th>
<th>Rated Output</th>
<th>Class of Accuracy</th>
<th>Ratio Error</th>
<th>Phase Angle Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>CORE-I</td>
<td></td>
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<tr>
<td>CORE-II</td>
<td></td>
<td></td>
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<tr>
<td>CORE-III</td>
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</tbody>
</table>

8. One minute power frequency dry withstand test voltage  KV rms
9. One minute power frequency wet withstand test voltage  KV rms
10. 1.2/50 microsecond impulse withstand crest voltage  KV peak
11. One minute power frequency withstand voltage on secondaries KV rms
12. Temp. rise of winding at rated voltage factor :
    i) At 1.2 voltage factor for continuous rating :
    ii) At 1.5 voltage factor for 30 seconds rating :
13. Creepage distance of Bushing
14. Protected creepage distance
15. Weight of oil  Kg.
16. Weight of core  Kg.
17. Total Weight  Kg.
18. Mounting details
19. Overall dimensions
# SURGE ARRESTOR

## GUARANTEED TECHNICAL PARTICULARS

1. Name of Manufacturer
2. Manufacturer’s type designation
3. Arrestor Class & Type
4. Applicable Standards
5. No. of Units
6. Rated arrester voltage
7. Rated system voltage
8. Nominal discharge current
9. Minimum discharge capability
10. Minimum power frequency discharge voltage
11. Maximum impulse spark over voltage (1.2/50 micro seconds wave)
12. Dry and wet power frequency withstand voltage of arrester insulation
13. One minute power frequency (dry) withstand voltage of arrester housing
14. Lightning Impulse withstand test voltage of arrestor housing with 1.2/50 microsec wave
15. Max. continuous operating voltage at 50 deg C ambient temperature
16. Protective level of the arrester
17. Virtual steepness for front of wave for above
18. Ratio of system voltage withstand level to protection level of surge arrester
19. Maximum residual voltage for discharge current of (8/20) micro second wave
   i) 5000 Amps.
   ii) 10000 Amps.
   iii) 20000 Amps.
20. Impulse Current withstand  
   a) High current short duration 
      (4/10 micro second wave in KV peak)  
   b) Low current long duration (2000 microsec.)  

21. Leakage current through Arrester (mA)  
   i) Capacitive  
   ii) Resistive  
   iii) Total  

22. Long Duration current test  
   i) Current peak  
   ii) Virtual duration  

23. Creepage distance (suitable for heavily polluted atmosphere)  

24. Current for Pressure Relief test  

25. Pressure relief class  

26. Long duration discharge class  

27. Reset capacity  

28. Type and specification of the surge counters  

29. Type and range of milli-Ampere meter  

30. Mounting flanges dimensional details  

31. Earthing arrangement provided for earthing side of arresters.  

32. Clearance required from grounded equipment at various heights of arresters units mm  

33. Minimum recommended spacing between arresters centre to centre mm  

34. Height of complete unit from base to the line side  

35. Weight of complete unit  

36. Compliance to technical Specification w.r.t  
   a) Surge monitor  
   b) Support Insulator  
   c) Terminal Connectors  

37. ZnO block details  
   a) Make and size of ZnO block  
   b) Whether equipment type tested  
      With offered type of ZnO block
38. Whether similar equipment are type tested
   As per IEC/IS or equivalent standard and are
   In successful operation for at least two years

39. Overall General Arrangement drawing of Surge
   Arrestor is to be enclosed.
# Schedule of Guaranteed Performance and Technical Particulars (Power Transformer):

1. Name of Manufacturer.

2. Service.

3. Normal continuous rating in MVA under site conditions at all taps:
   - HV Winding
   - LV Winding
   - Tertiary winding

4. Rated voltage:
   - HV Winding
   - LV Winding
   - Tertiary winding

5. Rated Frequency

6. Number of phases

7. Type of transformer.

8. Connections:
   - HV Winding
   - LV Winding
   - Tertiary winding

9. Connection symbols:
   - HV – LV
   - HV – Tertiary
   - LV – Tertiary

10. Tappings:
    - Range
    - Number of steps
    - Position of tapping on HT winding for high voltage variation.

11. Reference ambient temperatures:
    - Maximum ambient air temperature
    - Maximum daily average ambient air temperature
    - Minimum ambient air temperature
    - Maximum yearly weighted average ambient temperature

12. Maximum temperature rise over ambient temperature:
    - In oil by thermometer
    - In winding by resistance
    - Limit for hot spot temperature for which the transformer is designed.

13. Type and details of winding hot spot temperature detector.

14. Voltage to earth for which the star point will be insulated

15. Type of cooling.

   i. Total number of fans in the cooling bank/banks.
   ii. Total number of oil pumps.
   iii. Type, make and rating of each fan.
   iv. Type, make and rating of each oil pump motor

16. Fixed losses of 3 phase transformer at 75 °C
<table>
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<th>B</th>
<th>Load losses of 3 phase transformer at 75 ºC excluding cooler losses.</th>
<th>KW</th>
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<td>Cooler Losses:</td>
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<td>i. Fan losses</td>
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<td></td>
<td>ii. Oil Pump losses</td>
<td>KW</td>
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<td>D</td>
<td>Heater losses</td>
<td>KW</td>
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<td>E</td>
<td>Total losses of 3 phase transformer at max. attainable temperature (a plus b plus c plus d)</td>
<td>KW</td>
</tr>
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<td>16.</td>
<td>Max. current density in winding at CMR.</td>
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<tr>
<td></td>
<td>A HV winding</td>
<td>Amps/ Sec.</td>
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<tr>
<td></td>
<td>B LV winding</td>
<td>Amps/ Sec.</td>
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<td></td>
<td>C Tertiary winding</td>
<td>Amps/ Sec.</td>
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<td>17.</td>
<td>Impedance voltage at rated current, normal ratio and at 75 ºC expressed as percentage of normal voltage, on 100MVA base, between:</td>
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<tr>
<td></td>
<td>A HV to LV</td>
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</tr>
<tr>
<td></td>
<td>B HV to Tertiary</td>
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</tr>
<tr>
<td></td>
<td>C LV to Tertiary</td>
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<tr>
<td>18.</td>
<td>Reactance at rated current and rated frequency:</td>
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<td></td>
<td>A HV to LV</td>
<td>Ohms</td>
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<tr>
<td></td>
<td>B HV to Tertiary</td>
<td>Ohms</td>
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<tr>
<td></td>
<td>C LV to Tertiary</td>
<td>Ohms</td>
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<tr>
<td></td>
<td>D Reactance Voltage drop expressed at percentage of rated voltage</td>
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<td>19.</td>
<td>Resistance:</td>
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<tr>
<td></td>
<td>A HV winding</td>
<td>Ohms</td>
</tr>
<tr>
<td></td>
<td>B LV winding</td>
<td>Ohms</td>
</tr>
<tr>
<td></td>
<td>C Tertiary winding</td>
<td>Ohms</td>
</tr>
<tr>
<td></td>
<td>D Resistance voltage drop at 75 ºC coverage winding temperature expressed as percent of rated voltage.</td>
<td></td>
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<td>20.</td>
<td>Capacitance on open circuit conditions.</td>
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<td>21.</td>
<td>Input to cooling system</td>
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<td>22.</td>
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<td></td>
<td>A Separately source power frequency voltage withstand:</td>
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<tr>
<td></td>
<td>i. HV winding</td>
<td>KV rms.</td>
</tr>
<tr>
<td></td>
<td>ii. LV winding</td>
<td>KV rms.</td>
</tr>
<tr>
<td></td>
<td>iii. Tertiary winding</td>
<td>KV rms.</td>
</tr>
<tr>
<td></td>
<td>B Induced over-voltage withstand:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i. HV winding</td>
<td>KV rms.</td>
</tr>
<tr>
<td></td>
<td>ii. LV winding</td>
<td>KV rms.</td>
</tr>
<tr>
<td></td>
<td>iii. Tertiary winding</td>
<td>KV rms.</td>
</tr>
<tr>
<td></td>
<td>C Full – wave lightening impulse withstand voltage.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i. HV winding</td>
<td>KV peak</td>
</tr>
<tr>
<td></td>
<td>ii. LV winding</td>
<td>KV peak</td>
</tr>
<tr>
<td></td>
<td>iii. Tertiary winding</td>
<td>KV peak</td>
</tr>
<tr>
<td></td>
<td>D Switching impulse withstand voltage:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i. HV winding</td>
<td>KV peak</td>
</tr>
<tr>
<td></td>
<td>ii. LV winding</td>
<td>KV peak</td>
</tr>
<tr>
<td></td>
<td>iii. Tertiary winding</td>
<td>KV peak</td>
</tr>
<tr>
<td></td>
<td>E Power frequency high-voltage tests:</td>
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<tr>
<td></td>
<td>i. Test voltage for 1 minute withstand test on high-voltage winding (induced).</td>
<td>KV rms</td>
</tr>
<tr>
<td></td>
<td>ii. Test voltage for 1 minute withstand test on low-voltage winding</td>
<td>KV rms</td>
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<tr>
<td>iii.</td>
<td>Test voltage for 1 minute withstand test on neutral and of high voltage winding.</td>
<td></td>
</tr>
<tr>
<td>iv.</td>
<td>Impulse test on high voltage winding 1.2/50 full wave withstand.</td>
<td></td>
</tr>
<tr>
<td>v.</td>
<td>Impulse test on low-voltage winding 1.2/50 full wave withstand.</td>
<td></td>
</tr>
<tr>
<td>vi.</td>
<td>Wave form for impulse test</td>
<td></td>
</tr>
</tbody>
</table>

23. Magnetizing current:
- A No load current at rated voltage and rated frequency
- B Power factor of magnetizing current at rated voltage and frequency.

24. Stabilizing / Tertiary winding
- A Rated voltage
- B Normal rating
- C Normal rating (expressed as percent of main winding rating in the case of stabilizing winding).
- D Delta closed inside (in case of stabilizing winding).

25. Efficiency at 75°C at unity power factor:
- A Full load
- B 75% load
- C 50% load
- D 25% load

26. The minimum value of load at which the transformer will run at maximum efficiency.

27. Regulation at full load at 75°C
- A At unity power factor
- B 0.8 power factor (lagging)

28. Core Data
- A Grade of core material used.
- B Thickness of core plate laminations
- C Whether core laminations are grain oriented cold rolled.
- D Details of oil ducts in core:
  - i. Whether in the plane and at right angle to the plane of winding.
  - ii. Across the plane of lamination.
- E
  - i. Insulation of core lamination.
  - ii. Insulation of core bolt.
  - iii. Insulation of core bolt washers.
  - iv. Insulation of core and plates.
- F Type of core joints.

29. Flux density:
- A Designed continuous flux density at normal taps.
- B Operating continuous flux density at normal taps
- C Designed max. operating flux density which the transformer can withstand for 1 minute at normal tap.
- D Designed max. operating flux density which the transformer can withstand for 5 seconds at normal taps.

30. Inter-turn insulation extreme:
- A Extent of extreme end turns reinforcement.
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B</strong></td>
<td>Extent of end turns reinforcement.</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>Extent of turns adjacent to tappings reinforced.</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>Test voltage for 10 seconds, 50Hz interturn insulation test on (a)</td>
</tr>
<tr>
<td><strong>E</strong></td>
<td>Test voltage for 10 seconds, 50Hz inter turn insulation test on (b)</td>
</tr>
<tr>
<td><strong>F</strong></td>
<td>Test voltage for 10 seconds, 50Hz inter turn insulation test on (c)</td>
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<td><strong>31</strong></td>
<td><strong>WINDINGS:</strong></td>
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<tr>
<td><strong>A</strong></td>
<td>Type of windings:</td>
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<tr>
<td></td>
<td>i) HV winding</td>
</tr>
<tr>
<td></td>
<td>ii) LV winding</td>
</tr>
<tr>
<td></td>
<td>iii) Tertiary winding</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Insulation of HV winding</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>Insulation of LV winding</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>Insulation of Tertiary winding</td>
</tr>
<tr>
<td><strong>E</strong></td>
<td>Insulation between HV &amp; LV winding</td>
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<td><strong>32</strong></td>
<td>Continuous rating in KVA under following conditions</td>
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<td><strong>A</strong></td>
<td>At 50 deg C ambient air temperature at site</td>
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<tr>
<td><strong>B</strong></td>
<td>At 40 deg C ambient air temperature at site</td>
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<tr>
<td><strong>C</strong></td>
<td>At 30 deg C ambient air temperature at site</td>
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<td><strong>33</strong></td>
<td>Time for which transformer can run at rated capacity in case of failure of cooling equipment</td>
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<td><strong>34</strong></td>
<td>Width of Track-gauge</td>
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<tr>
<td><strong>35</strong></td>
<td>Whether HV windings are interleaved</td>
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<td><strong>36</strong></td>
<td>Thickness of transformer Tank</td>
</tr>
<tr>
<td>a)</td>
<td>Sides</td>
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<tr>
<td>b)</td>
<td>Bottom</td>
</tr>
<tr>
<td>37</td>
<td>Dimensions of 3 phase transformer:</td>
</tr>
<tr>
<td>----</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>a)</td>
<td>Max. height to top of bushings</td>
</tr>
<tr>
<td>b)</td>
<td>Over-all length</td>
</tr>
<tr>
<td>c)</td>
<td>Over-all breadth</td>
</tr>
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<table>
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<tr>
<th>38</th>
<th>Weight data of transformer components:</th>
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<tr>
<td>a)</td>
<td>Weight of core</td>
</tr>
<tr>
<td>b)</td>
<td>Weight of copper windings</td>
</tr>
<tr>
<td>c)</td>
<td>Weight of core &amp; windings</td>
</tr>
<tr>
<td>d)</td>
<td>Weight of tank, fittings and accessories</td>
</tr>
<tr>
<td>e)</td>
<td>Weight of insulating oil in OLTC chamber</td>
</tr>
<tr>
<td>f)</td>
<td>Weight of insulating oil in main tank</td>
</tr>
<tr>
<td>g)</td>
<td>Total weight of the Insulating oil in the transformer including oil in the conservator and cooling system</td>
</tr>
<tr>
<td>h)</td>
<td>Total weight of complete 3 Phase transformer</td>
</tr>
<tr>
<td>i)</td>
<td>Weight of transformer arranged for transportation</td>
</tr>
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<table>
<thead>
<tr>
<th>39</th>
<th>Bushing Data</th>
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<tbody>
<tr>
<td>a)</td>
<td>Type of bushing Insulator</td>
</tr>
<tr>
<td>b)</td>
<td>Weight of bushing Insulator (kg)</td>
</tr>
<tr>
<td>c)</td>
<td>Quantity of oil in one bushing (Lts)</td>
</tr>
<tr>
<td>d)</td>
<td>Minimum dry flashover voltage of bushing (KV)</td>
</tr>
<tr>
<td>e)</td>
<td>Minimum we flashover voltage of bushing (KV)</td>
</tr>
<tr>
<td>f)</td>
<td>Minimum impulse level (KV)</td>
</tr>
<tr>
<td>g)</td>
<td>Voltage rating (KV)</td>
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<tr>
<td>h)</td>
<td>Current rating (Amps)</td>
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<td>----</td>
<td>---------------------</td>
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<tr>
<td>i)</td>
<td>Creepage distance in air (mm)</td>
</tr>
<tr>
<td>j)</td>
<td>Recommended gap setting (mm)</td>
</tr>
<tr>
<td>k)</td>
<td>Free space required at top for removal of bushing (mm)</td>
</tr>
</tbody>
</table>

40 Bucholz relay:

Description, range of settings, schematic diagram etc.

41 Sudden pressure relay:

Description, data, range of settings, schematic diagram etc.

42 Conservator:

a) Total volume of the conservator [Cubic meters]

b) Volume of the conservator between the highest and lowest level [Cubic meters]

43 Details of bushing current transformer:

a) For differential protection

b) For restricted earth fault protection

44 Calculated time constants:

a) Natural cooling

b) Forced air cooling

c) Forced oil cooling

45 Type of axial coil supports:

a) HV winding

b) LV winding

c) Tertiary winding
### Details of On-load tap changing gear:

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<tr>
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<tbody>
<tr>
<td>a)</td>
<td>Make</td>
</tr>
<tr>
<td>b)</td>
<td>Type</td>
</tr>
<tr>
<td>c)</td>
<td>Rating:</td>
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<tr>
<td></td>
<td>i) Rated voltage</td>
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<td>ii) Rated current</td>
</tr>
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<td></td>
<td>iii) Step voltage</td>
</tr>
<tr>
<td></td>
<td>iv) Number of steps</td>
</tr>
<tr>
<td>d)</td>
<td>Control</td>
</tr>
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<td>e)</td>
<td>Auxiliary supply details</td>
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<td>f)</td>
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<td>i)</td>
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<td>j)</td>
<td>Approximate overall weight</td>
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<tr>
<td>k)</td>
<td>Approximate overall dimensions</td>
</tr>
<tr>
<td>l)</td>
<td>Approximate overall quantity of oil</td>
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### Dispatch details:

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<td>a)</td>
<td>Approximate mass of heaviest package kg</td>
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<tr>
<td>b)</td>
<td>Approximate dimensions of largest package</td>
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<tr>
<td></td>
<td>i) Length mm</td>
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<tr>
<td></td>
<td>ii) Breadth mm</td>
</tr>
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<td></td>
<td>iii) Height mm</td>
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<tbody>
<tr>
<td>48</td>
<td>Untanking height mm</td>
</tr>
</tbody>
</table>
A. **Complete GIS Module**

1. Nominal voltage of system  \( kV \)
2. Rated voltage of system  \( kV \)
3. Rated voltage for equipment (\( U_r \))  \( kV \)
4. **Rated insulation levels phase-to-earth and between phases**
   - Rated short-duration power-frequency withstand voltage (\( U_d \))  \( kV \)
5. **Rated switching impulse withstand voltage (\( U_s \))**
   - Phase-to-earth  \( kV \)
   - Between phases  \( kV \)
6. Rated lightning impulse withstand voltage (\( U_p \))
7. Rated frequency (\( f_r \))  Hz
8. Rated normal current (\( I_r \))  A
9. Rated short-time withstand current (\( I_k \))  kA
10. Rated peak withstand current (\( I_p \))  kA
11. Rated duration of short-circuit (\( t_k \))  s
12. Rated supply voltage of closing and opening devices and of auxiliary and control circuits (\( U_{a} \))  V
13. Rated supply frequency of closing and opening devices and of auxiliary circuits  Hz DC or 50 or 60
14. Neutral earthing Solidly or not solidly
15. Number of phases
16. Single- or three-phase design
17. Maximum SF6 leakage rate  % / year
18. Rated filling pressure \( p_r \)
   - Circuit-breaker
   - Other compartments
19. Alarm pressure \( p_a \)
   - Circuit-breaker
   - Other compartments
20. Minimum functional pressure \( p_m \)
   - Circuit-breaker
   - Other compartments
21. Design pressure of enclosures
   - Circuit-breaker
   - Other compartments
22. Type test pressure of enclosures
   - Circuit-breaker
   - Other compartments
23. Routine test pressure of enclosures
   Circuit-breaker
   Other compartments

24. Operating pressure of pressure relief device
   Circuit-breaker
   Other compartments

25. Internal fault
   Short-circuit current \( kA \)

26. Quantity of SF6 gas of complete GIS at filling pressure \( \text{kg} \)

27. Quantity of SF6 gas of the largest compartment at filling pressure \( \text{kg} \)

28. Maximum permissible gas dew point \( ^{\circ}C \)

29. Number of gas compartments

30. Length of longest section for transportation \( \text{m} \)

31. Weight of the heaviest piece of equipment to be handled during installation on-site \( \text{kg} \)

B. Bus ducts
   1. Inductance \( \text{H/m} \)
   2. Capacitance \( \text{pF/m} \)
   3. Resistance of enclosure at \( f_r \) \( \Omega/m \)
   4. Resistance of conductor at \( f_r \) \( \Omega/m \)
   5. Surge impedance \( \Omega \)

C. Bushing (Outdoor-immersed bushing)
   1. Type of internal insulation
   2. Type of external insulation
   3. Nominal specific creepage distance \( \text{mm/kV} \)
   4. Shed profile Normal or alternating
   5. Rated short-duration, power-frequency withstand voltage \( (U_d) \) \( \text{kV} \)
   6. Rated switching impulse withstand voltage \( (U_s) \) \( \text{kV} \)
   7. Rated lightning impulse withstand voltage \( (U_p) \) \( \text{kV} \)
   8. Cantilever test load \( N \)
   9. Cantilever operation load \( N \)
   10. Type of line termination
SECTION-IV

PRICE SCHEDULES
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<th>S.No.</th>
<th>Item Description</th>
<th>Unit Qty</th>
<th>Currency (INR)</th>
<th>CIF PRICE (INR)</th>
<th>Taxes &amp; Duties for Direct Transaction (Not included in CIF Price Component)</th>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>Unit FOB Unit CIF Total CIF</td>
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<td></td>
<td></td>
<td>Rate</td>
<td>Amount</td>
</tr>
<tr>
<td>1</td>
<td>A Power Transformer and associated equipment</td>
<td></td>
<td></td>
<td>Rate</td>
<td>Amount</td>
</tr>
<tr>
<td>2</td>
<td>B 245kV GIS Equipment</td>
<td></td>
<td></td>
<td>Rate</td>
<td>Amount</td>
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<td>3</td>
<td></td>
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<td></td>
<td>Rate</td>
<td>Amount</td>
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</table>

**Bids & Conditions**

- **Bidder's Name and Address**: Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.
Bidder's Name and Address:

Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.

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<th>Taxes &amp; Duties for Direct Transaction (Not included in CIF Price Component)</th>
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<td>3</td>
<td>Bus bar Module : 245kV/3 single phase (isolated) units, SF6 gas insulated, metal enclosed 2500A bus bar each enclosed in bus enclosures running along the length of the switchgear to interconnect each of Circuit breaker bay module. Each bus bar set shall be complete with voltage transformer, disconnector and safety grounding switch, SF6 gas monitoring system for complete bay etc.</td>
<td>Set 2</td>
<td>1</td>
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<td>4</td>
<td>Bus coupler Bay Module : 245kV, 2500A, SF6 gas insulated bus coupler bay module comprising of SF6 gas insulated circuit breaker (2500A), current transformer (1600-800/1-1-1-1), two bus-bar disconnectors (2500A) with safety grounding switches, SF6 gas monitoring system for complete bay etc.</td>
<td>Set 2</td>
<td>1</td>
<td>2</td>
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<tr>
<td>5</td>
<td>Bus sectionaliser bay Module: 245kV, 2500A, SF6 gas insulated bus sectionaliser bay module comprising of SF6 gas insulated circuit breaker (2500A), current transformer (1600-800/1-1-1-1), two disconnectors (2500A) with safety grounding switches, SF6 gas monitoring system for complete bay etc.</td>
<td>Set 2</td>
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<td>Sub-Total (B)</td>
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<td>C</td>
<td>66kV GIS Equipment</td>
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<tr>
<td>1.0</td>
<td>Feeder Bay Module : 72.5kV, 2000A, SF6 gas insulated feeder bay module comprising of SF6 gas insulated circuit breaker(2000A), current transformer, two bus-bar disconnectors with one earthing switch, line disconnector with one normal &amp; one high speed fault make grounding switch, surge arrestors, SF6 gas monitoring system for complete bay, PT, gas insulated terminal connection for connecting XLPE cable (XLPE cable/SF6) with cable termination enclosure and accessories with GIS, local control cubicle etc. to complete feeder bay module.</td>
<td>Set 8</td>
<td>1</td>
<td>2</td>
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<tr>
<td>2.0</td>
<td>Bus Coupler Bay : 72.5kV, 2500A, SF6 gas insulated bus coupler bay module comprising of SF6 gas insulated circuit breaker, current transformer, two nos. of disconnectors with earthing switches, SF6 gas monitoring system for complete bay, local control cubicle etc.</td>
<td>Set 1</td>
<td>1</td>
<td>2</td>
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<tr>
<td>3.0</td>
<td>Transformer Bay Module : 72.5kV, 2000A, SF6 gas insulated transformer bay module each comprising of SF6 gas insulated circuit breaker, current transformer, Two nos. of bus-bar disconnectors with common grounding switch, line disconnector with one normal &amp; one high speed fault make grounding switch, surge arrestors, SF6 gas monitoring system for complete bay, gas insulated terminal connection for connecting transformer (XLPE cable/SF6) through XLPE cable with cable end box and accessories with GIS, local control cubicle etc. to complete transformer bay module.</td>
<td>Set 2</td>
<td>1</td>
<td>2</td>
<td>3</td>
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Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.

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<tr>
<th>S.No.</th>
<th>Item Description</th>
<th>Unit Qty</th>
<th>Currency</th>
<th>CIF PRICE (INR)</th>
<th>Taxes &amp; Duties for Direct Transaction (Not included in CIF Price Component)</th>
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<td>Rate Amount</td>
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<tr>
<td>1</td>
<td>Bus Bars : 72.5kV, 3000A, 3-phase or single phase encapsulated unit, SF6 gas insulated, metal enclosed bus bars each enclosed in bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each bus bar set shall be complete with voltage transformer, disconnectors with safety grounding switch, local control cubicle, SF6 gas monitoring system etc.</td>
<td>4 4 5 6 7 8=4x7</td>
<td>9 10 11 12 13 14 15 16</td>
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<tr>
<td>2</td>
<td>Bus Coupler Bay : 36kV, 2500A, SF6 gas insulated bus coupler bay module comprising of circuit breaker (2500A), current transformer (2000A), SF6 gas monitoring system for complete bay etc.</td>
<td>Set 2</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>Transformer Bay Module : 36kV, 2500A, SF6 gas insulated transformer bay module each comprising of circuit breaker (2500A), current transformer (2000A), SF6 gas monitoring system for complete bay etc.</td>
<td>Set 2</td>
<td></td>
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<tr>
<td>4</td>
<td>Bus Bars : 36kV, 2500A, 3-phase or single phase encapsulated unit, SF6 gas insulated bus bars each enclosed in bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each bus bar set shall be complete with voltage transformer, disconnectors with safety grounding switch, SF6 gas monitoring system etc.</td>
<td>Set 2</td>
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<tr>
<td>D</td>
<td>33kV GIS Equipment</td>
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<tr>
<td>1</td>
<td>Feeder Bay Module : 36kV, 1250A, SF6 gas insulated feeder bay module each comprising of circuit breaker(1250A), current transformer (800-400/1-1-1), two bus-bar disconnectors (1250A) with common grounding switch, SF6 gas monitoring system for complete bay, PT, gas insulated terminal connection for connecting XLPE cable with cable termination enclosure and accessories with GIS etc.</td>
<td>Set 2</td>
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<tr>
<td>2</td>
<td>Bus-Coupler Bay : 36kV, 2500A, SF6 gas insulated bus coupler bay module comprising of circuit breaker (2500A), current transformer (2000A), SF6 gas monitoring system for complete bay etc.</td>
<td>Set 1</td>
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<td>E</td>
<td>Sub-Station Automation System and Relay &amp; Protection Panels</td>
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<tr>
<td>1</td>
<td>220kV Relay and Protection Panels</td>
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<td>a)</td>
<td>Bus Bar Protection Panel</td>
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<td>b)</td>
<td>Circuit Breaker Relay Panel Without Auto Reclose</td>
<td>No. 16</td>
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<tr>
<td>c)</td>
<td>Line Protection Panel</td>
<td>No. 8</td>
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<tr>
<td>d)</td>
<td>Transformer Protection Panel (for HV side)</td>
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<tr>
<td>e)</td>
<td>Bus-Coupler Protection Panel</td>
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<tr>
<td>f)</td>
<td>Bus-Section Protection Panel</td>
<td>No. 2</td>
<td></td>
<td></td>
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<tr>
<td>g)</td>
<td>Time synchronization equipment and other common equipments pertaining to Relay &amp; Protection system (Time synchronization equipment)</td>
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</table>
Bidder's Name and Address:

Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.

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<tr>
<th>S.No.</th>
<th>Item Description</th>
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<th>Qty</th>
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<th>CIF Price (INR)</th>
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<td>Rate</td>
<td>Amount</td>
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</tbody>
</table>

2 66KV Relay and Protection Panels

- a) Circuit Breaker Relay Panel Without Auto Reclose
- b) Line Protection Panel
- c) Transformer Protection Panel
- d) Bus-Coupler Protection Panel
- e) Other/common equipments pertaining to Relay & Protection System etc.

3 33KV Relay and Protection Panels

- a) Line Relay & Protection Panel
- b) Transformer Relay & Protection Panel for LV side
- c) Bus-Coupler Relay & Protection Panel
- d) Other/common equipments pertaining to Relay & Protection System (Included in above)

4 Automation & SCADA

- a) Substation automation equipment, optic fibre and other interface/converter equipment
- b) SCADA equipments
- c) Testing & Maintenance equipment
- d) Inverter of suitable capacity for HMI and peripheral devices i.e. Printer etc.

5 Air conditioning system

- a) Split AC (4 star rating) 220kV Relay & Protection room
- b) Split AC (4 star rating) 33kV Relay & Protection room
- c) Split AC (4 star rating) 66kV Relay & Protection room
- d) Split AC (4 star rating) for Control room
- e) Split AC (4 star rating) for Battery room
- f) Split AC (4 star rating) for Electrical lab and for office space
- g) Ventilation system for 220kV, 66kV and 33kV GIS Hall

Sub-Total (E)

F LT Switchgear & other items

1 LT Switchgear

- a) 415V Main Switchboard
- b) 415V ACDB
- c) 415V Main Lighting DB
- d) 415V Emergency Lighting DB
- e) 415V Air-conditioning & Ventilation DB
- f) 220V DCDB

2 Batteries & Batteries chargers

- a) Battery 220V (*AHT*)
- b) 220V Battery Charger System (*AHT*)

3 DG set alongwith control panel (250kVA, 440V)
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<td>4</td>
<td>Grounding/Earthing System</td>
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<td>Lighting System</td>
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<td>1.1kV Grade PVC insulated aluminium conductor armoured power cables and copper conductor armoured control cables alongwith lugs, glands and straight joints.</td>
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<td>7</td>
<td>Power cable with termination kit/bus duct on 33kV side for connecting 2 nos. Transformers to 33kV GIS</td>
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<td>8</td>
<td>Power cable with termination kit/bus duct on 66kV side for connecting 2 nos. Transformers to 66kV GIS</td>
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<td>9</td>
<td>Grounding/Earth System</td>
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Bidder's Name and Address:

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<td>EOT Crane (*)</td>
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<td>220kV GIS room (*)</td>
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<td>66kV GIS room (*)</td>
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<td>33kV GIS room (*)</td>
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<td>33kV, O/D type isolator with Earth switch MOM type</td>
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<td>33kV, O/D type CT, ratio 25/1-1 A</td>
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<td>c)</td>
<td>33kV, O/D type 63A, circuit breaker</td>
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<td>Control &amp; relay protection scheme</td>
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<td>11kV, O/D type PT, ratio (11kV/3x(110V/√3)/(110V/√3))</td>
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<td>13</td>
<td>11kV equipments for loading 400kVA auxiliary transformer</td>
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<tr>
<td>a)</td>
<td>11kV switchgear, 2 panel board (1 incomer and 1 outgoing)</td>
<td>LS 1</td>
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Sub-Total (F)

SUB-TOTAL I : MAIN EQUIPMENTS [(A) to (F)]

II. Testing/Maintenance equipments for GIS

<table>
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<th>S.No.</th>
<th>Item Description</th>
<th>Unit</th>
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<tr>
<td>1</td>
<td>SF6 gas filling and evacuating plant</td>
<td>Set 1</td>
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<td>Partial discharge monitoring system</td>
<td>Set 1</td>
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<td>3</td>
<td>Dew point meter</td>
<td>Set 1</td>
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<td>4</td>
<td>Three phase automatic relay test kit</td>
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<td>5</td>
<td>Contact resistance meter</td>
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<td>6</td>
<td>Fault breaker operational analyser</td>
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<td>7</td>
<td>SF6 gas leak detector</td>
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<tr>
<td>8</td>
<td>Gas masks</td>
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SUB-TOTAL II : TESTING EQUIPMENTS

III. MANDATORY SPARES

A. GIS

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<th>Item Description</th>
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</tr>
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<td>1</td>
<td>Cable Connection Enclosure with the main circuit (1 no. of each type)</td>
<td>Set 1</td>
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<tr>
<td>2</td>
<td>SF6 gas Pressure Relief Devices, 3 Nos. of each type</td>
<td>Set 2</td>
</tr>
<tr>
<td>3</td>
<td>SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable (1 no. of each type)</td>
<td>Set 1</td>
</tr>
<tr>
<td>4</td>
<td>Coupling device for pressure gauge cum switch for connecting Gas handling plant</td>
<td>Set 2</td>
</tr>
<tr>
<td>5</td>
<td>Rubber Gaskets, &quot;O&quot; Rings and Seals for SF6 gas of each type</td>
<td>Set 1</td>
</tr>
<tr>
<td>6</td>
<td>Molecular filter for SF6 gas with filter bags</td>
<td>25% of total weight</td>
</tr>
<tr>
<td>7</td>
<td>All types of Control Valves for SF6 gas of each type</td>
<td>Set 2</td>
</tr>
</tbody>
</table>
### SPECIFICATION NO. T14P070076

#### 220/66/33kV GIS SUBSTATION AT R.K.PURAM

__(Schedule of rates and prices)__

## Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item Description</th>
<th>Qty</th>
<th>Unit</th>
<th>Price</th>
<th>Rate</th>
<th>Amount</th>
</tr>
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<tbody>
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#### Currency (INR) and CIF Price (INR)

<table>
<thead>
<tr>
<th>Unit FOB Price</th>
<th>Unit CIF Price</th>
<th>Total CIF Rate</th>
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#### Taxes & Duties for Direct Transaction (Not included in CIF Price Component)

<table>
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<th>Custom</th>
<th>Octroi</th>
<th>Entry Tax</th>
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**Bidder’s Name and Address:**

**Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item Description</th>
<th>Qty</th>
<th>Unit</th>
<th>Price</th>
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<th>Amount</th>
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#### Currency (INR) and CIF Price (INR)

<table>
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<th>Unit FOB Price</th>
<th>Unit CIF Price</th>
<th>Total CIF Rate</th>
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#### Taxes & Duties for Direct Transaction (Not included in CIF Price Component)

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<th>Amount</th>
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---

### 220kV GIS

1. Cable Connection Enclosure with the main circuit (1 no. of each type)
2. SF6 gas Pressure Relief Devices, 3 nos. of each type
3. SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable (1 no. of each type)
4. Coupling device for pressure gauge cum switch for connecting Gas handling plant
5. Rubber Gaskets, \"O\" Rings and Seals for SF6 gas of each type
6. Molecular filter for SF6 gas with filter bags
7. All types of Control Valves for SF6 gas of each type
8. SF6 gas
9. All types of coupling for SF6 gas (1 no. of each type)
10. Pipe length (Copper or Steel as applicable) for SF6 Circuit of each type
11. Covers with all accessories necessary to close a compartment in case of dismantling of any part of the enclosure to ensure the sealing of this compartment (as applicable)
12. For 3 Phase Enclosure
13. For Single phase enclosure
14. Locking device to keep the Disconnectors (isolators) and Earthing switches in close or open position in case of removal of the driving Mechanism
15. Sealing for dielectric test on the Cable
16. Bus Support insulator of each type for 3 phase/single phase enclosure
17. Any other common spare, maintenance and testing tool for 220kV GIS

**Sub-Total - A(I)**

### 66kV GIS

1. Cable Connection Enclosure with the main circuit (1 no. of each type)
2. SF6 gas Pressure Relief Devices, 3 nos. of each type
3. SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable (1 no. of each type)
4. Coupling device for pressure gauge cum switch for connecting Gas handling plant
5. Rubber Gaskets, \"O\" Rings and Seals for SF6 gas of each type
6. Molecular filter for SF6 gas with filter bags
7. All types of Control Valves for SF6 gas of each type
8. SF6 gas
9. All types of coupling for SF6 gas (1 no. of each type)
10. Pipe length (Copper or Steel as applicable) for SF6 Circuit of each type
11. Covers with all accessories necessary to close a compartment in case of dismantling of any part of the enclosure to ensure the sealing of this compartment (as applicable)
12. For 3 Phase Enclosure
13. For Single phase enclosure
14. Locking device to keep the Disconnectors (isolators) and Earthing switches in close or open position in case of removal of the driving Mechanism
15. Sealing for dielectric test on the Cable
16. Bus Support insulator of each type for 3 phase/single phase enclosure
17. Any other common spare, maintenance and testing tool for 220kV GIS

**Sub-Total - A(II)**

---

**Page 7 of 15**
## Bidders Name and Address:

Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item Description</th>
<th>Unit Qty</th>
<th>Currency (INR)</th>
<th>Unit FOB Price</th>
<th>Unit CIF Price</th>
<th>Total CIF Price</th>
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<td></td>
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<tr>
<td>II.</td>
<td>33kV GIS</td>
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</tr>
<tr>
<td>1</td>
<td>SF6 Gas pressure relief devices, three no. each type</td>
<td>Set 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pressure gauges cum switch or density motor and pressure switch as applicable, one no. each type</td>
<td>Set 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Coupling device for pressure gauge cum switch for connecting gas handling plant</td>
<td>Set 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Rubber Gaskets, &quot;O&quot; Rings and seals for SF6 gas</td>
<td>Set 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Molecular filter for SF6 gas with filter bags</td>
<td>% age</td>
<td>20% of total weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>All types of Coupling for SF6 gas of each type</td>
<td>Set 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>All types of Control Valves for SF6 gas of each type</td>
<td>Set 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>SF6 gas</td>
<td>% age</td>
<td>20% of total gas qty</td>
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<td>9</td>
<td>Cable connection enclosure with the main hist., one no. each type</td>
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<td>10</td>
<td>Pipe length (copper or steel applicable) for SF6 circuit of each type</td>
<td>Set 1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>11</td>
<td>Covers with all accessories necessary to close a compartment in case of dismantling of any part of the enclosure to ensure the sealing of this compartment (as applicable)</td>
<td>Set 1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>12</td>
<td>For 3 Phase Enclosure</td>
<td>No. 2</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>13</td>
<td>For Single phase enclosure</td>
<td>No. 3</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>14</td>
<td>Locking device to keep the Disconnectors (isolators) and taping switches in close or open position in case of removal of the driving mechanism</td>
<td>Set 1</td>
<td></td>
<td></td>
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<tr>
<td>15</td>
<td>Bushing for dielectric test on the Cable</td>
<td>No. 1</td>
<td></td>
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<tr>
<td>16</td>
<td>Bus Support insulator of each type for 3 phase/single phase enclosure</td>
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<td></td>
<td></td>
<td></td>
<td>5% of population</td>
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<tr>
<td>17</td>
<td>Any other common spare, maintenance and testing tool for 33kV GIS</td>
<td>Set 1</td>
<td></td>
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<td><strong>Sub-Total - A(II)</strong></td>
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## B Spares for Circuit Breaker

<table>
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<th>S.No.</th>
<th>Item Description</th>
<th>Unit Qty</th>
<th>Currency (INR)</th>
<th>Unit FOB Price</th>
<th>Unit CIF Price</th>
<th>Total CIF Price</th>
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<tr>
<td>I.</td>
<td>220kV SF6 Circuit Breaker</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>Complete Circuit breaker pole of each type &amp; rating complete with interrupter, main circuit, enclosure and Marshalling Box with operating mechanism</td>
<td>No. 3</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>Fixed, moving and arcing contacts including insulating nozzles 3 Nos. of each type</td>
<td>Set 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Rubber gaskets, &quot;O&quot; rings and seals for SF6 gas of each type</td>
<td>Set 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Tip coil assembly with resistor as applicable, 3 Nos. of each type</td>
<td>Set 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Closing coil assembly with resistor as applicable, 3 Nos. of each type</td>
<td>Set 2</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>6</td>
<td>Molecular filter for SF6 gas with filter bags</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10% of total quantity used</td>
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<tr>
<td>7</td>
<td>SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable, 3 Nos. of each type</td>
<td>Set 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Coupling device for pressure gauge cum switch for connecting gas handling plant 3 Nos. of each type</td>
<td>Set 1</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>9</td>
<td>Corona rings if applicable</td>
<td>Set 1</td>
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<tr>
<td>10</td>
<td>Relays, Power contactors, push buttons, timers &amp; MCBs etc. of each type &amp; rating</td>
<td>Set 1</td>
<td></td>
<td></td>
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<tr>
<td>11</td>
<td>Closing assembly/ valve, 3 Nos. of each type</td>
<td>Set 2</td>
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</tbody>
</table>

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**Note:**
- CIF Price: Cost, Insurance, and Freight.
- Taxes & Duties: Customs, Octroi, Entry Tax, Others.
- Rate: Calculation rate for tax purposes.
- Amount: Calculated amount based on the rate.
- Unit: Unit of measurement for the item.
### SPECIFICATION NO. T14P070076

#### SCHEDULE-1

Bidder's Name and Address:

Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.

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<thead>
<tr>
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<th>Qty</th>
<th>Currency (INR)</th>
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<th>Taxes &amp; Duties for Direct Transaction (Not included in CIF Price Component)</th>
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<td>has to be included in the CIF Price</td>
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<td>Rate</td>
<td>Amount</td>
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<td></td>
<td></td>
<td>Rate</td>
<td>Amount</td>
<td></td>
</tr>
</tbody>
</table>

| 1    | Trip assembly valve, 3 Nos. of each type | Set    | 3   | 4              | 5              | 6              | 7              | 8=4x7           | 9     | 10   | 11   | 12   | 13   | 14   | 15   | 16   | Rate | Amount | Rate | Amount | Rate | Amount |
| 2    | Operation Counter, 3 Nos. of each type   | Set    | 1   | 1              | 1              | 1              | 1              |                |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 3    | Auxiliary switch assembly, 3 Nos. of each type | Set    | 1   | 1              | 1              | 1              | 1              |                |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 4    | Auxiliay switch assembly, 3 Nos. of each type | Set    | 1   | 1              | 1              | 1              | 1              |                |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 5    | Pressure transducer, 3 Nos. of each type  | Set    | 1   | 1              | 1              | 1              | 1              |                |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 6    | Pressure transducer, 3 Nos. of each type  | Set    | 1   | 1              | 1              | 1              | 1              |                |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 7    | Valve disc, 3 Nos. of each type          | Set    | 1   | 1              | 1              | 1              | 1              |                |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 8    | Windoscope / Observing window, 3 Nos. of each type, if applicable | Set    | 1   | 1              | 1              | 1              | 1              |                |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 9    | Spring operated closing mechanism, 1 No. of each type, if applicable | Set    | 1   | 1              | 1              | 1              | 1              |                |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 10   | Terminal Pad & connectors                | Set    | 1   | 1              | 1              | 1              | 1              |                |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 11   | For Hydraulic Operated Mechanism, if applicable |     |     |                |                |                |                |                |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 12   | Hydraulic oil                            | Set    | 2   | 20% of total qty. used |

### II. 66KV SF6 Circuit Breaker

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Currency (INR)</th>
<th>CIF PRICE (INR)</th>
<th>Taxes &amp; Duties for Direct Transaction (Not included in CIF Price Component)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>72.5 kV, Three phase, Circuit Breaker interrupting chamber complete with all necessary apparatus.</td>
<td>No.</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>2</td>
<td>Rubber gaskets, &quot;O&quot; rings and seals for SF6 gas of each type</td>
<td>Set</td>
<td>1</td>
<td>1</td>
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<td>3</td>
<td>Trip coil with resistor of each type (as applicable)</td>
<td>No.</td>
<td>3</td>
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<td>4</td>
<td>Closing coil with resistor of each type (as applicable)</td>
<td>No.</td>
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<td>5</td>
<td>Molecuear filter for SF6 gas with filter bags (as applicable)</td>
<td>No.</td>
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<td>Density/ pressure monitoring systems</td>
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<td>7</td>
<td>Relay, Power contactors, push buttons, timers &amp; MCBs etc of each type &amp; rating</td>
<td>Set</td>
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<td>8</td>
<td>Closing assembly valve</td>
<td>No.</td>
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<td>No.</td>
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<td>Operation Counter</td>
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<td>13</td>
<td>Rupture disc diaphrag</td>
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<tr>
<td>14</td>
<td>Windoscope / Observing window, if applicable</td>
<td>No.</td>
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<tr>
<td>15</td>
<td>72.5 kV, Three phase, Circuit Breaker operating mechanism, complete with all necessary connecting apparatus.</td>
<td>No.</td>
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<td>16</td>
<td>All types of coupling for SF6 gas! 1 no. of each type</td>
<td>Set</td>
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### III. 33KV SF6 Circuit Breaker

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<tr>
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<th>Item Description</th>
<th>Unit</th>
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<td>38kV, Three phase, Circuit Breaker interrupting chamber complete with all necessary apparatus.</td>
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<td>Rubber gaskets, &quot;O&quot; rings and seals for SF6 gas of each type</td>
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<td>Trip coil with resistor of each type (as applicable)</td>
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Bidder's Name and Address:

Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.

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- Custom
- Octroi
- Entry Tax
- Others

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- Unit FOB
- Unit CIF

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- Currency (INR)
- CIF PRICE (INR)

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- Taxes & Duties for Direct Transaction (Not included in CIF Price Component)

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- 220/66/33kV GIS SUBSTATION AT R,K,PURAM

(Schedule of rates and prices)
Bidder's Name and Address:

Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.

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<tr>
<td>1-14</td>
<td>Relays, Power contactors, resistors, fuses, push buttons &amp; MCBs (complete for one 3 phase equipment)</td>
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<td>1-15</td>
<td>Terminal pad and connectors (complete for one 3 phase equipment)</td>
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<td>1-16</td>
<td>Aux. switch assembly (complete) with 10 NC &amp; 10 NC OR more contacts for both isolator &amp; earth switch</td>
<td>Set 1</td>
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**II. 66kV Isolator**

1. 72.5kV, single ph., Disconnecting Switch internal parts, complete with all necessary gaskets, mounting hardware, etc.

2. 72.5kV, three ph., Disconnecting Switch operating mechanism, complete with all necessary connecting apparatus.

3. 72.5kV, single ph., Grounding Switch internal parts, complete with all necessary gaskets, mounting hardware etc

4. 72.5kV, three ph., Grounding Switch operating mechanism, complete with all necessary connecting apparatus.

5. 72.5kV, single phase, grounding switch, Internal parts complete with all necessary gaskets mounting hardware etc.

**III. 33kV Isolator**

1. 36kV, single ph., Disconnecting Switch internal parts, complete with all necessary gaskets, mounting hardware, etc.

2. 36kV, three ph., Disconnecting Switch operating mechanism, complete with all necessary connecting apparatus.

3. 36kV, single ph., Grounding Switch internal parts, complete with all necessary gaskets, mounting hardware etc

4. 36kV, three ph., Grounding Switch operating mechanism, complete with all necessary connecting apparatus.

**D. Spares for Current Transformer (GIS type)**

**L. 220kV CT**

1. Complete t of each type and rating with enclosure No. 2

2. Secondary bushing of each type Set 2

**II. 66kV CT**

1. Single phase current transformer of each rating No. three each type

**III. 33kV CT**

1. Single phase current transformer of each rating No. three each type

**Sub-Total - D(I+II+III)**
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### Schedule-1:

#### 220/66/33kV GIS SUBSTATION AT R.K.PURAM

#### Schedule of rates and prices

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<td>CFL with complete fittings</td>
<td>5% of total population of each type</td>
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<td>13</td>
<td>Metal halide lamp with complete fittings</td>
<td>2% of total population of each type</td>
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<td>3</td>
<td>Set of relays</td>
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<td>Set of Contactor</td>
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<td>Micro-switches (if applicable)</td>
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<td>Three phase full wave bridge rectifier (Thyristor/ Diode)</td>
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<td>8</td>
<td>Set of wound resistor (if applicable)</td>
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<td>Spares for Relay &amp; Protection Panels</td>
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<td></td>
<td>Breaker Relay Panel</td>
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<tr>
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<td>Breaker failure relay</td>
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<td>Trip circuit supervision relay</td>
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<td>1 (c)</td>
<td>Self reset trip relay of each type (if applicable)</td>
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<td>1 (d)</td>
<td>Trip relay of each type (if applicable)</td>
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<td>1 (e)</td>
<td>DC supervision relays (if applicable)</td>
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<td>Main 1 Numerical distance relay (excluding external trip relays)</td>
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<td>Transformer differential protection relay including all aux. CTs (if applicable)</td>
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<td>3 (c)</td>
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<td>3 (e)</td>
<td>CVT selection relay (if stand alone)</td>
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Bidder’s Name and Address:

Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.

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<th>S.No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Currency (INR)</th>
<th>CIF Price (INR)</th>
<th>Taxes &amp; Duties for Direct Transaction (Not included in CIF Price Component)</th>
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<td>Sub-Total - (O)</td>
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<td>P</td>
<td>Spares for 160MVA, 220/66/11 kV, Power Transformer</td>
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<tr>
<td></td>
<td>with motor</td>
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<td>2</td>
<td>Expansion Joint</td>
<td>No.</td>
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<td></td>
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<tr>
<td></td>
<td>(Complete replacement for one transformer)</td>
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<td>Sub-Total - (P)</td>
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**Currency (INR):**

- Unit FOB Price
- Unit CIF Price
- Total CIF Price

- Custom
- Octroi
- Entry Tax
- Others

---

**Notes:**

1. All items are mandatory spares parts unless otherwise specified.
2. All unit prices are in INR.
3. Taxes and duties are not included in CIF prices.
4. Overload relays with timer (if stand alone) are mandatory spares parts.
5. Fire Fighting System includes:
   - Fitted nitrogen cylinder (80 liter water capacity)
   - Heat sensor assembly
   - Fire survival cable sufficient for one system
   - PIRBV
   - Limit switch for fire detector
   - Fire detectors
   - Thermostat
   - Heating element

---

**Plant and Equipment:**

- 220/66/33 kV GIS Substation at R.K. Puram

---

**Schedule-1:**

- Details of plant and equipment to be supplied from abroad, including type test charges for type test to be conducted abroad.

---

**Specifications:**

- T14P070076
- Schedule-1

---

**Page:**

- Page 14 of 15
Bidder's Name and Address:

Plant and Equipment (including Mandatory Spares Parts) to be supplied from abroad, including Type Test charges for Type Test to be conducted in Abroad.

<table>
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<tr>
<th>S.No.</th>
<th>Item Description</th>
<th>Unit Qty</th>
<th>Unit FOB Price</th>
<th>Unit CIF Price</th>
<th>Total CIF Price</th>
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<td>Sub-Total (P)</td>
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<td>Oil Cooler Pump with motor</td>
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<td>2</td>
<td>Expansion Joint (Complete replacement for one transformer)</td>
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<td>3</td>
<td>Bushing CTs, each type and ratio</td>
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<td>Buchholz relay with complete contacts</td>
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<td>Pressure relief device</td>
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<td>Magnetic Oil level gauge</td>
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<td>Cooler fan with motor</td>
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<td>Set of valves of all sizes</td>
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<td>11</td>
<td>Fuses (Complete replacement)</td>
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<td>Aux Transformers for the control of cooler control cabinet and OLTC</td>
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<td>13</td>
<td>Starter contactors, switches and relays for electrical control panels</td>
<td>No. one each type</td>
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<td>Remote tap position indicator</td>
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<td>Stainless Steel Oil sampling bottles one liter capacity</td>
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<td>HV, LV, MV end bushing complete with metal parts &amp; gaskets of each type</td>
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<td>Oil Storage Tank with accessories</td>
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<td>SUB-TOTAL III : MANDATORY SPARES [(A) to (Q)]</td>
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<td>IV</td>
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Note: Bidder is required to quote prices in this Schedule for all the individual items/sub-items. Bidder is required to furnish the break-up of type test charges to be conducted abroad in Schedule - 5a.

#Bidder is required to quote prices in Indian currency i.e. INR only in line with clause 11.0 Section-ITB Volume I of the bidding documents.

Date: __________________________
Place: __________________________
Signature: _______________________
Printed Name: ____________________
Designation: _____________________
Common Seal: _____________________
Bidder's Name and Address:

Plant and Equipment (including Mandatory Spares Parts) to be supplied from India, including Type Test charges for Type Test to be conducted in India.

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<th>Item Description</th>
<th>Unit Qty</th>
<th>Currency (INR)</th>
<th>EX-WORKS PRICE</th>
<th>Mode of Transaction</th>
<th>Direct Bought Out</th>
<th>Taxes &amp; Duties for Direct Transaction (Not included in Ex Works Price Component)</th>
<th>Applicable Octroi and Entry tax (not included in ex works price component) for bought out finished items dispatch directly from sub vendors works</th>
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Schedule 2

SPECIFICATION NO. T14P070076

220/66/33 kV GIS SUBSTATION R.K.Puram

(Schedule of rates and prices)

---

**Bidder's Name and Address:**

**Plant and Equipment (including Mandatory Spares Parts) to be supplied from India, including Type Test charges for Type Test to be conducted in India.**

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<th>Item Description</th>
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<th>Taxes &amp; Duties for Direct Transaction (Not included in Ex Works Price Component)</th>
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**Schedule 2**

SPECIFICATION NO. T14P070076

220/66/33 kV GIS SUBSTATION R.K.Puram

(Schedule of rates and prices)
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</table>

C 66kV GIS Equipment

1.0 Feeder Bay Module : 72.5kV, 2000A, SF6 gas insulated feeder bay module each comprising of SF6 gas insulated circuit breaker(2000A), current transformer, two bus-bar disconnectors with one earthing switch, line disconnector with one normal & one high speed fault make grounding switch, surge arresters, SF6 gas monitoring system for complete bay, PT, gas insulated terminal connection for connecting XLPE cable (XLPE cable/SF6) with cable termination enclosure and accessories with GIS, local control cubicle etc. to complete feeder bay module.

Set 8

2.0 Bus Coupler Bay : 72.5kV, 2500A, SF6 gas insulated bus coupler bay module comprising of SF6 gas insulated circuit breaker, current transformer, two nos. of disconnectors with earthing switches, SF6 gas monitoring system for complete bay, local control cubicle etc.

Set 1

3.0 Transformer Bay Module : 72.5kV, 2000A, SF6 gas insulated transformer bay module each comprising of SF6 gas insulated circuit breaker, current transformer, Two nos. of bus-bar disconnectors with common grounding switch, line disconnector with one normal & one high speed fault make grounding switch, surge arresters, SF6 gas monitoring system for complete bay, gas insulated terminal connection for connecting transformer (XLPE cable/SF6) through XLPE cable with cable end box and accessories with GIS, local control cubicle etc. to complete transformer bay module.

Set 2

4.0 Bus Bars : 72.5kV, 2000A, 3-phase or single phase encapsulated unit, SF6 gas insulated, metal enclosed bus bars each enclosed in bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each bus bar set shall be complete with voltage transformer, disconnectors with safety grounding switch, local control cubicle, SF6 gas monitoring system etc.

Set 2

D 33kV GIS Equipment

1.0 Feeder Bay Module : 36kV, 1250A, SF6 gas insulated feeder bay module each comprising of circuit breaker(1250A), current transformer (800-400/1-1-1), two bus-bar disconnectors (1250A) with common grounding switch, surge arrester (30kV), SF6 gas monitoring system for complete bay, PT, gas insulated terminal connection for connecting XLPE cable with cable termination enclosure and accessories with GIS etc. to complete feeder bay module.

Set 9

2.0 Bus Coupler Bay : 36kV, 2500A, SF6 gas insulated bus coupler bay module comprising of circuit breaker (2500A), current transformer (2000/1-1-1 A), two bus bar disconnectors (2500A) each with safety grounding switch, SF6 gas monitoring system for complete bay etc.

Set 1

3.0 Transformer Bay Module : 36kV, 2500A, SF6 gas insulated transformer bay module each comprising of circuit breaker (2500A), current transformer (2000/1-1-1 A), Two bus-bar disconnectors (2500A) with common grounding switch, surge arrestors (30kV), SF6 gas monitoring system for complete bay, gas insulated terminal connection for connecting transformer through suitable size and no. of XLPE copper cable considering 110% continuous loading with cable termination enclosure/bus duct and accessories with GIS etc. to complete transformer bay module.

Set 2
<table>
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<th>S.No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Currency</th>
<th>EX-WORKS PRICE</th>
<th>Mode of Transaction</th>
<th>Taxes &amp; Duties for Direct Transaction (Not included in Ex Works Price Component)</th>
<th>Applicable Octroi and Entry tax (not included in ex works price component) for bought out finished items dispatch directly from sub vendors works.</th>
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<td><strong>Bus Bars</strong> : 38kV, 2500A, 3-phase or single phase encapsulated unit, metal</td>
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<td>the switchgear to interconnect each of circuit breaker bay module. Each bus</td>
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<td>bar set shall be complete with voltage transformer, disconnectors with safety</td>
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<td><strong>220kV Relay and Protection Panels</strong></td>
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<tr>
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<td>c) Live Protection Panel</td>
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<td>d) Transformer Protection Panel</td>
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<td>e) Bus-Coupler Protection Panel</td>
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<td>f) Bus-Section Protection Panel</td>
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<td>d) Other common equipments pertaining to Relay &amp; Protection System</td>
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<td>d) Split AC (4 star rating) for Control room</td>
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<td>e) Split AC (4 star rating) for Battery room</td>
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<td>f) Split AC (4 star rating) for Electrical lab and for office space</td>
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<td>g) Ventilation system for 220kV, 66kV and 33kV GIS Hall</td>
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<td>a) 415V Main Switchboard</td>
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<td>c) 415V Main Lighting DB</td>
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<td>d) 415V Emergency Lighting DB</td>
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<td>e) 415V Air-conditioning &amp; Ventilation DB</td>
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<td>f) 220V DCDB</td>
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**Notes:**
- (*) Bidder to estimate and indicate the capacities of batteries in Ampere-Hours. The estimated capacities should meet the functional requirement.
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<th>S.No.</th>
<th>Item Description</th>
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<td>220V Battery Charger System (*)</td>
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<td>Fire prevention &amp; extinguishing system</td>
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<td>3</td>
<td>照明系统 (*)</td>
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<td>4</td>
<td>1.1 kV Grade PVC insulated aluminium conductor armoured power cables and copper conductor armoured control cables alongwith lugs, glands and straight joints.</td>
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<td>Power Cable (XLPE) (*)</td>
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<td>6</td>
<td>Power Cable (PVC) (*)</td>
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<td>7</td>
<td>Control Cable (PVC) (*)</td>
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<td>8</td>
<td>Power cable with termination kit/bus duct on 33kV side for connecting 2 nos. Transformers to 33kV GIS</td>
<td></td>
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<td>9</td>
<td>Power cable with termination kit/bus duct on 66kV side for connecting 2 nos. Transformers to 66kV GIS</td>
<td></td>
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<td>10</td>
<td>Grounding/ Earthing System</td>
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<td>Steel Structure (*)</td>
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<td>12</td>
<td>EOT Crane (*)</td>
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<tr>
<td>13</td>
<td>Tertiary loading equipments for one 100 MVA transformer</td>
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</tr>
<tr>
<td>S.No.</td>
<td>Item Description</td>
<td>Unit Qty</td>
<td>Currency</td>
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<tr>
<td>1</td>
<td>33kV, O/D type CT, ratio 25/1-1 A</td>
<td>Nos. 1</td>
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</tr>
<tr>
<td>2</td>
<td>33kV, O/D type 800A, circuit breaker</td>
<td>No. 1</td>
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<tr>
<td>3</td>
<td>Control &amp; relay protection scheme</td>
<td>No. 1</td>
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</tr>
<tr>
<td>4</td>
<td>11kV, O/D type PT, ratio (11kV - 13)/(110kV - 3)/(110kV - 3)</td>
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**13 11kV equipments for loading 400KVA auxiliary transformer**

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<th>Item Description</th>
<th>Unit Qty</th>
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<th>Mode of Transaction</th>
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<th>Taxes &amp; Duties for Direct Transaction (Not included in Ex Works Price Component)</th>
<th>Applicable Octroi and Entry tax (not included in ex works price component) for bought out finished items dispatch directly from sub vendors works.</th>
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<td>33kV, O/D type CT, ratio 25/1-1 A</td>
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<td>6</td>
<td>33kV, O/D type 800A, circuit breaker</td>
<td>No. 1</td>
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<td>7</td>
<td>Control &amp; relay protection scheme</td>
<td>No. 1</td>
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<td>11kV, O/D type PT, ratio (11kV - 13)/(110kV - 3)/(110kV - 3)</td>
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**II. Testing/Maintenance equipments for GIS**

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<th>Mode of Transaction</th>
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<th>Taxes &amp; Duties for Direct Transaction (Not included in Ex Works Price Component)</th>
<th>Applicable Octroi and Entry tax (not included in ex works price component) for bought out finished items dispatch directly from sub vendors works.</th>
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<tbody>
<tr>
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<td>SF6 gas filling and evacuating plant</td>
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<td>2</td>
<td>Partial discharge monitoring system</td>
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<td>One point meter</td>
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<td>4</td>
<td>Three phase automatic relay test kit</td>
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<td>5</td>
<td>Contact resistance meter</td>
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<tr>
<td>6</td>
<td>Circuit breaker operational analyser</td>
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<td>7</td>
<td>SF6 gas leak detector</td>
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<td>8</td>
<td>Gas masks</td>
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**III. MANDATORY SPARES**

**A. GIS**

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<tr>
<td>2</td>
<td>SF6 gas Pressure Relief Devices, 3 Nos. of each type</td>
<td>Set 2</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable (1 nos. of each type)</td>
<td>Set 1</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td>Coupling device for pressure gauge cum switch for connecting Gas handling plant</td>
<td>Set 2</td>
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<td></td>
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<tr>
<td>5</td>
<td>Rubber Gaskets, ‘O’ Rings and Seals for SF6 gas of each type</td>
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<tr>
<td>6</td>
<td>Molecular filter for SF6 gas with filter bags</td>
<td>Set 1</td>
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<tr>
<td>7</td>
<td>All types of Control Valves for SF6 gas of each type</td>
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**B. 66kV GIS**

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<th>Taxes &amp; Duties for Direct Transaction (Not included in Ex Works Price Component)</th>
<th>Applicable Octroi and Entry tax (not included in ex works price component) for bought out finished items dispatch directly from sub vendors works.</th>
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<tr>
<td>2</td>
<td>SF6 gas Pressure Relief Devices, 3 Nos. of each type</td>
<td>Set 2</td>
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<tr>
<td>3</td>
<td>SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable (1 nos. of each type)</td>
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<td>4</td>
<td>Coupling device for pressure gauge cum switch for connecting Gas handling plant</td>
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**Sub-Total - A(i)**

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<th>Taxes &amp; Duties for Direct Transaction (Not included in Ex Works Price Component)</th>
<th>Applicable Octroi and Entry tax (not included in ex works price component) for bought out finished items dispatch directly from sub vendors works.</th>
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<td>SF6 gas Pressure Relief Devices, 3 Nos. of each type</td>
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<td>3</td>
<td>SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable (1 nos. of each type)</td>
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<td>Coupling device for pressure gauge cum switch for connecting Gas handling plant</td>
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**Sub-Total - A(ii)**
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<th>Taxes &amp; Duties for Direct Transaction (Not included in Ex Works Price Component)</th>
<th>Applicable Octroi and Entry tax (not included in ex works price component) for bought out finished items dispatch directly from sub vendors works.</th>
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<td>Rubber Gaskets, “O” Rings and Seals for SF6 gas of each type</td>
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<td>INR</td>
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<td>All types of Control Valves for SF6 gas of each type</td>
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<td>SF6 gas</td>
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<td>All types of coupling for SF6 gas (1 no. of each type)</td>
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<td>Pipe length (Copper or Steel as applicable) for SF6 Circuit of each type</td>
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<tr>
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<tr>
<td>13</td>
<td>For Single phase enclosure</td>
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<tr>
<td>14</td>
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<td>Coupling device for pressure gauge cum switch for connecting gas handling plant</td>
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<td>Pipe length (Copper or Steel applicable) for SF6 circuit of each type</td>
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<td>Covers with all accessories necessary to close a compartment in case of dismantling of any part of the enclosure to ensure the sealing of this compartment (as applicable)</td>
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<td>For 3 Phase Enclosure</td>
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<td>Locking device to keep the busconnectors (isolators) and Earthing switches in close or open position in case of removal of the driving Mechanism</td>
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<td>15</td>
<td>Bushing for dielectric test on the Cable</td>
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<td>Bus Support insulator of each type for 3 phase/single phase enclosure.</td>
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<td>220kV SF6 Circuit Breaker</td>
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<td>Complete Circuit Breaker pole of each type &amp; rating complete with interrupter, main circuit, enclosure and Marshalling Box with operating mechanism</td>
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<td>for Direct Bought Out</td>
<td>for bought out finished items dispatch directly from sub vendors works.</td>
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<td>Fixed moving and arcing contacts including insulating nozzles 3 Nos. of each type</td>
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Sub-Total - Bill

8. **66kV SF6 Circuit Breaker**

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<th>Taxes &amp; Duties for Direct Transaction</th>
<th>Applicable Octroi and Entry tax (not included in Ex Works Price Component)</th>
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Sub-Total - Bill

9. **33kV SF6 Circuit Breaker**

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Sub-Total - Bill

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<td>C</td>
<td>Spares for Isolators</td>
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<td>2</td>
<td>Complete set of 3 nos. of single phase / one no. of 3-phase dis-connector including main circuit, enclosure, driving mechanism.</td>
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<td>3</td>
<td>3 no. of single phase / one no. of 3-phase Earthling switch</td>
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<td>4</td>
<td>Copper contact fingers for dis-connector male &amp; female contact – for one complete (3 phase) dis-connector of each type and rating.</td>
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<td>5</td>
<td>Copper contact fingers for earthing switch male &amp; female contacts, for one complete (3 phase) earthing switch of each type and rating</td>
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<td>6</td>
<td>Open / Close contactor assembly, timers, key interlock for one complete (3 phase) dis-connector and (3 phase) earthing switch of each type and rating.</td>
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<td>Push button switch - each type, as applicable</td>
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<td>Limit switch and Aux. Switches for complete 3 phase equipment</td>
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<td>9</td>
<td>Motor with gear assembly for complete 3 phase equipment</td>
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<td>Gear box for gear assembly for complete 3 phase equipment</td>
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<td>11</td>
<td>Hinge pins for complete 3 phase equipment</td>
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<td>Bearings for complete 3 phase equipment</td>
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<td>13</td>
<td>Interlocking coil with resistors, timers, key interlock for complete 3 phase equipment (each type and rating)</td>
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<td>14</td>
<td>4 Ways, Power selectors, resistors, fuses, push buttons &amp; Contacts</td>
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<td>Terminal pad and connectors (complete for one 3 phase equipment)</td>
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<td>Act. switch assembly (complete) with 10 NO &amp; 10 NC. Or more contacts for both isolator &amp; earth switch</td>
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<td>E</td>
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<td>72.5kV, single ph., Disconnecting Switch internal parts.</td>
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<td>2</td>
<td>72.5kV, three ph., Disconnecting Switch operating mechanism, complete with all necessary connecting apparatus.</td>
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<td>72.5kV, single ph., Grounding Switch internal parts, complete with all necessary gaskets, mounting hardware etc.</td>
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<td>72.5kV, single phase, grounding switch, internal parts complete with all necessary gaskets mounting hardware etc.</td>
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<td>Spares for Current Transformer (GIS type)</td>
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<td>No. 3 each type</td>
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<td>Spares for Surge Arrestor (GIS type)</td>
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<td>Complete LA including insulating base with surge counter &amp; accessories : GIS type</td>
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<td>Optical cable with end terminations</td>
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<td>2</td>
<td>Line Protection Panel Equipment spare</td>
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<td>3</td>
<td>Transformer Protection Panel</td>
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<td>4</td>
<td>Common Spares</td>
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Sub-Total: (H)  
Sub-Total: (J)  
Sub-Total: (K)  
Sub-Total: (L)
<table>
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<tr>
<th>S.No.</th>
<th>Item Description</th>
<th>Unit Qty</th>
<th>Currency (INR)</th>
<th>EX-WORKS PRICE</th>
<th>Mode of Transaction</th>
<th>Taxes &amp; Duties for Direct Transaction (Not included in Ex Works Price Component)</th>
<th>Applicable Octroi and Entry tax (not included in ex works price component) for bought out finished items dispatch directly from sub vendors works.</th>
</tr>
</thead>
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</tr>
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</table>

**M Spares for LT switchgear**

Sub-Total - (M)

**N Spares for DG Set**

1. Set of fuel filter (each type) | Qty 1
2. Solenoid coil assembly | Qty 1
3. Self starter assembly with clutch engaging and disengaging arrangements complete with motors | Qty 1
4. Lube oil pressure safety control | Qty 1
5. High water temp. safety control | Qty 1
6. Volute | Qty 1

Sub-Total - (N)

**O Fire Fighting System**

1. Filled nitrogen cylinder (68 liter water capacity) | Qty 1
2. Heat sensor assembly | Qty 1
3. Fire survival cable sufficient for one system | Qty 1
4. PIR/RV | Qty 1
5. Limit switch for fire detector | Qty 1
6. Fire detectors | Qty 1
7. Thermostat | Qty 1
8. Heating element | Qty 1

Sub-Total - (O)

**P Spares for 160MVA, 220/66/11 kV, Power Transformer**

1. Oil Cooler Pump with motor | Qty 1
2. Expansion joint (complete replacement for one transformer) | Qty 1
3. Bushing C/Ts, each type and ratio | Qty 1
4. Buchholz relay with complete contacts | Qty 1
5. Local and remote WTI with contacts | Qty 1
6. Oil Temp Indicator with contacts | Qty 1
7. Pressure relief device | Qty 1
8. Magnetic Oil level gauge | Qty 1
9. Coiler fan with motor | Qty 1
10. Set of valves (all sizes) | Qty 1
11. Fuses (1 set for complete replacement) | Qty 1
12. Aux Transformers for the control of cooler control cabinet | Qty 1
13. Marker contacts, switches and relays for electrical control panels (one set of each type) | Qty 1
14. Remote tap position indicator | Qty 1
15. Stainless steel Oil sampling bottles one liter capacity | Qty 12
16. Oil surge relay for OLTC | Qty 1
17. Complete set of Gaskets | Qty 1
18. Neutral bushing complete with metal parts of each type | Qty 1
19. HT HV & MV and bushing complete with metal parts & gaskets of each type | Qty 1
20. Oil Storage Tank with accessories | Qty 1

Sub-Total - (P)

**Q Spares for 100MVA, 220/33/11 kV, Power Transformer**

1. Oil Cooler Pump with motor | Qty 1
2. Expansion joint (Complete replacement for one transformer) | Qty 1
3. Bushing C/Ts, each type and ratio | Qty 1
4. Buchholz relay with complete contacts | Qty 1
5. Local & Remote Winding Temp Indicator with contacts | Qty 1
6. Oil Temp Indicator with contacts | Qty 1
7. Pressure relief device | Qty 1
8. Magnetic Oil level gauge | Qty 1
9. Coiler fan with motor | Qty 1
10. Set of valves (all sizes) | Qty 1
11. Fuses (Complete replacement) | Qty 1
12. Aux Transformers for the control of cooler control cabinet and OLTC | Qty 1

Sub-Total - (Q)
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item Description</th>
<th>Unit Qty</th>
<th>Currency</th>
<th>EX-WORKS PRICE</th>
<th>Taxes &amp; Duties for Direct Transaction (Not included in Ex Works Price Component)</th>
<th>Mode of Transaction Direct Bought Out</th>
<th>Applicable Octroi and Entry tax (not included in ex works price component) for bought out finished items dispatch directly from sub vendors works.</th>
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<td>Unit Price</td>
<td>Total Price</td>
<td>Octroi</td>
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<tr>
<td>1</td>
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<td></td>
<td></td>
<td>Rate</td>
<td>Amount</td>
<td>Rate</td>
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<tr>
<td>13</td>
<td>Starter contactors, switches and relays for electrical control panels</td>
<td>No. one each type</td>
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<tr>
<td>14</td>
<td>Remote tap position indicator</td>
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<tr>
<td>15</td>
<td>Stainless Steel Oil sampling bottles one liter capacity</td>
<td>No. 12</td>
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<td>16</td>
<td>Oil surge relay for OL TC</td>
<td>No. 1</td>
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<tr>
<td>17</td>
<td>Complete set of gaskets</td>
<td>No. 2</td>
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<tr>
<td>18</td>
<td>Neutral bushing complete with metal parts of each type</td>
<td>No. 1</td>
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<tr>
<td>19</td>
<td>HV, LV, MV end bushing complete with metal parts &amp; gaskets of each type</td>
<td>No. 1</td>
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<tr>
<td>20</td>
<td>Oil Storage Tank with accessories</td>
<td>No. 1</td>
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</tbody>
</table>

| SUB-TOTAL III : MANDATORY SPARES (A) to (Q) |
|TOTAL (I + II +III) |

| IV | Total for Type Test Charges for Type Tests to be conducted in India (as per Schedule - 5b) |

| V | Total Ex-Works Price Including Type Test charges for Type Tests to be conducted in India (I + II + III + IV) |

* Specify amount of Sales and other taxes, payable on the transactions between contractor and employer and octroi entry tax as applicable for destination site/state on all terms of supply including brought-out finished items (to be identified in the contract) which shall be dispatched directly from the Subvendor’s works to the Employer’s site (sale-in-transit), only. Sales tax and other levies for all the brought-out are to be included in the ExW Price (Col. No.7) only and not to be indicated here.

Bidder is required to quote prices in this Schedule for all the individual items/sub-items. Bidder is required to furnish only the break-up of type test charges to be conducted in INDIA in Schedule - 5b. # Bidder is required to quote prices in Indian currency i.e. INR only in line with clause 11.0 Section-ITB Volume I of the bidding documents.

# In case any additional equipment is required, the same should be included in the scope with no additional payment and the offer should be complete and comprehensive.

Date: __________________________
Place: __________________________

Signature: ________________________
Printed Name: ____________________
Designation: _____________________
Common Seal: _____________________
### Local Transportation, Insurance and other Incidental Services (including port clearance etc.)

#### S. No. Item Description Unit Qty Unit Charges (INR) Total Charges (INR)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item Description</th>
<th>Unit Qty</th>
<th>Unit Charges (INR)</th>
<th>Total Charges (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Main Equipment.</strong></td>
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</tr>
<tr>
<td>1</td>
<td>100MVA, 220/33/11kV power transformer including bushing, accessories and first filling of oil with 10% spare quantity oil alongwith nitrogen injection fire prevention &amp; extinguishing system (NIFPES) for transformer.</td>
<td>No. 2</td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>17.5kV NCT of ratio 800-400/1 Amp for 220kV neutral of transformer.</td>
<td>No. 2</td>
<td></td>
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<tr>
<td>3</td>
<td>160kVA, 220/66/11kV Power Transformer including bushing, accessories and first filling of oil with 10% spare quantity oil alongwith nitrogen injection fire prevention &amp; extinguishing system (NIFPES) for transformer.</td>
<td>No. 2</td>
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<tr>
<td>4</td>
<td>17.5kV NCT of ratio 800-400/1 Amp for 220kV neutral of transformer.</td>
<td>No. 2</td>
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<tr>
<td>5</td>
<td>17.5kV NCT of ratio 200-1000/1 Amp for 33kV neutral of transformer.</td>
<td>No. 2</td>
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<tr>
<td>6</td>
<td>17.5kV NCT of ratio 200-1000/1 Amp for 66kV neutral of transformer.</td>
<td>No. 1</td>
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<tr>
<td>7</td>
<td>400KVA, 11/0.433kV, 75kVp BIL at 11kV side, three phase transformer including bushing, accessories and first filling of oil.</td>
<td>No. 1</td>
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<tr>
<td>8</td>
<td>400KVA, 11/0.433kV, 75kVp BIL at 11kV side, three phase transformer including bushing, accessories and first filling of oil.</td>
<td>No. 1</td>
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<td><strong>Sub-Total (A)</strong></td>
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<tr>
<td>1</td>
<td><strong>245kV GIS Equipment</strong></td>
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<tr>
<td>1</td>
<td>Transformer Bay Module : 245kV, 1600A, SF6 gas insulated transformer bay module each comprising of SF6 gas insulated circuit breaker (1600A), current transformer (800-400/1-1-1-1-1), two bus-bar disconnectors (1600A) with common grounding switch, line disconnectors with safety grounding switches, surge arrestors, SF6 gas monitoring system for complete bay, Three 1-phase SF6 ducts and SF6/Oil interface to connect to 220/66kV, 160/MVA and 220/33kV 100 MVA transformers and accessories with GIS etc. to complete transformer bay module.</td>
<td>Set 4</td>
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<tr>
<td>2</td>
<td>Feeder Bay Module : 245kV, 1600A, SF6 gas insulated feeder bay module each comprising of SF6 gas insulated circuit breaker (1600A), current transformer (800-400/1-1-1-1-1), two bus-bar disconnectors (1600A) with common grounding switch, line disconnectors with safety grounding switch, high speed fault making grounding switch, surge arresters, PT, SF6 gas monitoring system for complete bay, gas insulated terminal connection for connecting XLPE cable with cable termination enclosure and accessories with GIS etc. to complete feeder bay module.</td>
<td>Set 8</td>
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<tr>
<td>3</td>
<td>Bus bar Module : 245kV, 3 single phase (isolated) units, SF6 gas insulated, metal enclosed 2500A bus bar each enclosed in bus enclosures running along the length of the switchgear to interconnect each of Circuit breaker bay module. Each bus bar set shall be complete with voltage transformer, disconnectors and safety grounding switch, SF6 gas monitoring system for complete bay etc.</td>
<td>Set 2</td>
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<td>4</td>
<td>Bus coupler Bay Module : 245kV, 2500A, SF6 gas insulated bus coupler bay module comprising of SF6 gas insulated circuit breaker (2500A), current transformer (1600-800/1-1-1-1-1), two bus-bar disconnectors (2500A) with safety grounding switches, SF6 gas monitoring system for complete bay etc.</td>
<td>Set 2</td>
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<td>5</td>
<td>Bus sectionaliser bay Module : 245kV, 2500A, SF6 gas insulated bus sectionaliser bay module comprising of SF6 gas insulated circuit breaker (2500A), current transformer (1600-800/1-1-1-1-1), two disconnectors (2500A) with safety grounding switches, SF6 gas monitoring system for complete bay etc.</td>
<td>Set 2</td>
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<td><strong>Sub-Total (B)</strong></td>
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<tr>
<td>1</td>
<td><strong>66kV GIS Equipment</strong></td>
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<tr>
<td>1.0</td>
<td>Feeder Bay Module : 72.5kV, 2000A, SF6 gas insulated feeder bay module each comprising of SF6 gas insulated circuit breaker(2000A), current transformer, two bus-bar disconnectors with one earthing switch, line disconnectors with one normal &amp; one high speed fault make grounding switch, surge arrestors, SF6 gas monitoring system for complete bay, PT, gas insulated terminal connection for connecting XLPE cable (XLPE cable/SF6) with cable termination enclosure and accessories with GIS, local control cubicle etc. to complete feeder bay module.</td>
<td>Set 8</td>
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<td>2.0</td>
<td>Bus Coupler Bay : 72.5kV, 2500A, SF6 gas insulated bus coupler bay module comprising of SF6 gas insulated circuit breaker, current transformer, two nos. of disconnectors with earthing switches, SF6 gas monitoring system for complete bay, local control cubicle etc.</td>
<td>Set 1</td>
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<tr>
<td>S. No.</td>
<td>Item Description</td>
<td>Unit</td>
<td>Qty</td>
<td>Unit Charges (INR)</td>
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<tr>
<td>3.0</td>
<td>Transformer Bay Module : 72.5kV, 2000A, SF6 gas insulated transformer bay module each comprising of SF6 gas insulated circuit breaker, current transformer, Two nos. of bus-bar disconnectors with common grounding switch, line disconnecter with one normal &amp; one high speed fault make grounding switch, surge arrestors, SF6 gas monitoring system for complete bay, gas insulated terminal connection for connecting transformer (XLPE cable/SF6) through XLPE cable with cable end box and accessories with GIS, local control cubicle etc. to complete transformer bay module.</td>
<td>Set</td>
<td>2</td>
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<td>4.0</td>
<td>Bus Bars : 72.5kV, 3000A, 3-phase or single phase encapsulated unit, SF6 gas insulated, metal enclosed bus bars each enclosed in bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each bus bar set shall be complete with voltage transformer, disconnectors with safety grounding switch, local control cubicle, SF6 gas monitoring system etc.</td>
<td>Set</td>
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Sub-Total (C)

D 33kV GIS Equipment

| 1     | Feeder Bay Module : 36kV, 1250A, SF6 gas insulated feeder bay module each comprising of circuit breaker(1250A), current transformer (600-400/1-1-1), two bus-bar disconnectors (1250A) with common grounding switch, surge arrestor (30kV), SF6 gas monitoring system for complete bay, PT, gas insulated terminal connection for connecting XLPE cable with cable termination enclosure and accessories with GIS etc. to complete feeder bay module. | Set | 9 |
| 2     | Bus Coupler Bay : 36kV, 2500A, SF6 gas insulated bus coupler bay module comprising of circuit breaker (2500A), current transformer (2000/1-1-1 A), two bus bar disconnectors (2500A) each with safety grounding switch, SF6 gas monitoring system for complete bay etc. | Set | 1 |
| 3     | Transformer Bay Module : 36kV, 2500A, SF6 gas insulated transformer bay module each comprising of circuit breaker (2500A), current transformer (2000/1-1-1 A), Two bus-bar disconnectors (2500A) with common grounding switch, surge arrestors (30kV), SF6 gas monitoring system for complete bay, gas insulated terminal connection for connecting transformer through suitable size and no. of XLPE copper cable considering 110% continus loading with cable termination enclosure/bus duct and accessories with GIS etc. to complete transformer bay module. | Set | 2 |
| 4     | Bus Bars : 36kV, 2500A, 3-phase or single phase encapsulated unit, metal enclosed bus bars each enclosed in bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each bus bar set shall be complete with voltage transformer, disconnectors with safety grounding switch, SF6 gas monitoring system etc. | Set | 2 |

Sub-Total (D)

E Sub-Station Automation System and Relay & Protection Panels

1 220kV Relay and Protection Panels

| a) | Bus Bar Protection Panel | No. | 1 |
| b) | Circuit Breaker Relay Panel Without Auto Reclose | No. | 18 |
| c) | Line Protection Panel | No. | 8 |
| d) | Transformer Protection Panel (for HV side) | No. | 4 |
| e) | Bus-Coupler Protection Panel | No. | 2 |
| f) | Bus-Section Protection Panel | No. | 2 |
| g) | Time synchronization equipment and other common equipments pertaining to Relay & Protection system (Time synchronization equipment) | Lot | 1 |

2 66KV Relay and Protection Panels

| a) | Circuit Breaker Relay Panel Without Auto Reclose | No. | 11 |
| b) | Line Protection Panel | No. | 8 |
| c) | Transformer Protection Panel | No. | 2 |
| d) | Bus-Coupler Protection Panel | No. | 1 |
| e) | Other/common equipments pertaining to Relay & Protection System etc. | Lot | 1 |

3 33KV Relay and Protection Panels

| a) | Line Relay & Protection Panel | No. | 9 |
| b) | Transformer Relay & Protection Panel for LV side | No. | 2 |
| c) | Bus-Coupler Relay & Protection Panel | No. | 1 |
| d) | Other/common equipments pertaining to Relay & Protection System (included in above) | Lot | 1 |

4 Automation & SCADA

<p>| a) | Substation automation equipment, optic fibre and other interface/converter equipment | Set | 1 |</p>
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Unit Charges (INR)</th>
<th>Total Charges (INR)</th>
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<tbody>
<tr>
<td>1</td>
<td>SCADA equipments</td>
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<tr>
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<td>Testing &amp; Maintenance equipment</td>
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<tr>
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<td>Inverter of suitable capacity for HMI and peripheral devices i.e. Printer etc.</td>
<td>Set</td>
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<td>Air conditioning system</td>
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<tr>
<td></td>
<td>a) Split AC (4 star rating) 220kV Relay &amp; Protection room</td>
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<td>b) Split AC (4 star rating) 33kV Relay &amp; Protection room</td>
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<tr>
<td></td>
<td>c) Split AC (4 star rating) 66kV Relay &amp; Protection room</td>
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<tr>
<td></td>
<td>d) Split AC (4 star rating) for Control room</td>
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</tr>
<tr>
<td></td>
<td>e) Split AC (4 star rating) for Battery room</td>
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<tr>
<td></td>
<td>f) Split AC (4 star rating) for Electrical lab and for office space</td>
<td>LS</td>
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<td>g) Ventilation system for 220kV, 66kV and 33kV GIS Hall</td>
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<td>Sub-Total (E)</td>
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<tr>
<td>3</td>
<td>LT Switchgear &amp; other items</td>
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<tr>
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<td>a) 415V Main Switchboard</td>
<td>Set</td>
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<td></td>
<td>b) 415V Main Lighting DB</td>
<td>Set</td>
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<td></td>
<td>d) 415V Emergency Lighting DB</td>
<td>Set</td>
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<td></td>
<td>e) 415V Air-conditioning &amp; Ventilation DB</td>
<td>Set</td>
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<td>f) 220V DCD</td>
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<td>LT Switchgear</td>
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<td>a) Battery 220V [_____AH] (*)</td>
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<td>b) 220V Battery Charger System (*)</td>
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<td>(*) Bidder to estimate and indicate the capacities of batteries in Ampere-Hours. The estimated capacities should meet the functional requirement.</td>
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<td>(*) The rating of battery charger shall be decided by the bidder to meet the functional requirement.</td>
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<td>5</td>
<td>Batteries &amp; Batteries chargers</td>
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<td></td>
<td>a) Fire Protection for GIS Halls, control room building, etc. (Portable type fire extinguishers system)</td>
<td>Lot</td>
<td>1</td>
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<td>6</td>
<td>DG set alongwith control panel (250KVA, 440V)</td>
<td>Set</td>
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<td>7</td>
<td>Fire prevention &amp; extinguishing system</td>
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<td>8</td>
<td>a) Fire Protection for GIS Halls, control room building, etc. (Portable type fire extinguishers system)</td>
<td>Lot</td>
<td>1</td>
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<td></td>
<td>b) Switchyard/ Street Lighting (High Mast Lighting System)</td>
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<tr>
<td></td>
<td>Sub-Total (F)</td>
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<td>9</td>
<td>1.1 kV Grade PVC insulated aluminium conductor armoured power cables and copper conductor armoured control</td>
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<td>a) Power Cables (XLPE) (*)</td>
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<tr>
<td></td>
<td>i) 1Cx630 sq.mm</td>
<td>km</td>
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<tr>
<td></td>
<td>ii) 3.5Cx300 sq.mm</td>
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<td>b) Power Cable (PVC) (*)</td>
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<td>i) 1Cx150 sq.mm</td>
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<td>ii) 3.5Cx70 sq.mm</td>
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<td>iii) 3.5Cx35 sq.mm</td>
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<td>iv) 4Cx16 sq.mm</td>
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<td>v) 4Cx6 sq.mm</td>
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<td>vi) 2Cx6 sq.mm</td>
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<td>c) Control Cable (PVC) (*)</td>
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<td>i) 2Cx2.5 sq.mm</td>
<td>km</td>
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<td>ii) 3Cx2.5 sq.mm</td>
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<td></td>
<td>iii) 5Cx2.5 sq.mm</td>
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<td></td>
<td>iv) 7Cx2.5 sq.mm</td>
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<td>S. No.</td>
<td>Item Description</td>
<td>Unit</td>
<td>Qty</td>
<td>Unit Charges (INR)</td>
<td>Total Charges (INR)</td>
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<td>1</td>
<td>10Gx2.5 sq.mm</td>
<td>km</td>
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<td>14Gx2.5 sq.mm</td>
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<td>3</td>
<td>19Gx2.5 sq.mm</td>
<td>km</td>
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<td>4</td>
<td>2Gx2.5 sq.mm</td>
<td>km</td>
<td>5+4</td>
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<td>v)</td>
<td>The bidder has to estimate and fill the quantities as per his own assessment.</td>
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<td>Power cable with termination kit/bus duct on 33kV side for connecting 2 nos. Transformers to 33kV GIS</td>
<td>LS</td>
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<td>8</td>
<td>Power cable with termination kit/bus duct on 66kV side for connecting 2 nos. Transformers to 66kV GIS</td>
<td>LS</td>
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<tr>
<td>9</td>
<td>Grounding/ Earthing System</td>
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<td>a)</td>
<td>40mm MS rod for Earthmat</td>
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<td>b)</td>
<td>Lightning Mast/ GS Shield Wire</td>
<td>LS</td>
<td>1</td>
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<td>10</td>
<td>Steel Structure (*)</td>
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<tr>
<td>a)</td>
<td>Lattice Structure</td>
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<td>b)</td>
<td>Pipe Structure</td>
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<td>11</td>
<td>EOT Crane (*)</td>
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<td>a)</td>
<td>220kV GIS room (*)</td>
<td>Set</td>
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<tr>
<td>b)</td>
<td>66kV GIS room (*)</td>
<td>Set</td>
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<tr>
<td>c)</td>
<td>33kV GIS room (*)</td>
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<td>12</td>
<td>Tertiary loading equipments for one 100 MVA transformer</td>
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<td>a)</td>
<td>33kV, O/D type Isolator with Earth switch MOM type</td>
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<td>b)</td>
<td>33kV, O/D type CT, ratio 25/1-1 A</td>
<td>Nos.</td>
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<td>33kV, O/D type 630A, circuit breaker</td>
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<td>d)</td>
<td>Control &amp; relay protection scheme</td>
<td>No.</td>
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<td>e)</td>
<td>11kV, O/D type PT, ratio (11kV/110V/110V/110V)</td>
<td>Nos.</td>
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<td>11kV equipments for loading 400kVA auxiliary transformer</td>
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<td>11kV switchgear, 2 panel board (1 incomer and 1 outgoing) along with associated control &amp; relay system, 11kV cables etc.</td>
<td>LS</td>
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<tr>
<td>14</td>
<td>Testing/Maintenance equipments for GIS</td>
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<tr>
<td>1</td>
<td>SF6 gas filling and evacuating plant</td>
<td>Set</td>
<td>1</td>
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<tr>
<td>2</td>
<td>Partial discharge monitoring system</td>
<td>Set</td>
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<td>3</td>
<td>Dew point meter</td>
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<td>4</td>
<td>Three phase automatic relay test kit</td>
<td>Set</td>
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<td>5</td>
<td>Contact resistance meter</td>
<td>Set</td>
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<td>6</td>
<td>Circuit breaker operational analyser</td>
<td>Set</td>
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<td>7</td>
<td>SF6 gas leak detector</td>
<td>Set</td>
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<tr>
<td>8</td>
<td>Gas masks</td>
<td>No.</td>
<td>10</td>
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<td>15</td>
<td>MANDATORY SPARES</td>
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<tr>
<td>A</td>
<td>GIS</td>
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<td>I.</td>
<td>220kV GIS</td>
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<td>Cable Connection Enclosure with the main circuit (1 no. of each type)</td>
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<td>2</td>
<td>SF6 gas Pressure Relief Devices, 3 Nos. of each type</td>
<td>Set</td>
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<tr>
<td>S. No.</td>
<td>Item Description</td>
<td>Unit</td>
<td>Qty</td>
<td>Unit Charges (INR)</td>
<td>Total Charges (INR)</td>
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<tr>
<td>3</td>
<td>SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable (1 no. of each type)</td>
<td>Set</td>
<td>1</td>
<td></td>
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<tr>
<td>4</td>
<td>Coupling device for pressure gauge cum switch for connecting Gas handling plant</td>
<td>Set</td>
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<tr>
<td>5</td>
<td>Rubber Gaskets, “O” Rings and Seals for SF6 gas of each type</td>
<td>Set</td>
<td></td>
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<tr>
<td>6</td>
<td>Molecular filter for SF6 gas with filter bags</td>
<td></td>
<td></td>
<td>20% of total weight</td>
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</tr>
<tr>
<td>7</td>
<td>All types of Control Valves for SF6 gas of each type</td>
<td>Set</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>SF6 gas</td>
<td></td>
<td></td>
<td>20% of total gas quantity</td>
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</tr>
<tr>
<td>9</td>
<td>All types of coupling for SF6 gas (1 no. of each type)</td>
<td>Set</td>
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<td></td>
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<tr>
<td>10</td>
<td>Pipe length (Copper or Steel as applicable) for SF6 Circuit of each type</td>
<td>Set</td>
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<tr>
<td></td>
<td>Covers with all accessories necessary to close a compartment in case of dismantling of any part of the enclosure to ensure the sealing of this compartment (as applicable)</td>
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<tr>
<td>11</td>
<td>For 3 Phase Enclosure</td>
<td>No.</td>
<td>2</td>
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<tr>
<td>12</td>
<td>For Single phase enclosure</td>
<td>No.</td>
<td>3</td>
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<tr>
<td>13</td>
<td>Locking device to keep the Disconnectors (Isolators) and Earthing switches in close or open position in case of removal of the driving mechanism</td>
<td>Set</td>
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<tr>
<td>14</td>
<td>Bus Support insulator of each type for 3 phase/single phase enclosure.</td>
<td></td>
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<td>5% of population</td>
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<td>15</td>
<td>Any other common spare, maintenance and testing tool for 220kV GIS</td>
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<td>Sub-Total - A(I)</td>
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<td>66kV GIS</td>
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<td>2</td>
<td>SF6 gas Pressure Relief Devices, 3 Nos. of each type</td>
<td>Set</td>
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</tr>
<tr>
<td>3</td>
<td>SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable (1 no. of each type)</td>
<td>Set</td>
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<tr>
<td>4</td>
<td>Coupling device for pressure gauge cum switch for connecting Gas handling plant</td>
<td>Set</td>
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<td>5</td>
<td>Rubber Gaskets, “O” Rings and Seals for SF6 gas of each type</td>
<td>Set</td>
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<td>6</td>
<td>Molecular filter for SF6 gas with filter bags</td>
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<td>20% of total weight</td>
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<tr>
<td>7</td>
<td>All types of Control Valves for SF6 gas of each type</td>
<td>Set</td>
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<tr>
<td>8</td>
<td>SF6 gas</td>
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<td>20% of total gas quantity</td>
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<tr>
<td>9</td>
<td>All types of coupling for SF6 gas (1 no. of each type)</td>
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<td>10</td>
<td>Pipe length (Copper or Steel as applicable) for SF6 Circuit of each type</td>
<td>Set</td>
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<tr>
<td>11</td>
<td>Covers with all accessories necessary to close a compartment in case of dismantling of any part of the enclosure to ensure the sealing of this compartment (as applicable)</td>
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<td>12</td>
<td>For 3 Phase Enclosure</td>
<td>No.</td>
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<tr>
<td>13</td>
<td>For Single phase enclosure</td>
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<td>Locking device to keep the Disconnectors (Isolators) and Earthing switches in close or open position in case of removal of the driving mechanism</td>
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<td>15</td>
<td>Bus Support insulator of each type for 3 phase/single phase enclosure.</td>
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<td></td>
<td>5% of population</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Any other common spare, maintenance and testing tool for 66kV GIS</td>
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<td>Sub-Total - A(II)</td>
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<td>III.</td>
<td>33kV GIS</td>
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<td>SF6 Gas pressure relief devices, three no. each type</td>
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<td>2</td>
<td>Pressure gauges cum switch or density motor and pressure switch as applicable, one no. each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Coupling device for pressure gauge cum switch for connecting gas handling plant</td>
<td>Set</td>
<td>2</td>
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</tr>
<tr>
<td>4</td>
<td>Rubber Gaskets, “o” Rings and seals for SF6 gas</td>
<td>Set</td>
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<td></td>
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<tr>
<td>5</td>
<td>Molecular filter for SF6 gas with filter bags</td>
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<td>20% of total weight</td>
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<tr>
<td>6</td>
<td>All types of Coupling for SF6 gas of each type</td>
<td>Set</td>
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<td></td>
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<tr>
<td>7</td>
<td>SF6 gas</td>
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<td>20% of total gas qty</td>
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<tr>
<td>8</td>
<td>All types of Control Valves for SF6 gas of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
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<tr>
<td>9</td>
<td>Pipe connection enclosure with the main ckt , one no. each type</td>
<td>Set</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td>Covers with all accessories necessary to close a compartment in case of dismantling of any part of the enclosure to ensure the sealing of this compartment (as applicable)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. No.</td>
<td>Item Description</td>
<td>Unit</td>
<td>Qty</td>
<td>Unit Charges (INR)</td>
<td>Total Charges (INR)</td>
</tr>
<tr>
<td>--------</td>
<td>------------------</td>
<td>------</td>
<td>-----</td>
<td>--------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>1</td>
<td>Covers with all accessories necessary to close a compartment in case of dismantling of any part of the enclosure to ensure the sealing of this compartment (as applicable)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>For 3 Phase Enclosure</td>
<td>No.</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>For Single phase enclosure</td>
<td>No.</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Locking device to keep the Disconnectors (Isolators) and Earthing switches in close or open position in case of removal of the driving Mechanism</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Bus Support Insulator of each type for 3 phase/single phase enclosure</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Any other common spare, maintenance and testing tool for 33kV GIS</td>
<td>Set</td>
<td>1</td>
<td>5% of population</td>
<td></td>
</tr>
<tr>
<td><strong>Sub-Total - A(III)</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>16</td>
<td>220kV SF6 Circuit Breaker</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>Complete Circuit Breaker pole of each type &amp; rating complete with interrupter, main circuit, enclosure and Marshalling Box with operating mechanism</td>
<td>No.</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Fixed, moving and arcing contacts including insulating nozzles 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Rubber gaskets, ‘O’ rings and seals for SF6 gas of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Trip coil assembly with resistor as applicable, 3 Nos. of each type</td>
<td>Set</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Closing coil assembly with resistor as applicable, 3 Nos. of each type</td>
<td>Set</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td>10% of total quantity used</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Coupling device for pressure gauge cum switch/ for connecting Gas handling plant, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Corona rings if applicable</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Relays, Power contactors, push buttons, timers &amp; MCBs etc of each type &amp; rating</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Closing assembly/ valve, 3 Nos. of each type</td>
<td>Set</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Trip assembly/ valve, 3 Nos. of each type</td>
<td>Set</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Auxiliary switch assembly, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Operation Counter, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Rupture disc, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Windoscope / Observing window, 3 Nos. of each type, if applicable</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Spring operated closing mechanism, 1 No. of each type, if applicable</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Terminal Pad &amp; Connectors</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>For Hydraulic Operated Mechanism, if applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Hydraulic operating mechanism with drive motor, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.1</td>
<td>Ferrules, joints and couplings, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.2</td>
<td>Hydraulic filter, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.3</td>
<td>Hose pipe, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.4</td>
<td>N2 Accumulator, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.5</td>
<td>Pressure transducer, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.6</td>
<td>Valves 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.7</td>
<td>Pipe length (copper &amp; steel) 3 Nos. of each size &amp; type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.8</td>
<td>Pressure switches 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.9</td>
<td>Pressure gauge with coupling device, 3 Nos. of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.10</td>
<td>Pressure Relief Device, 3 Nos. of each type</td>
<td>Set</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sub-Total - B(I)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.11</td>
<td>Hydraulic oil</td>
<td>Set</td>
<td>1</td>
<td>20% of total qty. used</td>
<td></td>
</tr>
<tr>
<td>19.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II. 66kV SF6 Circuit Breaker</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>72.5 kV, Three phase, Circuit Breaker interrupting chamber complete with all necessary apparatus</td>
<td>No.</td>
<td>1</td>
<td>1 no. of each rating</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Rubber gaskets, ‘O’ rings and seals for SF6 gas of each type</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Trip coils with resistor of each type (as applicable)</td>
<td>No.</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Closing coils with resistor of each type (as applicable)</td>
<td>No.</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Molecular filter for SF6 gas with filter bags (as applicable)</td>
<td>Set</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. No.</td>
<td>Item Description</td>
<td>Unit</td>
<td>Qty</td>
<td>Unit Charges (INR)</td>
<td>Total Charges (INR)</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------------------------------</td>
<td>------</td>
<td>-----</td>
<td>-------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>6</td>
<td>Density/ pressure monitoring systems</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Relays, Power contactors, push buttons, timers &amp; MCBs etc of each type &amp; rating</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Closing assembly/ valve</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Trip assembly/ valve</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Pressure switches</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Auxiliary switch assembly</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Operation Counter</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Rupture disc/o diaphragm</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Windoscope / Observing window, if applicable</td>
<td>No.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>72.5kV, Three phase, Circuit Breaker operating mechanism, complete with all necessary connecting apparatus.</td>
<td>1 no. of each type</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>All types of coupling for SF6 gas(1 no. each type)</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sub-Total - B(II)

III. 33kV SF6 Circuit Breaker

| 1     | 36kV, Three phase, Circuit Breaker interrupting chamber complete with all necessary apparatus. | No.  | 1 no. of each rating | 1                   |                    |
| 2     | Rubber gaskets, ‘O’ rings and seals for SF6 gas of each type                       | Set  | 1   |                   |                    |
| 3     | Trip coils with resistor of each type (as applicable)                              | No.  | 3   |                   |                    |
| 4     | Closing coils with resistor of each type (as applicable)                           | No.  | 3   |                   |                    |
| 5     | Molecular filter for SF6 gas with filter bags (as applicable)                      | Set  | 3   |                   |                    |
| 6     | Density/ pressure monitoring systems                                              | No.  | 1   |                   |                    |
| 7     | Relays, Power contactors, push buttons, timers & MCBs etc of each type & rating    | Set  | 1   |                   |                    |
| 8     | Closing assembly/ valve                                                            | No.  | 1   |                   |                    |
| 9     | Trip assembly/ valve                                                              | No.  | 1   |                   |                    |
| 10    | Pressure switches                                                                 | Set  | 1   |                   |                    |
| 11    | Auxiliary switch assembly                                                          | No.  | 1   |                   |                    |
| 12    | Operation Counter                                                                 | No.  | 1   |                   |                    |
| 13    | Rupture disc/o diaphragm                                                          | No.  | 1   |                   |                    |
| 14    | Windoscope / Observing window, if applicable                                      | No.  | 1   |                   |                    |
| 15    | 36kV, Three phase, Circuit Breaker operating mechanism, complete with all necessary connecting apparatus. | 1 no. of each type | 1   |                   |                    |
| 16    | All types of coupling for SF6 gas(1 no. each type)                               | Set  | 1   |                   |                    |

Sub-Total - B(III)

C Spares for Isolators

<p>| I     | 220kV Isolator                                                                    | Set  | 1   |                   |                    |
| 1     | Complete set of 3 nos. of single phase / one no. of 3-phase dis-connector including main circuit, enclosure, driving mechanism. | Set  | 1   |                   |                    |
| 2     | 3 no. of single phase / one no of 3-phase Earthing switch including main circuit, enclosure, driving mechanism | Set  | 1   |                   |                    |
| 3     | Copper contact fingers for dis-connector male &amp; female contact – for one complete (3 phase) dis-connector of each type and rating | Set  | 1   |                   |                    |
| 4     | Copper contact fingers for earthing switch male &amp; female contacts, for one complete (3 phase) earthing switch of each type and rating | Set  | 1   |                   |                    |
| 5     | Open / Close contactor assembly, timers, key interlock for one complete (3 phase) dis-connector and (3 phase) earthing switch of each type and rating | Set  | 1   |                   |                    |
| 6     | Push button switch – each type, as applicable                                     | Set  | 1   |                   |                    |
| a)    | For Isolator                                                                       | Set  | 3   |                   |                    |
| b)    | For Earth switch                                                                  | Set  | 1   |                   |                    |
| 8     | Rotor housing bearing assembly for complete 3 phase equipment                      | Set  | 2   |                   |                    |
| a)    | For Isolator                                                                       | Set  | 2   |                   |                    |
| b)    | For Earth switch                                                                  | Set  | 1   |                   |                    |
| 9     | Motor with gear assembly for complete 3 phase equipment                            | Set  | 3   |                   |                    |
| a)    | For Isolator                                                                       | Set  | 3   |                   |                    |
| b)    | For Earth switch                                                                  | Set  | 1   |                   |                    |</p>
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Unit Charges (INR)</th>
<th>Total Charges (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Corona shield rings as applicable</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Hinge pins for complete 3 phase equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>For isolator</td>
<td>Set</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>For earth switch</td>
<td>Set</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Bearings for complete 3 phase equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>For isolator</td>
<td>Set</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>For earth switch</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Interlocking coil with resistors, timers, key interlock for complete 3 phase equipment (each type and rating)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Relays, Power contactors, resistors, fuses, push buttons &amp; MCBs (complete for one 3 phase equipment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>For isolator</td>
<td>Set</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>For earth switch</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Terminal pad and connectors (complete for one 3 phase equipment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>For isolator</td>
<td>Set</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td>For earth switch</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Aux. switch assembly (complete) with 10 NO &amp; 10 NC OR more contacts for both isolator &amp; earth switch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sub-Total - C(I)

II. 66kV Isolator

| 1    | 72.5 kV, single ph., Disconnecting Switch internal parts, complete with all necessary gaskets, mounting hardware, etc. | Set  | 1   |                    |                     |
| 2    | 72.5 kV, three ph., Disconnecting Switch operating mechanism, complete with all necessary connecting apparatus.     | Set  | 1   |                    |                     |
| 3    | 72.5 kV, single ph., Grounding Switch internal parts, complete with all necessary gaskets, mounting hardware etc.  | Set  | 1   |                    |                     |
| 4    | 72.5 kV, three ph., Grounding Switch operating mechanism, complete with all necessary connecting apparatus.      | Set  | 1   |                    |                     |
| 5    | 72.5 kV, single phase, grounding switch, Internal parts complete with all necessary gaskets mounting hardware etc. | Set  | 1   |                    |                     |

Sub-Total - C(II)

III. 33kV Isolator

| 1    | 36 kV, single ph., Disconnecting Switch internal parts, complete with all necessary gaskets, mounting hardware, etc. | Set  | 1   |                    |                     |
| 2    | 36 kV, three ph., Disconnecting Switch operating mechanism, complete with all necessary connecting apparatus.     | Set  | 1   |                    |                     |
| 3    | 36 kV, single ph., Grounding Switch internal parts, complete with all necessary gaskets, mounting hardware etc.  | Set  | 1   |                    |                     |
| 4    | 36 kV, three ph., Grounding Switch operating mechanism, complete with all necessary connecting apparatus.      | Set  | 1   |                    |                     |

Sub-Total - C(III)

D Spares for Current Transformer (GIS type)

I. 220kV CT

| 1    | Complete CT of each type and rating with enclosure.                                | No.  | 2   |                    |                     |
| 2    | Secondary bushing of each type                                                    | Set  |     |                    |                     |

II. 66kV CT

| 1    | Single phase current transformer of each rating                                   | No.  | three each type |                     |

III. 33kV CT

| 1    | Single phase current transformer of each rating                                   | No.  | three each type |                     |

Sub-Total - D(I+I+III)

E Spares for Voltage Transformer (GIS type)

I. 220kV VT

| 1    | Complete PT of each type and rating                                              | No.  | 1   |                    |                     |

II. 66kV VT

| 1    | Single phase VT complete with all gaskets and mounting hardware                   | No.  | 3   |                    |                     |

III. 33kV VT

<p>| 1    | Single phase VT complete with all gaskets and mounting hardware                   | No.  | 3   |                    |                     |</p>
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Unit Charges (INR)</th>
<th>Total Charges (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sub-Total - E(I+II+III)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Spares for Surge Arrestor (GIS type)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I. 220kV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Gas insulated LA for 220kV of each type and ratings with all accessories as applicable</td>
<td>No. 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II. 66kV</td>
<td>Complete LA including insulating base with surge counter &amp; accessories : GIS type</td>
<td>No. 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Surge counter/monitor</td>
<td>No. 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III. 33kV</td>
<td>Complete LA including insulating base with surge counter &amp; accessories : GIS type</td>
<td>No. 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surge counter/monitor</td>
<td>No. 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Sub-station Automation System</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Bay Control Unit (of each type)</td>
<td>No. 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Ethernet Switch of Each type</td>
<td>No. 1</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>Longest optical cable with end terminations</td>
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<td></td>
<td>Sub-Total - (G)</td>
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<tr>
<td>H</td>
<td>Spares for illuminations</td>
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<tr>
<td>1</td>
<td>Single Pole MCB</td>
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<td>2</td>
<td>Triple pole MCB</td>
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<tr>
<td>3</td>
<td>Sodium vapour/Mercury vapour Lamps</td>
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<tr>
<td>4</td>
<td>Lamp</td>
<td>No. 10</td>
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<td>5</td>
<td>Ballast</td>
<td>No. 5</td>
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</tr>
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<td>6</td>
<td>Condenser/ Igniter</td>
<td>No. 5</td>
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<td>7</td>
<td>Lamp holder</td>
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<td>Covers &amp; reflectors</td>
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<td>9</td>
<td>Complete fittings</td>
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<td>10</td>
<td>Switches and sockets</td>
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<td>11</td>
<td>Junction box</td>
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<td>12</td>
<td>CFL with complete fittings</td>
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<td>5%</td>
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<td>13</td>
<td>Metal halide lamp with complete fittings</td>
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<tr>
<td>2</td>
<td>Set of relays</td>
<td>Set 1</td>
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<tr>
<td>3</td>
<td>Set of Contactor</td>
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<td>Micro-switches (If applicable)</td>
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<td>Item Description</td>
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<td>6</td>
<td>Three phase full wave bridge rectifier (Thyristor/ Diode)</td>
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<td>7</td>
<td>Set of wound resistor (if applicable)</td>
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<td>Set of switches</td>
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<td>Potentiometer</td>
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<td>10</td>
<td>Fuses of Thyristor with indicator</td>
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<td><strong>Sub-Total - (K)</strong></td>
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<table>
<thead>
<tr>
<th>L</th>
<th>Spares for Relay &amp; Protection Panels</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Breaker Relay Panel</strong></td>
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<tr>
<td>(a)</td>
<td>Breaker failure relay</td>
</tr>
<tr>
<td>(b)</td>
<td>Trip circuit supervision relay</td>
</tr>
<tr>
<td>(c)</td>
<td>Self reset trip relay of each type (if applicable)</td>
</tr>
<tr>
<td>(d)</td>
<td>Timer relay of each type (if applicable)</td>
</tr>
<tr>
<td>(e)</td>
<td>DC supervision relays (if applicable)</td>
</tr>
<tr>
<td>2</td>
<td><strong>Line Protection Panel Equipment spare</strong></td>
</tr>
<tr>
<td>(a)</td>
<td>Main 1 Numerical distance relay (excluding external trip relays)</td>
</tr>
<tr>
<td>(b)</td>
<td>Main-2 Numerical distance relay (excluding external trip relays)</td>
</tr>
<tr>
<td>(c)</td>
<td>Disturbance recorder comprising of acquisition units with software (if stand alone)</td>
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<tr>
<td>3</td>
<td><strong>Transformer Protection Panel</strong></td>
</tr>
<tr>
<td>(a)</td>
<td>Transformer differential protection relay including all aux. CTs (If applicable)</td>
</tr>
<tr>
<td>(b)</td>
<td>Restricted earth fault protection relay with non-linear resistor (if applicable)</td>
</tr>
<tr>
<td>(c)</td>
<td>Back up protection relay with 3 O/C and E/F element</td>
</tr>
<tr>
<td>(d)</td>
<td>Over fluxing relay (if stand alone)</td>
</tr>
<tr>
<td>(e)</td>
<td>CVT selection relay (if stand alone)</td>
</tr>
<tr>
<td>(f)</td>
<td>Over load relay with timer. (if stand alone)</td>
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<tr>
<td>4</td>
<td><strong>Common Spares</strong></td>
</tr>
<tr>
<td>(a)</td>
<td>Power supply module for Bus Bar protection</td>
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<td><strong>Sub-Total - (L)</strong></td>
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<tr>
<th>M</th>
<th>Spares for LT switchgear</th>
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<td><strong>Sub-Total - (M)</strong></td>
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<table>
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<th>N</th>
<th>Spares for DG Set</th>
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<tr>
<td>1</td>
<td>Set of fuel filter (each type)</td>
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<tr>
<td>2</td>
<td>Solenoid coil assembly</td>
</tr>
<tr>
<td>3</td>
<td>Self starter assembly with clutch engaging and disengaging arrangements complete with motors</td>
</tr>
<tr>
<td>4</td>
<td>Lube oil pressure safety control</td>
</tr>
<tr>
<td>5</td>
<td>High water temp. safety control</td>
</tr>
<tr>
<td>6</td>
<td>Diode</td>
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<tr>
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<td><strong>Sub-Total - (N)</strong></td>
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<table>
<thead>
<tr>
<th>O</th>
<th>Fire Fighting System</th>
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<tbody>
<tr>
<td>1</td>
<td>Fitted nitrogen cylinder (68 liter water Capacity)</td>
</tr>
<tr>
<td>2</td>
<td>Heat sensor assembly</td>
</tr>
<tr>
<td>3</td>
<td>Fire survival cable sufficient for one system</td>
</tr>
<tr>
<td>4</td>
<td>PNRBV</td>
</tr>
<tr>
<td>5</td>
<td>Limit switch for fire detector</td>
</tr>
<tr>
<td>6</td>
<td>Fire detectors</td>
</tr>
<tr>
<td>7</td>
<td>Thermostat</td>
</tr>
<tr>
<td>8</td>
<td>Heating element</td>
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<td><strong>Sub-Total - (O)</strong></td>
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</table>

<table>
<thead>
<tr>
<th>P</th>
<th>Spares for 160MVA, 220/66/11 kV. Power Transformer</th>
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<tbody>
<tr>
<td>1</td>
<td>Oil Cooler Pump with motor</td>
</tr>
<tr>
<td>2</td>
<td>Expansion Joint (Complete replacement for one transformer)</td>
</tr>
<tr>
<td>3</td>
<td>Bushing CTs, each type and ratio</td>
</tr>
<tr>
<td>4</td>
<td>Buchholz relay with complete contacts</td>
</tr>
<tr>
<td>5</td>
<td>Local and remote WTI with contacts</td>
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**SCHEDULE-3**
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<th>S. No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Unit Charges (INR)</th>
<th>Total Charges (INR)</th>
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<tbody>
<tr>
<td>6</td>
<td>Oil Temp indicator with contacts</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>7</td>
<td>Pressure relief device</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Magnetic Oil level gauge</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Cooler fan with motor</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Set of valves (of all sizes)</td>
<td>Set  1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Fuses (1 set for complete replacement)</td>
<td>Set  1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>12</td>
<td>Aux Transformers for the control of cooler control cabinet and OLTC</td>
<td>Set  1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Starter contactors, switches and relays for electrical control panels (one set of each type)</td>
<td>Set  1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Remote tap position indicator</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>15</td>
<td>Stainless Steel Oil sampling bottles one liter capacity</td>
<td>No. 12</td>
<td>1</td>
<td>12</td>
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</tr>
<tr>
<td>16</td>
<td>Oil surge relay for OLTC</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>17</td>
<td>Complete set of Gaskets</td>
<td>Set  2</td>
<td>1</td>
<td>2</td>
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<tr>
<td>18</td>
<td>Neutral bushing complete with metal parts of each type</td>
<td>No. 1</td>
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<tr>
<td>19</td>
<td>LV, HV &amp; MV end bushing complete with metal parts &amp; gaskets of each type</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>20</td>
<td>Oil Storage Tank with accessories</td>
<td>No. 1</td>
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<td>Sub-Total - (P)</td>
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<tr>
<td>Q</td>
<td>Spares for 100MVA, 220/33/11 kV, Power Transformer</td>
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</tr>
<tr>
<td>1</td>
<td>Oil Cooler Pump with motor</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>2</td>
<td>Expansion Joint (Complete replacement for one transformer)</td>
<td>Set  1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>3</td>
<td>Bushing CTs, each type and ratio</td>
<td>Set  1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Buchholz relay with complete contacts</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>5</td>
<td>Local &amp; Remote Winding Temp Indicator with contacts</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>6</td>
<td>Oil Temp indicator with contacts</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>7</td>
<td>Pressure relief device</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>8</td>
<td>Magnetic Oil level gauge</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>9</td>
<td>Cooler fan with motor</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Set of valves of all sizes</td>
<td>No. one each type</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Fuses (Complete replacement)</td>
<td>Set  1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>12</td>
<td>Aux Transformers for the control of cooler control cabinet and OLTC</td>
<td>No. one each type</td>
<td>1</td>
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<tr>
<td>13</td>
<td>Starter contactors, switches and relays for electrical control panels (one set of each type)</td>
<td>No. one each type</td>
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<td></td>
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<tr>
<td>14</td>
<td>Remote tap position indicator</td>
<td>No. 1</td>
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<td>1</td>
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<tr>
<td>15</td>
<td>Stainless Steel Oil sampling bottles one liter capacity</td>
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<td>16</td>
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<tr>
<td>17</td>
<td>Complete set of Gaskets</td>
<td>No. 2</td>
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<td>2</td>
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<tr>
<td>18</td>
<td>Neutral bushing complete with metal parts of each type</td>
<td>No. 1</td>
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<td>1</td>
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<tr>
<td>19</td>
<td>HV, LV, MV end bushing complete with metal parts &amp; gaskets of each type</td>
<td>No. 1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Oil Storage Tank with accessories</td>
<td>No. 1</td>
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<td>SUB-TOTAL III : MANDATORY SPARES [(A) to (Q)]</td>
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<td>TOTAL [(I + II +III)]</td>
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</table>

Note: Bidder is required to quote the prices in this Schedule for all the individual items/sub-items.

# In case any additional equipment is required, the same should be included in the scope with no additional payment and the offer should be complete and comprehensive.

Date: __________________________

Signature: __________________________

Place: __________________________

Printed Name: __________________________

Designation: __________________________

Common Seal: __________________________
SPECIFICATION NO. T14P070076

220/66/33 kV GIS SUBSTATION R.K.Puram
(Schedule of rates and prices)

Bidder's Name and Address:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Unit Charges (INR)</th>
<th>Total Charges (INR)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Main Equipment.</strong></td>
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</tr>
<tr>
<td></td>
<td><strong>Power Transformer and associated equipment</strong></td>
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<tr>
<td>1</td>
<td>100MVA, 220/33/11kV power transformer including bushing, accessories and first filling of oil with 10% spare quantity oil alongwith nitrogen injection fire prevention &amp; extinguishing system (NIFPES) for transformer.</td>
<td>No.</td>
<td>2</td>
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<td>2</td>
<td>17.5kV NCT of ratio 800-400/1 Amp for 220kV neutral of transformer</td>
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<td>17.5kV NCT of ratio 800-400/1 Amp for 220kV neutral of transformer</td>
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<tr>
<td>7</td>
<td>400KVA, 11/0.433kV, 170kVp BIL at 11kV side, three-phase transformer including bushing, accessories and first filling of oil.</td>
<td>No.</td>
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<tr>
<td>8</td>
<td>400KVA, 11/0.433kV, 75kVp BIL at 11kV side, three-phase transformer including bushing, accessories and first filling of oil.</td>
<td>No.</td>
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<td></td>
<td><strong>Sub-Total (A)</strong></td>
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<tr>
<td></td>
<td><strong>B 245kV GIS Equipment</strong></td>
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<tr>
<td>1</td>
<td>Transformer Bay Module: 245kV, 1600A, SF6 gas insulated transformer bay module each comprising of SF6 gas insulated circuit breaker (1600A), current transformer (800-400/1-1-1-1), two bus-bar disconnectors (1600A) with common grounding switch, line disconnector with safety grounding switches, surge arrestors, SF6 gas monitoring system for complete bay, Three 1-phase SF6 ducts and SF6/Oil interface to connect to 220/66kV, 160MVA and 220/33kV 100 MVA transformers and accessories with GIS etc. to complete transformer bay module.</td>
<td>Set</td>
<td>4</td>
<td></td>
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</tr>
<tr>
<td>S.No.</td>
<td>Item Description</td>
<td>Unit</td>
<td>Qty</td>
<td>Unit Charges (INR)</td>
<td>Total Charges (INR)</td>
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<tr>
<td>2</td>
<td><strong>Feeder Bay Module</strong>: 245kV, 1600A, SF6 gas insulated feeder bay module each comprising of SF6 gas insulated circuit breaker (1600A), current transformer (800-400/1-1-1-1-1), two bus bar disconnectors (1600A) with common grounding switch, line disconnector with safety grounding switch, high speed fault making grounding switch, surge arrestors, PT, SF6 gas monitoring system for complete bay, gas insulated terminal connection for connecting XLPE cable with cable termination enclosure and accessories with GIS etc. to complete feeder bay module.</td>
<td>Set</td>
<td>8</td>
<td></td>
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<tr>
<td>3</td>
<td><strong>Bus bar Module</strong>: 245kV, 3 single phase (isolated) units, SF6 gas insulated, metal enclosed 2500A bus bar each enclosed in bus enclosures running along the length of the switchgear to interconnect each of Circuit breaker bay module. Each bus bar set shall be complete with voltage transformer, disconnector and safety grounding switch, SF6 gas monitoring system for complete bay etc.</td>
<td>Set</td>
<td>2</td>
<td></td>
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<td>4</td>
<td><strong>Bus coupler Bay Module</strong>: 245kV, 2500A, SF6 gas insulated bus coupler bay module comprising of SF6 gas insulated circuit breaker (2500A), current transformer (1600-800/1-1-1-1-1), two bus-bar disconnectors (2500A) with safety grounding switches, SF6 gas monitoring system for complete bay etc.</td>
<td>Set</td>
<td>2</td>
<td></td>
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<tr>
<td>5</td>
<td><strong>Bus sectionaliser bay Module</strong>: 245kV, 2500A, SF6 gas insulated bus sectionaliser bay module comprising of SF6 gas insulated circuit breaker (2500A), current transformer (1600-800/1-1-1-1-1), two disconnectors (2500A) with safety grounding switches, SF6 gas monitoring system for complete bay etc.</td>
<td>Set</td>
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<td></td>
<td><strong>Sub-Total (B)</strong></td>
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<tr>
<td>C</td>
<td>66kV GIS Equipment</td>
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<tr>
<td>1.0</td>
<td><strong>Feeder Bay Module</strong>: 72.5kV, 2000A, SF6 gas insulated feeder bay module each comprising of SF6 gas insulated circuit breaker(2000A), current transformer, two bus-bar disconnectors with one earthing switch, line disconnector with one normal &amp; one high speed fault make grounding switch, surge arrestors, SF6 gas monitoring system for complete bay, PT, gas insulated terminal connection for connecting XLPE cable (XLPE cable/SF6) with cable termination enclosure and accessories with GIS, local control cubicle etc. to complete feeder bay module.</td>
<td>Set</td>
<td>8</td>
<td></td>
<td></td>
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<tr>
<td>2.0</td>
<td><strong>Bus Coupler Bay</strong>: 72.5kV, 2500A, SF6 gas insulated bus coupler bay module comprising of SF6 gas insulated circuit breaker, current transformer, two nos. of disconnectors with earthing switches, SF6 gas monitoring system for complete bay, local control cubicle etc.</td>
<td>Set</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.No.</td>
<td>Item Description</td>
<td>Unit</td>
<td>Qty</td>
<td>Unit Charges (INR)</td>
<td>Total Charges (INR)</td>
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<td>-------</td>
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<tr>
<td>3.0</td>
<td><strong>Transformer Bay Module</strong>: 72.5kV, 2000A, SF6 gas insulated transformer bay module each comprising of SF6 gas insulated circuit breaker, current transformer, Two nos. of bus-bar disconnectors with common grounding switch, line disconnector with one normal &amp; one high speed fault make grounding switch, surge arrestors, SF6 gas monitoring system for complete bay, gas insulated terminal connection for connecting transformer (XLPE cable/SF6) through XLPE cable with cable end box and accessories with GIS, local control cubicle etc. to complete transformer bay module.</td>
<td>Set</td>
<td>2</td>
<td></td>
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<tr>
<td>4.0</td>
<td><strong>Bus Bars</strong>: 72.5kV, 3000A, 3-phase or single phase encapsulated unit, SF6 gas insulated, metal enclosed bus bars each enclosed in bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each bus bar set shall be complete with voltage transformer, disconnectors with safety grounding switch, local control cubicle, SF6 gas monitoring system etc.</td>
<td>Set</td>
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<td></td>
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<td></td>
<td><strong>Sub-Total (C)</strong></td>
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<tr>
<td><strong>D</strong></td>
<td><strong>33kV GIS Equipment</strong></td>
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<tr>
<td>1</td>
<td><strong>Feeder Bay Module</strong>: 36kV, 1250A, SF6 gas insulated feeder bay module each comprising of circuit breaker(1250A), current transformer (800-400/1-1-1), two bus-bar disconnectors (1250A) with common grounding switch, surge arrestor (30kV), SF6 gas monitoring system for complete bay, PT, gas insulated terminal connection for connecting XLPE cable with cable termination enclosure and accessories with GIS etc. to complete feeder bay module.</td>
<td>Set</td>
<td>9</td>
<td></td>
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<tr>
<td>2</td>
<td><strong>Bus Coupler Bay</strong>: 36kV, 2500A, SF6 gas insulated bus coupler bay module comprising of circuit breaker (2500A), current transformer (2000/1-1-1 A), two bus bar disconnectors (2500A) each with safety grounding switch, SF6 gas monitoring system for complete bay etc.</td>
<td>Set</td>
<td>1</td>
<td></td>
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<tr>
<td>3</td>
<td><strong>Transformer Bay Module</strong>: 36kV, 2500A, SF6 gas insulated transformer bay module each comprising of circuit breaker (2500A), current transformer (2000/1-1-1 A), Two bus-bar disconnectors (2500A) with common grounding switch, surge arrestors (30kV), SF6 gas monitoring system for complete bay, gas insulated terminal connection for connecting transformer through suitable size and no. of XLPE copper cable considering 110% continuous loading with cable termination enclosure/bus duct and accessories with GIS etc. to complete transformer bay module.</td>
<td>Set</td>
<td>2</td>
<td></td>
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<tr>
<td>4</td>
<td><strong>Bus Bars</strong>: 36kV, 2500A, 3-phase or single phase encapsulated unit, metal enclosed bus bars each enclosed in bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each bus bar set shall be complete with voltage transformer, disconnectors with safety grounding switch, SF6 gas monitoring system etc.</td>
<td>Set</td>
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<td></td>
<td><strong>Sub-Total (D)</strong></td>
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<tr>
<td>S.No.</td>
<td>Item Description</td>
<td>Unit</td>
<td>Qty</td>
<td>Unit Charges (INR)</td>
<td>Total Charges (INR)</td>
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<td></td>
<td><strong>Sub-Station Automation System and Relay &amp; Protection Panels</strong></td>
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<tr>
<td>1</td>
<td><strong>220kV Relay and Protection Panels</strong></td>
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<tr>
<td></td>
<td>a) Bus Bar Protection Panel</td>
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<tr>
<td></td>
<td>b) Circuit Breaker Relay Panel Without Auto Reclose</td>
<td>No.</td>
<td>16</td>
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<td></td>
<td>c) Line Protection Panel</td>
<td>No.</td>
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<td></td>
<td>d) Transformer Protection Panel (for HV side)</td>
<td>No.</td>
<td>4</td>
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<td></td>
<td>e) Bus-Coupler Protection Panel</td>
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<td></td>
<td>f) Bus-Section Protection Panel</td>
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<td></td>
<td>g) Time synchronization equipment and other common equipments pertaining to Relay &amp; Protection system (Time synchronization equipment)</td>
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<td>2</td>
<td><strong>66KV Relay and Protection Panels</strong></td>
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<tr>
<td></td>
<td>a) Circuit Breaker Relay Panel Without Auto Reclose</td>
<td>No.</td>
<td>11</td>
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<tr>
<td></td>
<td>b) Line Protection Panel</td>
<td>No.</td>
<td>8</td>
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<tr>
<td></td>
<td>c) Transformer Protection Panel</td>
<td>No.</td>
<td>2</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>d) Bus-Coupler Protection Panel</td>
<td>No.</td>
<td>1</td>
<td></td>
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<tr>
<td></td>
<td>e) Other/common equipments pertaining to Relay &amp; Protection System etc.</td>
<td>Lot</td>
<td>1</td>
<td></td>
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<tr>
<td>3</td>
<td><strong>33KV Relay and Protection Panels</strong></td>
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<tr>
<td></td>
<td>a) Line Relay &amp; Protection Panel</td>
<td>No.</td>
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<tr>
<td></td>
<td>b) Transformer Relay &amp; Protection Panel for LV side</td>
<td>No.</td>
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<tr>
<td></td>
<td>c) Bus-Coupler Relay &amp; Protection Panel</td>
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<tr>
<td></td>
<td>d) Other/common equipments pertaining to Relay &amp; Protection System (included in above)</td>
<td>Lot</td>
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<tr>
<td>4</td>
<td><strong>Automation &amp; SCADA</strong></td>
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<tr>
<td></td>
<td>a) Substation automation equipment, optic fibre and other interface/converter equipment</td>
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<td></td>
<td>b) SCADA equipments</td>
<td>Set</td>
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<td></td>
<td>c) Testing &amp; Maintenance equipment</td>
<td>Set</td>
<td>1</td>
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<tr>
<td></td>
<td>d) Inverter of suitable capacity for HMI and peripheral devices i.e. Printer etc.</td>
<td>Set</td>
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<tr>
<td>5</td>
<td><strong>Air conditioning system</strong></td>
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<tr>
<td></td>
<td>a) Split AC (4 star rating) 220kV Relay &amp; Protection room</td>
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<td></td>
<td>b) Split AC (4 star rating) 33kV Relay &amp; Protection room</td>
<td>LS</td>
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<tr>
<td></td>
<td>c) Split AC (4 star rating) 66kV Relay &amp; Protection room</td>
<td>LS</td>
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<td></td>
<td>d) Split AC (4 star rating) for Control room</td>
<td>LS</td>
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<td></td>
<td>e) Split AC (4 star rating) for Battery room</td>
<td>LS</td>
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<tr>
<td></td>
<td>f) Split AC (4 star rating) for Electrical lab and for office space</td>
<td>LS</td>
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<tr>
<td>S.No.</td>
<td>Item Description</td>
<td>Unit</td>
<td>Qty</td>
<td>Unit Charges (INR)</td>
<td>Total Charges (INR)</td>
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<td>1</td>
<td><strong>Ventilation system for 220kV, 66kV and 33kV GIS Hall</strong></td>
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<td><strong>Sub-Total (E)</strong></td>
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<td>2</td>
<td><strong>LT Switchgear &amp; other items</strong></td>
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<td></td>
<td><strong>LT Switchgear</strong></td>
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<tr>
<td>3</td>
<td><strong>Batteries &amp; Batteries chargers</strong></td>
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<td>4</td>
<td><strong>Fire prevention &amp; extinguishing system</strong></td>
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<td>5</td>
<td><strong>Illumination System</strong></td>
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<tr>
<td>6</td>
<td><strong>1.1 kV Grade PVC insulated aluminium conductor armoured power cables and copper conductor armoured control cables alongwith lugs, glands and straight joints.</strong></td>
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</tbody>
</table>

### Ventilation system for 220kV, 66kV and 33kV GIS Hall

Sub-Total (E)

### LT Switchgear

1. **415V Main Switchboard**
2. **415V ACDB**
3. **415V Main Lighting DB**
4. **415V Emergency Lighting DB**
5. **415V Air-conditioning & Ventilation DB**
6. **220V DCDB**

### Batteries & Batteries chargers

1. **Battery 220V [AH] (\*)**
   - (*) Bidder to estimate and indicate the capacities of batteries in Ampere-Hours. The estimated capacities should meet the functional requirement.
2. **220V Battery Charger System (\*)**
   - (*) The rating of battery charger shall be decided by the bidder to meet the functional requirement.

### DG set alongwith control panel (250KVA, 440V)

### Fire prevention & extinguishing system

1. **Fire Protection for GIS Halls, control room building, etc. (Portable type fire extinguishers system)**

### Illumination System

1. **Control Room Building, GIS Building etc, Illumination with CFL/Metal Halide Lamp**
2. **Switchyard/ Street Lighting (High Mast Lighting System)**

### Power Cables (XLPE) (\*)

1. **1Cx630 sq.mm**
2. **3.5Cx300 sq.mm**

### Power Cable (PVC) (\*)

1. **1Cx150 sq.mm**
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Qty</th>
<th>Unit Charges (INR)</th>
<th>Total Charges (INR)</th>
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<tr>
<td></td>
<td>i) 3.5Cx70 sq.mm</td>
<td>km</td>
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<td></td>
<td>ii) 3.5Cx35 sq.mm</td>
<td>km</td>
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<td></td>
<td>iv) 4Cx16 sq.mm</td>
<td>km</td>
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<td>v) 4Cx6 sq.mm</td>
<td>km</td>
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<td></td>
<td>vi) 2Cx6 sq.mm</td>
<td>km</td>
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<td></td>
<td>c) <strong>Control Cable (PVC)</strong> (*)</td>
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<tr>
<td></td>
<td>i) 2Cx2.5 sq.mm</td>
<td>km</td>
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<td></td>
<td>ii) 3Cx2.5 sq.mm</td>
<td>km</td>
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<td></td>
<td>iii) 5Cx2.5 sq.mm</td>
<td>km</td>
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<td>iv) 7Cx2.5 sq.mm</td>
<td>km</td>
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<td>v) 10Cx2.5 sq.mm</td>
<td>km</td>
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<td></td>
<td>vi) 14Cx2.5 sq.mm</td>
<td>km</td>
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<td>vii) 19Cx2.5 sq.mm</td>
<td>km</td>
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<td></td>
<td>viii) 27Cx2.5 sq.mm</td>
<td>km</td>
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<td>(* ) The bidder has to estimate and fill the quantities as per his own assessment.</td>
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<tr>
<td>7</td>
<td>Power cable with termination kit/bus duct on 33kV side for connecting 2 nos.</td>
<td>LS</td>
<td>1</td>
<td></td>
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<tr>
<td></td>
<td>Transformers to 33kV GIS</td>
<td></td>
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<tr>
<td>8</td>
<td>Power cable with termination kit/bus duct on 66kV side for connecting 2 nos.</td>
<td>LS</td>
<td>1</td>
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<tr>
<td></td>
<td>Transformers to 66kV GIS</td>
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<tr>
<td>9</td>
<td>Grounding/ Earthing System</td>
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<tr>
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<td>a) 40mm MS rod for Earthmat</td>
<td>LS</td>
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<td></td>
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<tr>
<td></td>
<td>b) Lightning Mast/ GS Shield Wire</td>
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<td>Steel Structure (*)</td>
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<td>a) Lattice Structure</td>
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<td></td>
<td>b) Pipe Structure</td>
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<td>(*) Bidder to estimate and fill the quantities as per his own assessment.</td>
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<td>EOT Crane (*)</td>
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<td>b) 66kV GIS room (*)</td>
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<td>(*) Bidder has to estimate and design EOT crane for erection &amp; maintenance of largest GIS component/ assembly.</td>
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<td>Tertiary loading equipments for one 100 MVA transformer</td>
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<td>a)</td>
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<td>d)</td>
<td>Control &amp; relay protection scheme</td>
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<td>e)</td>
<td>11kV, O/D type PT, ratio (11kV/√3)/(110V/√3)/(110V/√3)</td>
<td>Nos.</td>
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| 13    | 11kV equipments for loading 400kVA auxiliary transformer                          |      |     |                    |                     |
| a)    | 11kV switchgear, 2 panel board (1 incomer and 1 outgoing) along with asscoaited control & relay system, 11kV cables etc. | LS   | 1   |                    |                     |

Sub-Total (F)

SUB-TOTAL I: MAIN EQUIPMENTS [(A) to (F)]
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<td>(a) 160 MVA, 220/66/11kV Transformer with soak pit and sump pit etc. No. 2</td>
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<td>(b) 100 MVA, 220/33/11kV, Transformer with soak pit and sump pit etc. No. 2</td>
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<td>(e) 250 KVA, DG set</td>
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<td>(f) Pump house</td>
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<td>2. RCC in Foundation including earthwork in excavating disposal of surplus earth, PCC, RCC, reinforcement steel, shuttering, testing etc. for structures and equipment (Cu.M) (***)</td>
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<td>3. Cable Trench including all types of crossings (Mtr.)</td>
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<td>5. Site surfacing (gravelling) &amp; Anti weed Treatment (*) (Sq. Mtr.)</td>
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<td>6. Roads (including all crossings), (Mtr.)</td>
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<td>i) 7.0 mtr wide road</td>
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<td>ii) 3.75 mtr wide road</td>
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<td>7. Storm Water drainage &amp; Rainwater Harvesting</td>
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<td>8. Switchyard Fencing along with gates (Mtr.)</td>
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<td>i) Well furnished (including furniture) 220kV, 66kV and 33kV GIS-cum-Control Room Building with conference room AC’s, modern furnitures etc. (as per specification of Section-Civil Works)</td>
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<td>ii) Pump house</td>
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<td>iii) DTL Site Office (Pota Cabin with furniture and AC) and Store (as per specification of Section-Civil Works)</td>
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Note:

# Bidder is required to quote prices in this Schedule for all the individual items / sub-items.
# Bidder is required to quote prices in Indian currency i.e. INR only in line with clause 11.0 Section-ITB Volume I of the bidding documents.
# In case any additional equipment is required, the same should be included in the scope with no additional payment and the offer should be complete and comprehensive.

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Place: __________________________
Printed Name _____________________
Designation ______________________
Signature: ________________________
Common Seal ______________________
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<th>DESCRIPTION OF TEST</th>
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<th>TEST CHARGES</th>
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**Sub-Total (B)**

**C** TYPE TEST OF GIS (As per IEC-62271-200) - 33 KV

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<td></td>
<td></td>
<td></td>
<td></td>
<td>Grand Total (A+B+C+D+E+F+G) for Type Test Charges [Total Schedule 5a]</td>
</tr>
</tbody>
</table>

Date: ____________________________

Place: ____________________________

Signature: ____________________________

Printed Name: ____________________________

Designation: ____________________________

Common Seal: ____________________________
Bidder's Name and Address:

Break-up of Type Test Charges for Type Tests to be conducted in India

<table>
<thead>
<tr>
<th>S.No.</th>
<th>EQUIPMENT</th>
<th>DESCRIPTION OF TEST</th>
<th>Testing Location</th>
<th>TEST CHARGES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Currency (INR)</td>
</tr>
<tr>
<td>1</td>
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</tr>
<tr>
<td>1</td>
<td></td>
<td>Tests to verify the insulation level of the equipment and dielectric tests on auxiliary circuits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Tests to prove the Radio Interference Voltage (RIV) level (if applicable)</td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td></td>
<td>Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Tests to prove the ability of the main and earthing circuits to carry the rated peak and rated short-time withstand current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Tests to verify the making and breaking capacity of the included switching devices</td>
<td></td>
<td></td>
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<tr>
<td>6</td>
<td></td>
<td>Tests to prove the satisfactory operation of the included switching devices</td>
<td></td>
<td></td>
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<tr>
<td>7</td>
<td></td>
<td>Tests to prove the strength of enclosures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Verification of the degree of protection of the enclosure</td>
<td></td>
<td></td>
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<tr>
<td>9</td>
<td></td>
<td>Gas tightness tests</td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td></td>
<td>Electromagnetic compatibility tests (EMC)</td>
<td></td>
<td></td>
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<tr>
<td>11</td>
<td></td>
<td>Additional tests on auxiliary and control circuits</td>
<td></td>
<td></td>
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<tr>
<td>12</td>
<td></td>
<td>Tests on partitions</td>
<td></td>
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<tr>
<td>13</td>
<td></td>
<td>Tests to prove the satisfactory operation at limit temperatures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Tests to prove performance under thermal cycling and gas tightness tests on insulators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Corrosion test on earthing connections (if applicable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>Tests on assess the effects of arcing due to internal fault</td>
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<td></td>
<td><strong>Sub-Total (A)</strong></td>
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</tr>
<tr>
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<td>TYPE TEST OF GIS (As per IEC-62271-203) - 66 KV</td>
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</tr>
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<td>Tests to verify the insulation level of the equipment and dielectric tests on auxiliary circuits</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Tests to prove the Radio Interference Voltage (RIV) level (if applicable)</td>
<td></td>
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<tr>
<td>3</td>
<td></td>
<td>Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit</td>
<td></td>
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<tr>
<td>4</td>
<td></td>
<td>Tests to prove the ability of the main and earthing circuits to carry the rated peak and rated short-time withstand current</td>
<td></td>
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<tr>
<td>S.No.</td>
<td>EQUIPMENT</td>
<td>DESCRIPTION OF TEST</td>
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<td>-------------------------------------------------------------------------------------</td>
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<tr>
<td>1</td>
<td></td>
<td><strong>TYPE TEST OF GIS (As per IEC-62271-200) - 33 KV</strong></td>
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<td>1 Tests to verify the insulation level of the equipment and dielectric tests on</td>
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<td></td>
<td></td>
<td>auxiliary circuits</td>
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<td>2 Tests to prove the Radio Interference Voltage (RIV) level (if applicable)</td>
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<td>3 Tests to prove the temperature rise of any part of the equipment and</td>
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<td></td>
<td>measurement of the resistance of the main circuit</td>
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<td>4 Tests to prove the ability of the main and earthing circuits to carry the rated</td>
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<tr>
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<td></td>
<td>peak and rated short-time withstand current</td>
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<td>5 Tests to verify the making and breaking capacity of the included switching</td>
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<td></td>
<td></td>
<td>devices</td>
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<td>6 Tests to prove the satisfactory operation of the included switching devices</td>
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<td>7 Tests to prove the strength of enclosures</td>
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<td>8 Verification of the degree of protection of the enclosure</td>
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<td></td>
<td>9 Gas tightness tests</td>
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<td>10 Electromagnetic compatibility tests (EMC)</td>
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<td>13 Tests to prove the satisfactory operation at limit temperatures</td>
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<td>14 Tests to prove performance under thermal cycling and gas tightness tests on</td>
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<td><strong>Sub-Total (C)</strong></td>
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**Sub-Total (B)**
<table>
<thead>
<tr>
<th>S.No.</th>
<th>EQUIPMENT</th>
<th>DESCRIPTION OF TEST</th>
<th>Testing Location</th>
<th>TEST CHARGES</th>
</tr>
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<tbody>
<tr>
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<td></td>
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<td></td>
<td>Currency (INR)</td>
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<td></td>
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<tr>
<td>D</td>
<td>TYPE TEST OF Battery Charger</td>
<td>As per latest IS/IEC.</td>
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<tr>
<td></td>
<td></td>
<td>Breakup of type test charges to be provided.</td>
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<tr>
<td></td>
<td></td>
<td><strong>Sub-Total (D)</strong></td>
<td></td>
<td></td>
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<tr>
<td>E</td>
<td>TYPE TEST FOR CABLE AS PER IS/IEC</td>
<td>Breakup of type test charges to be provided.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>i. 1.1 kV Grade</td>
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<tr>
<td></td>
<td></td>
<td>ii. 66kV XLPE Power Cable</td>
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<td></td>
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<td>iii. 33kV XLPE Power Cable</td>
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<td></td>
<td></td>
<td><strong>Sub Total (E)</strong></td>
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<tr>
<td>F</td>
<td>TYPE TEST OF 220/66/11kV, 160MVA POWER Transformer as per latest IS/IEC.</td>
<td>Breakup of type test charges to be provided.</td>
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<td></td>
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<td>G</td>
<td>TYPE TEST OF 220/33/11kV, 100MVA POWER Transformer as per latest IS/IEC.</td>
<td>Breakup of type test charges to be provided.</td>
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<td><strong>Grand Total (A+B+C+D+E+F+G) for Type Test Charges [Total Schedule 5b]</strong></td>
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</tr>
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</table>

Date: ____________________________  Signature: ____________________________

Place: ____________________________  Printed Name: ____________________________

Designation: ____________________________  Common Seal: ____________________________
220/66/33kV GIS SUBSTATION at R K Puram
(Schedule of rates and prices)

As per clause 12.0 Section Project Vol-II, the training shall be provided at no extra cost to employer, the training charges shall be inclusive in the bid price

Bidder’s Name and Address :
Training Charges for Training to be imparted abroad

<table>
<thead>
<tr>
<th>S.No</th>
<th>DESCRIPTION</th>
<th>Country where training is to be imparted</th>
<th>No. of Trainees</th>
<th>Training duration in days</th>
<th>Total Mandays</th>
<th>Training Charges</th>
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<td>Training Charges per Manday</td>
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<td>Currency (INR)</td>
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<td>Total Training Charges</td>
</tr>
<tr>
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<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
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<td>NOT APPLICABLE</td>
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</tbody>
</table>

Total for Training Charges (Total Schedule 6a)

Date :
Signature : ___________________________

Place :
Printed Name _________________________
Designation _________________________
Common Seal _________________________
As per clause 12.0 Section Project Vol-II, the training shall be provided at no extra cost to employer, the training charges shall be inclusive in the bid price.

<table>
<thead>
<tr>
<th>S.No</th>
<th>DESCRIPTION</th>
<th>Country where training is to be imparted</th>
<th>No. of Trainees</th>
<th>Training duration in days</th>
<th>Total Mandays</th>
<th>Training Charges</th>
<th>Total Training Charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td></td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
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</tbody>
</table>

**NOT APPLICABLE**

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Date: ___________________________
Signature: _______________________
Place: ___________________________
Printed Name: ____________________
Designation: _____________________
Common Seal: _____________________
**GRAND SUMMARY OF THE QUOTED BID PRICE.**

<table>
<thead>
<tr>
<th>S.No</th>
<th>DESCRIPTION</th>
<th>Total Price (INR)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>TOTAL SCHEDULE NO. 1</td>
<td>Plant and Equipment (including Mandatory Spare Parts) to be supplied from Abroad, including Type Test Charges for Type Tests to be conducted Abroad.</td>
</tr>
<tr>
<td>2</td>
<td>TOTAL SCHEDULE NO. 2</td>
<td>Plant and Equipment (including Mandatory Spare Parts) to be supplied from within India, including Type Test Charges for Type Tests to be conducted in India</td>
</tr>
<tr>
<td>3</td>
<td>TOTAL SCHEDULE NO. 3</td>
<td>Local Transportation, Insurance and other Incidental Services (including port clearance etc.)</td>
</tr>
<tr>
<td>4</td>
<td>TOTAL SCHEDULE NO. 4</td>
<td>Installation Charges</td>
</tr>
<tr>
<td>5.a</td>
<td>TOTAL SCHEDULE NO. 5a</td>
<td>Break-up of Type Test charges for Type Tests to be conducted abroad. <em>(Total of this schedule is included in Schedule - 1 above)</em></td>
</tr>
<tr>
<td>5.b</td>
<td>TOTAL SCHEDULE NO. 5b</td>
<td>Break-up of Type Test charges for Type Tests to be conducted in India <em>(Total of this Schedule is included in Schedule - 2 above.)</em></td>
</tr>
</tbody>
</table>

GRAND TOTAL 'A' = [1 + 2 + 3 + 4]

# Bidder is required to quote prices in Indian currency i.e. INR only in line with clause 11.0 Section-ITB Volume I of the bidding documents.
II. We declare that the following are our quoted bid price in INR for the entire Scope of work as specified in the specifications and documents.

A. Quoted Bid Price:
   i. In figures _________________________________
   ii. In Words _________________________________

Excluding taxes & duties
(Grand Summary of the quoted Bid Price as in I above.)

B. Applicable Taxes & Duties and other levies, payable additionally, in respect of the transaction between the Owner and the Contractor.
   i. Excise duty
      Estimated at the rate of ………………………………………..
   ii. Custom Duty
      Estimated at the rate of ………………………………………..
   iii. Sales Tax
      Estimated at the rate of ………………………………………..
   iv. Other levies
      a. Octroi : …………………….. estimated @ ______
      b. Entry Tax : …………………….. estimated @ ______
      c. Others (please specify) : …………………….. estimated @ ______
      i. 
      ii. 

v) Total taxes & duties(i+ii+iii+iv) : …………………

C. Applicable Octroi/ Entry Tax, payable additionally, in respect of bought-out finished items which shall be dispatched directly from our sub-vendor's works to Owner's site (Sale in transit)
   i. Octroi : …………………….. estimated @ ______
   ii. Entry Tax : …………………….. estimated @ ______

iii. Total levies [(i) + (ii)] :

D. Total Quoted Bid Price including Taxes and Duties and other levies, if contract is awarded to us
   i.e A+B+C above
   i. In figures: INR
   ii. In Words: INR

Date: ____________________________
Signature: ____________________________
Printed Name ____________________________
Designation ____________________________
Common Seal ____________________________
Bidder's Name and Address:

Details of taxes & duties not included in the Bid Price (in line with clause CC 14.4, CC 14.5 & CC 14.6 Volume I of Bidding Documents) is furnished below:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description of Tax/Duty/Levy etc.</th>
<th>Rate of Tax/Duty/Levy [%]</th>
<th>Amount on which Tax/Duty/Levy Applicable</th>
<th>Tax/Duty/Levy Applicable</th>
<th>Total Tax/Duty/Levy Payable</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Main Equipment</td>
<td>Main Equipment</td>
<td>Mandatory Spares</td>
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<td>Mandatory Spares</td>
<td>Main Equipment</td>
<td>Mandatory Spares</td>
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</tr>
</tbody>
</table>

TOTAL:

DATE: ____________________________  Signature: ____________________________

PLACE: __________________________  Printed Name: __________________________

                  __________________________  Designation: __________________________

                  __________________________  Common Seal: __________________________
220/66/33 kV GIS SUBSTATION R.K.Puram
(MINIMUM VALUE OF BOUGHT-OUT ITEMS FOR THE PURPOSE
OF SALES TAX DECLARATION FORMS)

Bidder's Name and Address:

We indicate the minimum value of bought-out items only for the purpose of Sales-Tax declaration form

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description of bought-out items</th>
<th>Minimum value for the purpose of sales tax declaration form</th>
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</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Date: ________________

Signature: __________________________

Place: __________________________

Printed Name: __________________________

Designation: __________________________

Common Seal: __________________________


<table>
<thead>
<tr>
<th>Item No.</th>
<th>Name &amp; Description of Parts</th>
<th>Name of Original Manufacturer</th>
<th>Part No.</th>
<th>Number of Units in each set</th>
<th>Total No. of Sets to be provided</th>
<th>Unit Price</th>
<th>Total Price</th>
<th>Remarks</th>
</tr>
</thead>
</table>

Date:
Signature: __________________________
Printed Name _______________________
Designation _______________________
Common Seal _______________________