REC TRANSMISSION PROJECTS COMPANY LIMITED

On Behalf of POWER DEVELOPMENT DEPARTMENT J&K GOVERNMENT

As Project Implementation Agency

(Invites bid through e-Tendering mode only)

FOR
TURNKEY CONTRACT PACKAGE OF

"Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15".

Tender Specification No- RECTPCL/PIA/JKPDD/SS -02 dt: 18.11.17

VOL-I

November 2017

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

SECTION – I

INVITATION FOR BIDS (IFB)

INVITATION FOR BIDS (IFB)
FOR

Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15

(SINGLE STAGE TWO ENVELOPE BIDDING)
under e-procurement

DATE OF ISSUANCE OF IFB : **18/11/2017**

SPECIFICATION NO(s) : RECTPCL/PIA/JKPDD/SS -02

FUNDING : DOMESTIC (PMDP Scheme-15)

1.0 This invitation for bids follows the e-procurement notice (Invitation for Bids) for the subject packages which appeared in National and Regional Newspapers on **18/11/2017**. The tender document is available at RECTPCL website (**www.rectpcl.in**), REC website (**www.recindia.com**), e-bidding portal (**http://www.mstcecommerce.com/eprochome/rectpcl**) **and** (**www.eprocure.gov.in).** Interested bidders may view, download the e-Bid document, seek clarification and submit their e-Bid online up to the date and time mentioned in the table at Clause no-5.0 of IFB:

2.0 **Jammu Kashmir Power Development Department**, J&K (hereinafter referred to as 'JKPDD/'Owner') has decided to set up, as an Owner, "**Strengthening of Transmission System in J&K under PMDP Scheme-15".**

2.1 The Project Implementing activities in respect of the aforesaid Project on behalf of JKPDD have been entrusted to REC Transmission Projects Company Limited (RECTPCL) is a wholly owned subsidiary of Rural Electrification Corporation Limited, a Navratna Public Sector Undertaking, and was incorporated on 8 January 2007 as Public Limited Company. RECTPCL's registered office is situated at Core-4, SCOPE Complex, 7, Lodhi Road, New Delhi-110003, India and Corporate office is at (hereinafter referred to as **'RECTPCL'/'EMPLOYER'/'PURCHASER'**) and RECTPCL intends to use funds to be provided by JKPDD for eligible payments under the contracts for the Package as mentioned above. The Ownership of the project shall, however, remain vested with JKPDD.

3.0 RECTPCL, on behalf of JKPDD therefore, invites bids from eligible bidders for the aforesaid packages on Domestic Competitive Bidding basis under secured e-procurement procedure.

This Invitation for Bids extended through media, website or written communication or by any other means, shall not be construed to mean that the

prospective bidders to whom the Invitation for Bids has been extended is deemed to be an eligible bidder. The eligibility of the bidders shall be determined as per the provisions of Bidding Documents.

3.1 **SUBSTATION PORTION OF PACKAGE- SS-02- Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15**

The scope of work shall include design, engineering, manufacture, fabrication, testing at manufacturer's works, delivery, unloading at site, storage, erection, testing and commissioning of substations including associated civil works for the following:

Construction of 220/33 kV Lassipora (GIS) Grid Substation:-

i. 220kV Line Bay (LILO of WMTL D/C)- 4 nos.
ii. 220kV Bus Coupler Bay - 1 nos.
iii. 220kV Transformer Bay - 1 nos.
iv. 220 kV Transfer Bus Bay - 1 nos.
v. Aux.,Neutral & Tertiary buses. - 1 nos.
vi. Single Phase Auto Transformer (53.33 MVA, 220/33kV) - 4 nos
vii. 33kV Line Bay - 6 nos.
viii. 33kV Bus Coupler Bay - 1 nos.
ix. 33kV Transformer Bay - 1 nos.
x. 33kV Station Auxiliary Bay - 1 nos.
xi. Auxiliary Transformer (Platform mounted) - 1 job
xii. Common Miscellaneous works of 220/33kV Grid Station
xiii. Common Civil works and Air conditioning System of 220/33kV Grid Station

The above scope of work is indicative and the detailed scope of work is given in the Technical Specification (Volume-II) of the Bidding Documents.

3.2 The completion period for the subject Substation Package shall be the **24 Months.**

3.3 Bidding will be conducted through the **Domestic Competitive Bidding** procedures as per the provisions of ITB and the contract shall be executed as per the provisions of the Contract. The respective rights of the Employer and the Bidder/Contractor shall be governed by the Bidding Documents/Contract signed between the Employer and the Contractor for the package.

4.0 The detailed Qualification Requirements (QR) are given in the Section-III, Vol-I of Bidding Document.

5.0 The tender document is available at RECTPCL website (**www.rectpcl.in**), REC website (**www.recindia.com**), e-tendering portal

(http://www.mstcecommerce.com/eprochome/rectpcl) **and** (**www.eprocure.gov.in).** However, in case of any contradiction the tender documents at e-tendering portal http://www.mstcecommerce.com/eprochome/rectpcl shall prevail. Interested bidders may view, download the e-Bid document, commence preparation of bids to gain time, seek clarification and submit their e-Bid online up to the date and time mentioned in the table below:

Important Dates	
Date of Release of Bid Document	**18/11/2017**
Last date of queries/ seeking Clarification on Tender Document	**24/11/2017, up to 17:00 Hrs. (IST)**
Pre bid Meeting	**28/11/2017, at 11:00 Hrs. (IST)**
Start of Registration on MSTC portal	**18/11/2017, 10:00 Hrs. onwards**
Starting Date & Time of Bid submission	**12/11/2017, 10:00 Hrs. onwards**
Close of Registration on MSTC portal	**19/12/2017, at 15:00 Hrs. (IST)**
Last Date & Time of submission of Bid	**19/12/2017, till 15:00 Hrs. (IST)**
Date of opening of Technical bid	**19/12/2017, at 16:00 Hrs. (IST)**
Tender Document	The details can be downloaded free of cost from the websites www.rectpcl.in (or) www.recindia.com (or) http://www.mstcecommerce.com/eprochome/rectpcl (or) www.eprocure.gov.in
Pre Bid Meeting Address	REC Transmission Projects Company Limited ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Tel: 011 – 47964705, Telefax : 011-47964747
Cost of Tender	Rs 25000/- (Rs Twenty Five Thousand Only)
EMD #	**Rs. 50,00,000.00 (Rs. Fifty Lakhs only)**
Address for Bid submission/EMD/PBG	**Shri. Bhupender Gupta,** Addl. CEO REC Transmission Projects Company Limited ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Tel: 011 – 47964705, Fax : 011-47964704 Email- bgupta@recl.nic.in
Contact Person	**Shri. Vivek Aggarwal, Chief Manager** REC Transmission Projects Company Limited

	ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Tel: 8800444788 Email- vivekagarwal.rec@gmail.com

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

6.0 Interested bidders have to necessarily register themselves on the e-bidding portal of MSTC and are strongly recommended to go through the E-Tendering methodology & Tips for successful online Bid submission in the MSTC's e-procurement platform i.e **https://www.mstcecommerce.com/eprochome/rectpcl** provided in the Section-IIA (Annexure to ITB) of the Bidding Document.

Resolution to all general queries and system setting is given in the bidders guide. In case of any other issue please contact:

e-Bidding portal: http://www.mstcecommerce.com/eprochome/rectpcl

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

Even though the MSTC support team will be available from 0930 hrs to 1800 hrs on all working days, but in case Bidders are unable to reach MSTC then communications can also be done through e-mail or sms and MSTC team will be respond to the queries within 24 hrs.

The said registration shall be on chargeable basis and bidders are requested to refer Section-IIA (Annexure-A to ITB) MSTC Registration for details.

Bidders are advised to deposit the transaction fee atleast two days before the last date of submission and to submit their bids least one day before the last day of submission to avoid any last minute issues

They may obtain further information regarding this IFB from the office of Additional Chief Executive Officer, RECTPCL at the address given at para 12.0 below from 15:00 hours to 17:00 hours on all working days.

7.0 For proper uploading of the bids on the portal namely **http://www.mstcecommerce.com/eprochome/rectpcl** *(hereinafter*

referred to as the 'portal'), it shall be the sole responsibility of the bidders to apprise themselves adequately regarding all the relevant procedures and provisions as detailed at the portal as well as by contacting from M/s MSTC Limited, New Delhi directly, as and when required, for which contact details are mentioned above. The Employer in no case shall be responsible for any issues related to timely or properly uploading/submission of the bid in accordance with the relevant provisions of Section II – ITB of the Bidding Documents.

7.1 A pre-bid meeting will be held at the address mentioned in on **28.11.2017** at 11:00 Hrs to clarify the bidders various issues raised in accordance with clause 6.4 of ITB.

8.0 A Single Stage Two Envelope Bidding Procedure will be adopted and will proceed as detailed in the Bidding Documents.

8.1 Soft Copy Part of the Bids must be uploaded under Single Stage Two Envelope Bidding Procedure on the portal at or before 15:00 hours on **19.12.2017**. The e-Procurement system would not allow any late submission of bids through the portal after due date & time as specified.

Hard Copy Part of the Bids must be submitted under Single Stage Two Envelope Bidding Procedure at the address given in Table at Clause no-5.0 of IFB at or before 15:00 hours on **19.12.2017**. In case Hard copy part of the bid is not received by the Employer till the deadline for submission of the same prescribed by the Employer, but the bidder has uploaded the soft copy part of the bid, the bid will be considered as late bid. Such bids will be rejected during preliminary examination.

First Envelope i.e. Techno -Commercial Part shall be opened on **19.12.2017** in the presence of the bidders' representatives who choose to attend in person at the address below at **16:00 hours** or may be viewed by the bidders by logging in to the portal. Second Envelope i.e. Price Part of those bidders who qualify techno-commercially, shall be opened in the presence of the bidders' representatives who choose to attend at the time and date and at the address given in the intimation for opening of Second Envelope in accordance with Clause 25 of ITB or may be viewed by the bidders by logging in to the portal.

All bids must be accompanied by a bid security of **Rs. 50,00,000/- (Rupees Fifty lakhs for Substation Package SS -02**

Bid Security, Integrity Pact and Safety Pact must be submitted in physical form at the address given at para 12.0 below.

9.0 The Employer reserves the right to conduct e-Reverse Auction (e-RA) in accordance with clause 29.0 of ITB.

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

11.0 The Integrity Pact Program (IPP) of RECTPCL will be applicable for the Package(s). Shri Jatin Kumar Nayak , shall be the Independent External Monitor for the **Substation Packages –SS02 Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15** respectively. Correspondence, if any, to the IEM be addressed to the following:

Shri Jatin Kumar Nayak
C/o Office of the Chief Financial Officer,
REC Transmission Projects Company Limited,
ECE House, 3rd Floor, Annexe – II,
28 A, K G MARG, NEW DELHI – 110 001
Tel: 011 – 47964706, Fax : 011-47964704
Email- nayakjatin@rectpcl.in

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

(By Post/In Person)
Additional Chief Executive Officer,
REC Transmission Projects Company Limited
ECE House, 3rd Floor, Annexe – II,
28 A, K G MARG, NEW DELHI – 110 001
Tel: 011 – 47964705, Fax : 011-47964704
Email- bgupta@recl.nic.in

For more information on RECTPCL, visit our site at: http://www.rectpcl.in
For more information on the portal, visit on site of
M/s MSTC Limited, New Delhi at:
http://www.mstcecommerce.com/eprochome/rectpcl

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

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SECTION – II
INSTRUCTION TO BIDDERS (ITB)

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INSTRUCTION TO BIDDERS (ITB)

Preamble

This section (Section–II) of the Bidding Documents provides the information necessary for bidders to prepare responsive bids, in accordance with the requirements of the Employer. It also provides information on bid submission and uploading the bid on portal (**http://www.mstcecommerce.com/eprochome/rectpcl)** on line bid opening, evaluation and on contract award. This Section (Section II) contains provisions that are to be used unchanged

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

The respective rights of the Employer and Bidders/Contractors shall be governed by the Bidding Documents/Contracts signed between the Employer and the Contractor for the respective package(s).

A. Introduction

1. Source of Funds

1.1 **Jammu Kashmir Power Development Department**, J&K (hereinafter referred to as 'JKPDD/'Owner') intends to use domestic funding under Prime Minster Development Project (PMDP-15) for this Project.

All eligible payments under the contract for the package for which this Invitation for Bids is issued shall be made by the Employer.

2. Eligible Bidders

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

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

(a) they have a controlling partner in common; or

(b) they receive or have received any direct or indirect subsidy from any of them; or

(c) they have the same legal representative for purposes of this bid; or

(d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or

(e) a Bidder submits more than one bid in this bidding process, either individually [including bid submitted as an authorised representative on behalf of one or more manufacturer(s) or through Licensee – Licensor route, wherever permitted as per the provision of Qualification Requirement for the Bidders in Section-III, Volume-I or as a partner in a joint venture, except for alternative offers if permitted under ITB Clause 9.3. This will result in the disqualification of all such bids. However, this does not limit the participation of a Bidder as a subcontractor in another bid, or of a firm as a subcontractor in more than one bid; or

(f) a Bidder or any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the Plant and Installation Services that are the subject of the bid; or

(g) A Bidder or any of its affiliates has been hired (or is proposed to be hired) by the Employer as Project Manager for the contract.

2.3 The Bidder, directly or indirectly shall not be a dependent agency of the Employer.

3. Eligible Plant, Equipment, and Services

3.1 For the purposes of these Bidding Documents, the words "facilities," "plant and equipment," "installation services," etc., shall be construed in accordance with the respective definitions given to them in the General Conditions of Contract.

3.2 All plant and equipment to be supplied and installed and services carried out under the contract shall have their origin in any country barring those countries against whom sanction for conducting business is imposed by Government of India and barring those firms with whom business is banned by the Employer.

3.3 For purposes of this clause, "origin" means the place where the plant and equipment or component parts thereof are mined, grown, or produced. Plant and equipment are produced when, through manufacturing, processing or substantial and major assembling of components, a commercially recognized product results that is substantially different in basic characteristics or in purpose or utility from its components.

3.4 The origin of the plant, equipment, and services is distinct from the nationality of the Bidder.

4. Cost of Bidding

4.1 The Bidder shall bear all costs associated with the preparation and submission of its bid including post-bid discussions, technical and other presentations etc., and the Employer will in no case be responsible or liable for these costs, regardless of the conduct or outcome of the bidding process.

4.2 The bidder has to ensure his registration with M/s MSTC Limited, New Delhi on their portal **http://www.mstcecommerce.com/eprochome/rectpcl.** The said registration shall be on chargeable basis and the details are provided in Annexure-A to ITB.

B. The Bidding Documents

5. Content of Bidding Documents

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

VOLUME – I: Conditions of Contract
Section I Invitation for Bids (IFB)
Section II Instructions to Bidders (ITB)
Section III Qualification Requirement
Section IV General Conditions of Contract (GCC)
Section V Special Conditions of Contract (SCC)
Section VI Model Rule for Health and sanitary Arrangement
Section VII Contractor's Labour Regulation
Section VIII Safety Regulation
Section IX Sample Format and Procedures

1. Bid Form & price Schedule
1.1 Bid Form
1.2 Price Schedule
2. Bid Security Form
3. Form of Notification by the Employer to the Bank
4. Form of Contract Agreement
4.1 Appendix-1: Procedures of Payment
4.2 Appendix-2: Price Adjustment
4.3 Appendix-3: Insurance Requirements
4.4 Appendix-4: Time Schedule
4.5 Appendix-5: List of Approved Subcontractors
4.6 Appendix-6: List of Document for Approval or Review
4.7 Appendix-7: Guarantees, Liquidated Damages for Non-Performance
4.8 Integrity Pact
4.9 Safety Pact
5. Performance Security Form
6. Form of Taking Over Certificate
7. Form of Indemnity Bond to be executed by the Contractor for the Equipment handed over in one lot by Employer for performance of its contract.
8. Form of Indemnity Bond to be executed by the Contractor for the Equipment handed over in installments by Employer for performance of its contract.
9. Form of Authorisation Letter
10. Form of Trust Receipt for Plant, Equipment and Materials received
11. Form of Extension of Bank Guarantee
12. Form of Power of Attorney for Joint Venture
13. Form of Joint Venture Agreement
14. Format for Evidence of Access to or Availability of Credit/ Facilities
15. Form of Operational Acceptance
16. Form of Safety Plan to be submitted by the Contractor within sixty days of award of contract
17. Form for Information to be furnished by the Contractor in respect of the Procurement made from MSE Vendors

Volume-II: Technical Specification

Volume-III: Bid Form, Price Schedules & Technical Data Sheets

5.2 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.

5.3 Scope of Work is given in Volume-II of Bidding Documents titled "Technical Specifications".

Utmost care has been taken by the Employer in formulating the programmed Attachments and Price Schedules. Bidders are expected to thoroughly verify with trial run at their end and notify to the Employer Arithmetical, Logical, Formatting or any such error, if found in the same for suitable action. Irrespective of corrections made in this regard through amendment(s), if any, rectification of error for evaluation shall be carried out in accordance with stipulated provisions of Bidding Documents.

5.4 All the Bidders except those exempted pursuant to ITB Sub-Clause-5.5 shall submit along with the hard copy part of bid a non-refundable fee as mentioned below towards the cost of Bidding Documents in the form of demand draft in favour of REC Transmission Projects Company Limited, payable at New Delhi.

The non-refundable fee towards the cost of Bidding Documents shall be INR 25,000/-

Any bid not accompanied by an acceptable Demand Draft towards the cost of Bidding Documents, except as exempted in ITB Sub- Clause 5.5 below, shall be rejected by the Employer as being nonresponsive.

5.5 Micro and Small Enterprises (MSEs) registered with National Small Industries Corporation (NSIC) or with any other designated Authority of GoI under the Public Procurement Policy for MSEs are exempted from submission of fee towards the cost of Bidding Documents as per the Provisions of the Public Procurement Policy for Micro and Small Enterprises (MSEs) order 2012. This shall be subject to production of documentary evidence with regard to registration with authorities mentioned above.

6. Clarification of Bidding Documents; and Pre-Bid Meeting

6.1 A prospective Bidder requiring any clarification of the Bidding Documents may notify the Employer and may also seek clarification in writing or by cable (hereinafter, the term cable is deemed to include Electronic Data Interchange (EDI) or telefax) at the Employer's mailing address indicated in the **IFB**. Similarly, if a Bidder feels that any important provision in the documents, such as those listed in ITB Sub-Clause 22.3.1, will be unacceptable, such an issue should be raised as above. The Employer will respond through the portal **http://www.mstcecommerce.com/eprochome/rectpcl** to any request for clarification or modification of the Bidding Documents that it receives no later than Thirty (30) days prior to the original deadline for submission of bids prescribed by the Employer. The Employer shall not be obliged to respond to any request for clarification received later than the above period. Further, the mere request for clarification from the Bidders shall not be a ground for seeking extension in the deadline for submission of bids. Employer's response (including an explanation of the query but not identification of its source) will be uploaded on portal **http://www.mstcecommerce.com/eprochome/rectpcl** where all the bidders can see clarification/reply to query.

6.2 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 and cost 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.

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

6.4 The Bidder's designated representative(s) is/are invited to attend a pre-bid meeting, which, if convened, will take place at the venue and time stipulated in the **IFB**. The purpose of the meeting will be to clarify any issues regarding the e-procurement method, the Bidding Documents in general and the Technical Specifications in particular. The Bidder is requested, as far as possible, to submit any question in writing, to reach the Employer not later than one week before the meeting. It may not be practicable at the meeting to answer questions received late, but questions and responses will be transmitted as indicated hereafter. Minutes of the meeting, including the text of the questions raised (without identifying name of the bidders) and the responses given, together with any responses prepared after the meeting, will be transmitted without delay through the e-bidding portal only. Any modification of the Bidding Documents listed in ITB Sub-Clause 5.1, which may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to ITB Clause 7 and not through the minutes of the pre-bid meeting.

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

7. Amendment of Bidding Documents

7.1 At any time prior to the deadline for submission of bids, the Employer may, for any reason, whether at its own initiative, or in response to a clarification requested by a prospective Bidder, amend the Bidding Documents.

7.2 The amendment will be notified only through the portal **http://www.mstcecommerce.com/eprochome/rectpcl**. The amendments to the Bidding Documents will be binding on the bidders and the notification of the amendment through portal shall be deemed to be construed that such amendment(s) to the Bidding Documents have been taken into account by the Bidder in its bid.

7.3 In order to afford reasonable time to the prospective Bidders 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 through portal **http://www.mstcecommerce.com/eprochome/rectpcl** where all prospective bidders may see the extended deadline.

In case of extension of deadline for the submission of bids by the Employer for reasons inter-alia including the above, prospective bidders can download the Bidding Documents from the portal **http://www.mstcecommerce.com/eprochome/rectpcl**, as per the provisions available therein.

C. Preparation of Bids

8. Language of Bid

8.1 The bid prepared by the Bidder and all correspondence and documents exchanged by the Bidder and the Employer related to the bid 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 English translation of its pertinent passages, in which case, for purposes of interpretation of the bid, the English translation shall govern.

9. Documents Comprising the Bid

I. Hard Copy Part

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

(i) DD towards Bidding Document fee of the amount as specified in the in accordance with clause 5.4 of ITB or documentary evidence in support of exemption of Bidding Document fee as per ITB 5.5

(ii) Bid Security (in Original) or documentary evidence in support of exemption of Bid Security, in separate envelope in accordance with clause 13 of ITB, Section-II

(iii) Integrity Pact (in Original) in accordance with clause 9.3 (o) of ITB, Section-II in separate envelope

(iv) Power of Attorney as per Clause 9.3 (b).

(v) In case of Bid from Joint Venture, the Joint Venture Agreement & Power of Attorney of Joint Venture Agreement, both in original

(vi) Safety Pact (in Original) in accordance with clause 9.3 (s) of ITB, Section-II in separate envelope

(vii) Bidders shall also submit Joint Deed of Undertaking by the collaborator along with the bidder/manufacturer, duly signed and stamped on each page in original, if applicable as per Qualification Requirement for the Bidders in Section-III and

(viii) Any other document further specified in the Bidding Document duly signed and stamped on each page.

Bidder shall note that no document is required to be submitted as part of Second envelope in Hard Copy.

II. Soft Copy Part

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

(a) <u>As part of First Envelope</u>

(i) Programmed file -Attachments (Attachment to Bid Form including attachment to QR) in MS Excel format & its revision covering various attachments, Integrity Pact and bid form for first envelope.

(ii) Scanned copies of all the documents mentioned at 15.4 of ITB.

(b) As part of Second Envelope

(i) The Electronic Form/Template of the bid for Second Envelope (Price - Part) covering details regarding summary of price details.

(ii) Price Schedules & Bid Forms in MS excel format & its revision covering various price schedules and bid forms for Second Envelope.

9.1 The bid shall be submitted by the Bidder under "Single Stage – Two Envelope" procedure of bidding. Under this procedure, the bid submitted by the Bidder in two envelopes - First Envelope (also referred to as Techno - Commercial Part) and Second Envelope (also referred to as Price Part) shall comprise of the following documents:

First Envelope:

(a) Bid Form (First Envelope) duly completed and signed by the Bidder, together with all Attachments & Technical Data Sheets (available in Volume-III) as uploaded on the portal **http://www.mstcecommerce.com/eprochome/rectpcl** and identified in ITB Sub-Clause 9.3 below.

(b) Hard copy of the following documents submitted at the address mentioned at 1.1 above:

(i) DD towards Bidding Document fee of the amount as specified in the in accordance with clause 5.4 of ITB or documentary evidence in support of exemption of Bidding Document fee as per ITB 5.5

(ii) Bid Security (in Original) or documentary evidence in support of exemption of Bid Security, in separate envelope in accordance with clause 13 of ITB, Section-II

(iii) Integrity Pact (in Original) in accordance with clause 9.3 (o) of ITB, Section-II in separate envelope;

(iv) Power of Attorney as per Clause 9.3 (b);

(v) In case of Bid from Joint Venture, the Joint Venture Agreement & Power of Attorney of Joint Venture Agreement

(vi) Safety Pact (in Original) in accordance with clause 9.3 (s) of ITB, Section-II in separate envelope

(vii) Any other document further specified in the Bidding Document duly signed and stamped on each page.

Second Envelope:

(a) Bid Form (Second Envelope) together with Price Schedules (available in Volume-III), duly completed as uploaded on the portal **http://www.mstcecommerce.com/eprochome/rectpcl** .

9.2 Alternative bids shall not be permitted.

9.3 Bidder is required to provide complete and precise information in the bid along with supporting documentary evidences, as applicable. The bidder should attach separate sheet(s) in case space provided is not sufficient. RECTPCL will consider the bid solely on the basis of information/details/data/documentary evidences etc. provided by the bidder in the bid only without seeking further clarifications from the bidder in normal circumstances.

Incomplete, partially complete, not clearly filled bid giving incorrect information is liable to be rejected without any consideration.

Where the answer is a statement of fact it must be accurate and supported by documentary evidence wherever required. It is the bidder's responsibility to respond with such clarity that will ensure RECTPCL not to mis-interpret the bid.

Bidder shall submit soft copy of following documents by uploading on the portal **http://www.mstcecommerce.com/eprochome/rectpcl** and Hard copy of documents wherever stipulated in the manner specified in ITB Clause 9.1 above along with its Techno - Commercial Part (First Envelope):

(a) Attachment 1: Bid Security (if required) or documentary evidence in support of exemption of Bid Security *(submission of Hard Copy in „Original for Bid Security and in Copy for documentary proof in support of exemption)*

A bid security or documentary evidence in support of exemption of Bid Security, in sealed separate envelope shall be furnished in accordance with ITB Clause 13 & ITB Clause 16.

Bidder shall submit the hard copy of the Bid Security or documentary evidence in support of exemption of Bid Security in original.

(b) Attachment 2: Power of Attorney *(submission of Hard copy in "Original and uploading of Scanned Copy)*

A power of attorney, duly notarized, indicating that the person(s) signing the bid has(ve) the authority to sign the bid and thus that the bid is binding upon the Bidder during full period of its validity, in accordance with ITB Clause 14.

Scanned copy of above documents shall be uploaded. (refer para 15.4 below)

(c) Attachment 3: Bidders Eligibility and Qualifications *(Uploading of Scanned Copies of documentary evidence in support of Bidders qualification. In case of Joint Venture bid, submission of Hard Copy in "Original of the JV Agreement and POA for JV")*

In the absence of prequalification, documentary evidence establishing that the Bidder is eligible to bid in accordance with ITB Clause 2 and is qualified to perform the contract in accordance with **Qualification Requirement Sec-III, Vol-I**, if its bid is accepted.

The documentary evidence of the Bidders eligibility to bid shall establish to the Employers satisfaction that the Bidder, at the time of submission of its bid, is eligible as

defined in ITB Clause 2.

The documentary evidence of the Bidders qualifications to perform the contract, if its bid is accepted, shall establish to the Employers satisfaction that the Bidder has the financial, technical, production, procurement, shipping, installation and other capabilities necessary to perform the contract, and, in particular, meets the experience and other criteria outlined in the Qualification Requirement for the Bidders in Sec-III, Vol-I and shall also include:

The documentary evidence defining i) the constitution or legal status; (ii) The principal place of business; (iii) The place of incorporation (for bidders who are corporations); or the place of registration and the nationality of the Owners (for applicants who are partnerships or individually-owned firms)

Declaration for anticipated change in legal structure/ ownership, if any.

The complete annual reports together with Audited statement of accounts of the company for last five years of its own (separate) immediately preceding the date of submission of bid. The Bidder shall also furnish documentary evidence/ declaration regarding Financial re-structuring of the company, if any.

Scanned copy of above documents shall be uploaded (refer para 15.4 below).

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

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

Unless otherwise mentioned in **bidding document**, bids submitted by a joint venture of two or more firms as partners, if allowed as per stipulated Qualification Requirements in SEC-III, Vol-I, shall comply with the following requirements:

(i) The bid shall include all the information required for Attachment 3 as described above for each joint venture partner.

(ii) The bid shall be signed so as to be legally binding on all partners.

(iii) One of the partners responsible for performing a key component of the contract shall be designated as leader; this authorization shall be evidenced by submitting with the bid a power of attorney signed by legally authorized signatories as per Form-12 of Section-IX, Vol-I.

(iv) The leader shall be authorized to incur liabilities and receive instructions for and on behalf of any and all partners of the joint venture, and the entire execution of the contract, including payment, shall be done exclusively with the

leader, provided otherwise requested by the joint venture and agreed between the Employer and the leader.

(v) All partners of the joint venture shall be liable jointly and severally for the execution of the contract in accordance with the contract terms.

(vi) A copy of the agreement entered into by the joint venture partners shall be submitted with the bid as per Form-13 of Section-IX, Vol-I, including interalia delineation of responsibilities and obligations of each partners appended thereto, notwithstanding the joint and several liability.

(vii) The joint venture agreement should indicate precisely the responsibility of all members of JV in respect of planning, design, manufacturing, supply, installation, commissioning and training. All members of JV should have active participation in execution during the currency of the contract. This should not be varied/modified subsequently without prior approval of the Employer; and

In order for a joint venture to qualify, each of its partners or combination of partners must meet the minimum criteria listed in the Qualification Requirement for the Bidder as per Sec –III, Vol-I for an individual Bidder for the component of the contract they are designated to perform. Failure to comply with this requirement will result in rejection of the joint venture bid.

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

In the case of a Bidder who offers to supply and/or install plant and equipment under the contract that the Bidder did not manufacture or otherwise produce and/or install, the Bidder shall (i) have the financial and other capabilities necessary to perform the contract; (ii) have been duly authorized by the manufacturer or producer of the related plant and equipment or component as per proforma in attachment 8 to supply and/or install that item in the Employers country; and (iii) be responsible for ensuring that the manufacturer or producer complies with the requirements of ITB Sub-Clause 3.2 and meets the minimum criteria listed for an individual Bidder for that item.

(d) Attachment 4: Eligibility and Conformity of the Facilities *(uploading of Scanned Copy)*

Documentary evidence established in accordance with ITB Clause 3 that the facilities offered by the Bidder in its bid or in any alternative bid (if permitted pursuant to ITB Sub-Clause 9.2) 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 a period of Fifteen (15) years following completion of facilities in accordance

with provisions of contract; and

(iii) a commentary on the Employers 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 Employers satisfaction that the substitutions are substantially equivalent or superior to the standards designated in the Technical Specifications.

(iv) All details regarding after sale service support offered.

(v) All details regarding proposed training for Employers personnel.

(vi) Detailed answers to all the Questions in the Questionnaire, if prescribed in the Bidding Document.

(vii) Details establishing the responsiveness of the offer in accordance with Technical Specification, Volume-II.

(e) Attachment 5: Subcontractors Proposed by the Bidder

The Bidder shall include in its bid details of all major items of supply or services **i.e. items, whose price is more than 10% of the Bid Price**, that it proposes to purchase or sublet, and shall give details of the name and nationality of the proposed Subcontractor, including vendors, for each of those items. Bidders are free to list more than one Subcontractor against each item of the facilities. Their participation should be confirmed with a letter of intent between the parties, as needed, in Attachment 8. Quoted rates and prices will be deemed to apply to whichever Subcontractor is appointed, and no adjustment of the rates and prices will be permitted.

(f) Attachment 5A: (Items, Components, Raw Material, Services proposed to be sourced from Micro and Small Enterprises)

The Employer encourages the Contractor to source items, components, raw material, services from Micro and Small Enterprises for development of the Micro and Small Enterprises

The bidder shall furnish the details of the items, components, raw material, services which they propose to buy/avail from Micro and Small Enterprises for the purpose of completion of works.

(g) Attachment 6: Deviations

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

Bidders attention is also drawn to the provisions of ITB Sub- Clause 22.3.1.

(h) Attachment 7: Alternative Bids Not Applicable

(i) Attachment 8: Manufacturers Authorisation Form

Scanned copy of above documents shall be uploaded (refer para 15.4 below)

(j) Attachment 9: Work Completion Schedule.

Attach Bar Chart for Work Completion Schedule

Scanned copy of above documents shall be uploaded (refer para 15.4 below)

(k) Attachment 10: Guarantee Declaration.

Scanned copy of above documents shall be uploaded (refer para 15.4 below)

(l) Attachment 11: Not Applicable

(m) Attachment 12: Price Adjustment Data

(n) Attachment 13: Declaration regarding Social Accountability

(o) Attachment 14: Integrity Pact *(submission of Hard Copy in Original)*

The Bidder shall complete the accompanying Integrity Pact, which shall be applicable for bidding as well as contract execution, duly signed on each page by the person signing the bid and shall be returned by the Bidder in two (2) originals alongwith the Techno - Commercial Part in a separate envelope, duly superscripted with Integrity Pact. The Bidder shall submit the Integrity Pact on a non-judicial stamp paper of Rs. 100/-.

The required Integrity Pact is automatically generated as Attachment 14-Integrity Pact in the file Attachment (in Excel format). Bidders shall take print out in two copies discussed above and as explained in the Attachment 14-Integrity Pact.

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

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

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

Scanned copy of Sample Cheque (Cancelled) shall also be uploaded (refer para 15.4 below).

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

(q) Attachment 16:Additional Information *(uploading of Scanned Copy, as applicable)*

i. Certificate from their Banker(s) (as per prescribed formats in Form 14, Section-IX, Vol-I: Sample Forms and Procedures) indicating various fund based/non fund based limits sanctioned to the Bidder and the extent of utilization as on date. Such certificate should have been issued not earlier than three months prior to the date of bid opening. Wherever necessary the Employer may make queries with the Bidders Bankers.

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

iii. Details of Provident Fund Code Number of the Bidder.

iv. Any other information which the Bidder intends to furnish

v. Bidder shall also furnish information/documentation in support that the Bidder have adequate sub-station design infrastructure and erection facilities and capacity and procedures including quality control.

vi. The Bidder shall furnish the CV and experience details of a project manager with 15 years' experience in executing such contract of comparable nature including not less than five years as manager.

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

Scanned copy of above documents shall be uploaded (refer para 15.4 below).

(r) Attachment 17: Declaration for tax exemptions, reductions, allowances or benefits

(s) Attachment 18: Safety Pact (submission of Hard Copy in „Original")

The Bidder shall complete the accompanying Safety Pact, which shall be applicable for bidding as well as contract execution, duly signed on each page by the person signing the bid and shall be submitted by the Bidder in two (2) originals along with the Techno - Commercial Part in a separate envelope, duly superscripted with Safety Pact. The Bidder shall submit the Safety Pact on a non-judicial stamp paper of Rs. 100/-.

Bidders shall take print out in two copies discussed above and as explained in the Attachment 18- Safety Pact.

If the Bidder is a partnership firm or a consortium, the Safety Pact shall be signed by all the partners or consortium members.

Bidders failure to submit the Safety Pact duly signed in Original along with the Bid or subsequently pursuant to ITB Sub-Clause 21.1 shall lead to outright rejection of the Bid.

(t) Attachment 19: Declaration

(u) Attachment – 20: Affidavit (submission of Hard Copy in 'Original')

signed and stamped with company seal by a full time Director/ CEO/ Chairman-cum-Managing Director and attested/ notarized by a Magistrate/ Notary for correctness of all the information/details/data/documentary evidences etc. as submitted by the bidder are correct.

10. Bid Form and Price Schedules

10.1 The Bidder shall complete the Bid Form(s) and the appropriate Price Schedules furnished in the Bidding Documents as indicated therein, following the requirements of ITB Clauses 11 and 12.

11. Bid Prices

11.1 Unless otherwise specified in the Technical Specifications, bidders shall quote for the entire facilities on a "single responsibility" basis such that the total bid price covers all the Contractors 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 Contractors responsibilities for testing, pre-commissioning and commissioning of the facilities and, where so required by the Bidding Documents, the acquisition of all permits, approvals and licenses, etc.; the operation, maintenance and training services and such other items and services as may be specified in the Bidding Documents, all in accordance with the requirements of the General Conditions of Contract. Items against which no price is entered by
the Bidder will not be paid for by the Employer when executed and shall be deemed to be covered by the prices for other items.

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

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

Separate numbered Schedules shall be used for each of the following elements. The total amount from each Schedule 1 to 5 shall be summarized in a grand summary of Price Proposal (Schedule 6) giving the total bid price(s) to be entered in the Bid Form.

Schedule 1	Plant and Equipment (including mandatory Spares) to be supplied including Type Test Charges
Schedule 2	Local Transportation, Insurance, loading and unloading
Schedule 3	Installation Services
Schedule 4	Charges for Training to be imparted
Schedule 5	Taxes and Duties not included in Schedule 1 to 4
Schedule 6	Grand Summary (Schedule Nos. 1 to 5)
Schedule 7	Break-up of Type Test Charges

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

11.3.1 The bid price for the items for which quantities have been estimated by the Employer shall be governed based on the unit price quoted by the bidder. In case additional quantities, over and above the quantities indicated in the respective Price Schedules, are required for successful completion of the Scope of Work by Employer, the Bidder shall execute additional quantities of these items for which payment based on the unit prices quoted by the bidder shall be made.

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

11.3.3 It shall be the responsibility of the bidders to pay all statutory taxes, duties and levies(including GST) and interest, if applicable on account of additional revised invoice issued for actual material supplied to the concerned authorities for such return/supply of surplus material, which would otherwise have been, lawfully payable. The bidders shall submit an indemnity bond to keep Employer harmless from any liability, before release of such material to the bidder by Employer.

11.3.4 Set/Lot/Lumpsum shall be governed as per the requirement of the corresponding item description read in conjunction with relevant provisions of Technical Specifications.

11.4 In the schedules, Bidder shall give the required details and a breakdown of their price **considering and taking into account the Input Tax Credit (ITC) as may be available under the Goods and Services Tax (GST) Laws and Regulations**, in the schedules as follows:

a) Plant and equipment including mandatory spares, shall be quoted on an EXW (ex-factory, ex-works, ex-warehouse or off-the-self, as applicable) basis and Type Test Charges (including the Type Test to be conducted abroad in case of an Indian Bidder), shall also be quoted in Schedule 1.

Further, in case of imported Equipments/items offered as 'Off the Shelf' or dispatched directly from the Indian Port of disembarkation, the price of such Equipments/items shall be inclusive of all cost **as well as any duties paid/payable in relation to import of such goods (viz., customs duties, GST & levies etc.) considering and taking into account the ITC as may be available under the applicable laws including GST**.

The price quoted in respect of all items in the above schedule shall be excluding GST applicable on transaction between the Employer and the Contractor.

b) Local/inland transportation, **In-transit** insurance, **loading and unloading** of the Plant and Equipment including mandatory spares to be supplied shall be quoted separately in Schedule 2, **as composite supply of services, with local/inland transportation being the Principal Supply**. **It is the Employer's understanding that as per extant provisions, on the charges for supply of services related to Inland transportation, In-transit insurance, loading and unloading by the Bidder to the Employer, GST is not payable. The Bidder is, however, advised to check the position from their own sources. If payable, the same shall be to the Bidder's account and Employer shall not reimburse any GST on this account.**

c) Installation Charges shall be quoted separately (Schedule 3) and shall include rates and prices for all labour, Contractor's equipment, temporary works, materials, consumables and all matters and things of whatsoever nature, provision of operations and maintenance manuals, etc. wherever identified in the Bidding Documents as necessary for the proper execution of all installation services except those priced in other Schedules. **The price quoted in respect of all items in the above schedule shall be excluding GST.**

d) The Training Charges shall be furnished separately in Schedule-4 for the training. **The price quoted in respect of all items in the above schedule shall be excluding GST.**

e) The break-up of Type test charges shall be furnished separately in Schedule 7. **The price indicated in respect of all items in the above schedule shall be excluding GST. Type test shall be considered an incidental expense incurred prior to the delivery of Equipment/item and would be added to the value of goods for GST purposes and rate of GST shall be quoted accordingly.**

f) To take the confirmation of Tax Bracket (item wise), Bidder has to fill respective HSN/ SAC code and rate of GST in %age against each item in the Price Schedule. It shall entirely be the responsibility of the bidder to check and fill the HSN/SAC code and rate of GST given against each item. The bidders shall solely be responsible for HSN/SAC classification and the rate of GST for each item. Employer's liability for reimbursement of GST shall be lower of the GST applicable at the rate as confirmed/deemed confirmed in the bid or actual GST paid/payable by the bidder for that item.

g) **Total GST on Supply of goods and Services shall be indicated in Schedule -5**

h) The Input Tax Credit (ITC) available, if any, under the GST law as per the relevant Government policies wherever applicable shall be taken into account by the Bidder while quoting bid price.

i) The Bidder shall include **In-transit** insurance charges in its bid prices as per insurance requirement mentioned in Section – IV: General Conditions of Contract (GCC) and Appendix-3: Insurance Requirements to Form of Contract Agreement as contained in Section IX: Sample Forms and Procedures (FORMS) of the Bidding Documents. Bidder shall further note that the Employer shall not be liable to make any payment/ reimbursement to the Contractor whatsoever for insurance of Contractor's Plant and Machinery.

j) The bidder shall fill up only the marked cell (shaded in green colour) in the work sheets of Schedule 1 to 7 and Discount, Taxes & duties. Bidder shall not carry out any modification or changes in any other cell. Required calculations will be carried out automatically in the respective work sheets of Schedule-6(Grand Summary), Schedule-6 (After Discount) (Grand Summary after discount) and Bid Form.

k) Bidders may like to ascertain availability of exemptions, reductions, allowances or benefits in case of goods and services to be supplied to the Employer. They shall solely be responsible for obtaining such benefits, and in case of failure to receive such benefits for any reasons whatsoever, the Employer will not compensate the Bidder. The Bidder shall furnish along with their bid, a declaration to this effect in Attachment 17 as per the format enclosed in the Bidding Documents.

Further, if issuance of the necessary certificate for availing such exemptions, reductions, allowances or benefits is permitted and is required to be issued by the Employer in line with the relevant policies, rules and procedures of Govt. of India in vogue, the same shall be considered for issuance by the Employer, provided the Bidder explicitly indicates in their bid that they have quoted prices after considering the applicable concessional duty/exemption. However, the Bidder alone shall be responsible for obtaining any benefits there from as may be admissible under Govt. policies/procedures and in case of their failure to receive such benefits, partly or fully, for any reason whatsoever, the Employer will neither be responsible nor be liable to compensate the Contractor, and the Employer shall have no financial liability on this account.

Where the Bidder has quoted taking into account such benefits, he must give all information required for issuance of such certificate in terms of the relevant notifications of the Govt. of India along with his bid in Attachment 17. In case bidder has not indicated such information or has indicated "to be furnished later on" in Attachment 17, the same shall be construed to mean that no benefit has been passed on by the bidder to the Employer, and the Employer shall not issue any certificate to the contractor for availing the same even if admissible.

l) **Employer shall, deduct taxes at source as per the applicable laws/rules, if any, and issue Tax Deduction at Source (TDS) Certificate to the Contractor.**

11.5 The prices shall be in accordance with the following:

Adjustable Price: Prices quoted by the Bidder shall be subject to adjustment during

performance of the contract to reflect changes in the cost elements such as labor, material, etc. in accordance with the procedures specified in the corresponding Appendix – 2 to the Form of Contract Agreement. A bid submitted with a fixed price quotation will not be rejected, but the price adjustment will be treated as zero. The price adjustment provision will not be taken into consideration in bid evaluation. Bidders are required to indicate the source of labour & materials indices in Attachment 12.

12. Bid Currencies

12.1 Prices shall be quoted in Indian Rupees Only.

13. Bid Security

13.1 The Bidder shall furnish, except as exempted herein below, as part of its bid, a bid security in the amount and currency as stipulated in the **IFB**. The bid security must be submitted in the form provided in the Bidding Documents.

Micro and Small Enterprises (MSEs) registered with National Small Industries Corporation (NSIC) or with any other designated Authority of GoI under the Public Procurement Policy for MSEs are exempted from submission of Bid Security as per the Provisions of the Public Procurement Policy for Micro and Small Enterprises (MSEs) order 2012. This shall be subject to production of documentary evidence with regard to registration with authorities mentioned above.

13.2 The bid security shall, at the bidders option, be in the form of a crossed bank draft/pay order /banker certified cheque in favour of Employer as stipulated in **IFB** or a bank guarantee from a scheduled bank selected by the bidder. The format of the bank guarantee shall be in accordance with the form of bid security included in the Bidding Documents. Bid security shall remain valid for a period of thirty (30) days beyond the original bid validity period, and beyond any extension subsequently requested under ITB Sub-Clause 14.2.

Bid security shall remain valid for a period of thirty (30) days beyond the original bid validity period i.e., for a period of **TEN (10)** months after the last date of bid submission, and beyond any extension subsequently requested under ITB Sub-Clause 14.2.

The Bid Security shall be in favour of REC Transmission Projects Company Limited payable at New Delhi.

13.3 Any bid not accompanied by an acceptable bid security, except as exempted at 13.1 above, shall be rejected by the Employer as being nonresponsive, pursuant to ITB Sub-Clause 22.4. The bid security of a joint venture must be in the name of all the partners in the joint venture submitting the bid.

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

13.5 The successful Bidder shall be required to keep its bid security valid for a sufficient period till the performance security(ies) pursuant to ITB Clause 35 are furnished to the satisfaction of the Employer. The bid security of the successful Bidder will be returned when the Bidder has signed the Contract Agreement, pursuant to ITB Clause 34, and has furnished the required performance security, pursuant to ITB Clause 35.

13.6 The bid security may be forfeited

(a) if the Bidder withdraws its bid during the period of bid validity specified by the Bidder in the Bid Form; or

(b) In case the Bidder does not withdraw the deviations proposed by him, if any, at the cost of withdrawal stated by him in the bid and/or accept the withdrawals/rectifications pursuant to the declaration/confirmation made by him in Attachment –
Declaration of the Bid; or

(c) If a Bidder does not accept the corrections to arithmetical errors identified during preliminary evaluation of his bid pursuant to ITB Sub-Clause 27.2; or

(d) If, as per the requirement of Qualification Requirements the Bidder is required to submit a Deed of Joint Undertaking and he fails to submit the same, duly attested by Notary Public of the place(s) of the respective executant(s) 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 34, or

(ii) to furnish the required performance security(ies), in accordance with ITB Clause 35 and/or to keep the bid security valid as per the requirement of ITB Sub-Clause 13.5.

13.7 No interest shall be payable by the Employer on the above Bid Security.

14. Period of Validity of Bid

14.1 Bids shall remain valid for the period of **Nine (09)** months after the last date of bid submission. A bid valid for a shorter period shall be rejected by the Employer as being non-responsive.

14.2 In exceptional circumstance, the Employer may solicit the 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 or permitted to modify its bid.

15. Format and Signing of Bid

15.1 The bidder shall prepare the bid in the manner indicated in ITB Clause 9.0 and submit the bid in following manner:

First Envelope:

(i) The soft copy of the bid consisting of the documents listed in ITB Clause 9 including relevant scanned documents (refer ITB Clause 15.4) shall be uploaded through the

portal only. Submission of Soft Copy of any documents by any other means shall not be accepted by the Employer in any circumstances.

(ii) Hard copy of followings:

a) DD towards Bidding Document fee of the amount in accordance with clause 5.4 of ITB or documentary evidence in support of exemption of Bidding Document fee as per ITB 5.5;
b) Bid Security (in Original) or documentary evidence in support of exemption of Bid Security, in separate envelope in accordance with clause 13 of ITB, Section-II;
c) Integrity Pact (in Original) in accordance with clause 9.3 (o) of ITB, Section-II in separate envelope;
d) Power of Attorney as per Clause 9.3 (b);
e) In case of Bid from Joint Venture, the Joint Venture Agreement & Power of Attorney of Joint Venture Agreement;
f) Safety Pact (in Original) in accordance with clause 9.3 (s) of ITB, Section-II in separate envelope**.**
g) Affidavit signed and stamped with company seal by a full time Director/ CEO/ Chairman-cum-Managing Director and attested/ notarized by a Magistrate/ Notary for correctness of all the information/details/data/documentary evidences etc. as submitted by the bidder are correct.
h) Any other document further specified in the ITB duly signed and stamped on each page

Second Envelope:

The soft copy of the price schedules as per ITB Clause 11 to be uploaded on the portal. Submission of Soft Copy of any documents by any other means shall not be accepted by the Employer in any circumstances.

15.2 The bid shall contain no alterations, omissions or additions, unless such corrections are initialed by the person or persons signing the bid.

15.3 –deleted-.

15.4 The List of following documents shall be scanned & uploaded on the portal as per table given below:

S. No.	**Description of Documents**	**Name of File to be uploaded on the portal**
1.	Power of Attorney	poa.pdf
2.	DD against Bidding Document fee	dd.pdf
3.	Constitution of legal status	legal.pdf
4.	Declaration for anticipated change in legal structure/ ownership	decl_legal.pdf
5.	The principal place of business	principal.pdf

6.	The place of Incorporation or the place of registration and the nationality of the owner	incorporation.pdf
7.	Technical Experience certificate issued by utility	techexp.pdf
8.	Financial Balance Sheets (for last five years)	balsheet.pdf
9.	Declaration in regard to Financial re-structuring	Decl_Fin_re_struc.pdf
10.	Technical GTP	gtp.pdf
11.	Type Test Report	ttreport.pdf
12.	Bank Certificate	bank.pdf
13.	Manufacturer Authorization	manuauth.pdf
14.	Work Schedule (BAR Chart)	barchart.pdf
15.	Guarantee Declaration	guarantee.pdf
16.	Documentary Evidence for Base Price Indices	pvindex.pdf
17.	Cancelled Cheque	cheque.pdf
18.	Other Documents	other.pdf

1. The various documents are to be uploaded with the help of ATTACH button provided at relevant section of Attachment-QR sheet of Volume-III, Attachment.xls.
2. Bidder may put three(03) characters suffix for each file preceded by an under score for their identification. (Example- poa_xyz.pdf)
3. In case more file are to be uploaded under the same head Numeric suffix may be put by the bidder. (Example - poa1_xyz.pdf, poa2_xyz.pdf, poa3_xyz.pdf……..).
4. For uploading any additional documents bidder may decide the name of file with prefix as „other" succeeded by „under score" and suffix as name of document in short. (Example – other_ISO certificate1_xyz.pdf, other_ISO certificate2_xyz.pdf ……..)
5. For other types of files supported on the portal, please refer the related provisions on the portal.

D. Submission of Hard Copy of Bids

16. Sealing and Marking of Bids

16.1 The Bidder shall upload the soft copy part of the bid as per the provisions of the portal (refer para 15.1& 15.4 above) and submit the hard copy of DD towards Bidding Document fee or documentary evidence in support of exemption of Document fee (as applicable), Bid Security or documentary evidence in support of exemption of Bid Security (as applicable), Integrity Pact, Safety Pact, Power of Attorney, Joint Venture Agreement (as applicable) and Power of Attorney of Joint Venture Agreement (as applicable) and Joint Deed of Undertaking (as applicable) (refer para 15.1 above), duly marked <u>First Envelope (Techno – Commercial Part) in the following manner.</u>

<u>Envelope – 1</u>: Bidding Document fee /documentary evidence in support of exemption of Bidding Document fee

Envelope – 2: Bid Security/ documentary evidence in support of exemption of Bid Security

Envelope – 3: Integrity Pact

Envelope – 4: Power of Attorney, Joint Venture Agreement (as applicable) and Power of Attorney of Joint Venture Agreement (as applicable) and Joint Deed of Undertaking (as applicable) and any other documents as required (refer para 15.1 above).

Envelope –5: Safety Pact

The Bidder shall upload the Excel files of Price Schedule and Attachments downloaded from the portal as part of the bid duly filled in the required cells. If the bid submitted by the bidder is found different from the files downloaded from the portal, as part of the bidding document or tampered/modified locked contents, the bidder may run with risk of rejection of bid.

16.2 The envelope shall

(a) be addressed to the Employer at the address given in the **IFB**, and

(b) bear the contract name & Tender Specification No. indicated in the **IFB**, and the statement "Do Not Open Before [*date*]," to be completed with the time and date specified in the **IFB**.

16.3 DD towards Bidding Document, Bid Securities, Integrity Pact and the Safety Pact in original shall be submitted in separate superscribed envelopes (one for DD towards Bidding Document, one for Bid Security, one for Integrity Pact and one for Safety Pact) alongwith First Envelope.

Bidder may upload Soft copy of the any other documents which they consider relevant along with First Envelope.

All the 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."

In case, pursuant to Ministry of Finance, GOIs Circular dated 17th July, 2012, the Bank Guarantee is issued using SFMS Platform by the banks located in India, the copy of such Bank Guarantee shall be submitted by the bidder along with the First Envelope.

The Account details of RECTPCL for the purpose of Bank Guarantee (towards Bid Security) to be issued using SFMS Platform are as given below:

Name of the Bank and Address	**IFSC Code**	**RECTPCL Current A/c No.**
	XXXXXXXX	XXXXXXXXXX

16.4 If the envelope is not sealed and marked as required by ITB Sub- Clause 16.2 above, the Employer will assume no responsibility for the bid's misplacement or premature opening.

17. Deadline for Submission of Bids

17.1 Soft copy of the bid shall be uploaded through the portal **http://www.mstcecommerce.com/eprochome/rectpcl** at or before the submission time and date as stipulated in the bidding document. Demand Draft, hard copy of Bid Security in accordance with clause 13 of ITB, Section-II in separate envelope, Integrity Pact, Safety Pact, Power of Attorney, Joint Venture Agreement & Power of Attorney of Joint Venture Agreement (in case bid from Joint Venture) (as applicable), JDUs (as applicable), and Affidavit for correctness must be received by the Employer at the address specified under ITB Sub-Clause 16.2 no later than the time and date stated in the IFB. In the event of the specified date for the submission of bids being declared a holiday for the Employer, the bids will be received/uploaded upto the appointed time on the next working day.

Hard copy of Joint Deed of Undertaking must be received by the Employer at the address specified under ITB Sub-Clause 16.2 not later than the time and date stated in the IFB.

17.2 Bidding timelines will be defined as per the e-Procurement server clock only.

17.3 The Employer may, at its discretion, extend this deadline for submission of bids any time prior to opening of bids, in which case all rights and obligations of Employer and bidders will thereafter be subject to the deadline as extended.

Further the Employer also reserves the right to extend bid submission timeline or recall the tender if e- Procurement server is down (i.e. inaccessible / inoperative) for a prolonged period of time within the last 24 hours of the bid submission due date.

18. Late Bids

18.1 The bidder shall not be permitted to submit the soft copy part of the bid by any mode other than uploading on the portal within the specified deadline for submission of bids. The e-Procurement system
would not allow any late submission of bids through the portal after due date & time as specified in IFB. After electronic online proposal submission, the system generates a unique identification number which is time stamped. This shall be treated as acknowledgement of the bid submission.

In case Hard copy part of the bid is received by the Employer after the deadline for submission of the same prescribed by the Employer in the IFB but the bidder has uploaded the soft copy part of the bid, the bid will be considered as late bid. Such bids will be rejected during preliminary examination.

19. Modification and Withdrawal of Bids

19.1 Bidder may modify its bids through the relevant provisions on the portal **http://www.mstcecommerce.com/eprochome/rectpcl**.The Bidder may modify or withdraw its bid after submission, provided that modification is done on the portal as well as notice is received by the Employer prior to the deadline prescribed for bid submission.

19.2 The Bidders modifications shall be done and submitted as follows:

(i) Soft copy of the entire bid if any modification is there.

19.3 Bidder may withdraw its bid through the relevant provisions of portal only.

19.4 No bid may be withdrawn in the interval between the bid submission deadline and the expiration of the bid validity period specified in ITB Clause 14. Withdrawal of a bid during this interval may result in the Bidders forfeiture of its bid security, pursuant to ITB Sub-Clause 13.6.

E. Bid Opening and Evaluation

20. Opening of First Envelope by Employer

20.1 After receipt of Bids till last date of submission of Bids as per schedule, the First Envelope i.e., Techno – Commercial Part of Bids shall be kept unopened by the Employer.

The Employer will open the First Envelope i.e. Techno – Commercial Part in public, including withdrawals and modifications made pursuant to ITB Clause 19, in the presence of bidders designated representatives who choose to attend, at the time, date, and location stipulated in the **IFB**. The bidders representatives who are present shall sign a register evidencing their attendance. Bidder who have submitted their bid may view on line tender opening on the portal from their end. In the event of the specified date for the submission of bids being declared a holiday for the Employer, the bids will be received upto the appointed time on the next working day

20.2 During the opening of bids, Envelopes marked "Withdrawal" shall be opened first. Bids withdrawn pursuant to ITB Clause 19 shall be not be opened.

20.3 For all other Bids, the bidders names, deviation having cost of withdrawal, if any, the presence of bid security, Integrity Pact, Safety Pact and any such other details as the Employer may consider appropriate, will be get declared through the Portal by the Employer. Subsequently, all envelopes marked "Modification" shall be opened. Opening of bid, whether or not accompanied with the Tender fee and/or bid security and/ or Integrity Pact and/or Safety Pact, shall not be construed to imply its acceptability which shall be examined in detail pursuant to the provisions contained in this Section-II.

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

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

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

21. Clarification of Bids

21.1 During bid evaluation, the Employer may, at its discretion, ask the Bidder for a clarification of its bid. In case of erroneous/non submission of documents related to/identified in ITB Sub-Clause 9.3 (b), (o), (s) and (t) or Deed of Joint Undertaking pursuant to ITB Sub- Clause 9.3 (c) & (e), 9.3 (u) required to be submitted by the Bidder as per the provisions of the

Bidding Documents, the Employer may give the Bidder not more than 7 working days notice to rectify/furnish such documents, failing which the bid shall be rejected. The request for clarification and the response shall be in writing, and no change in the price or substance of the bid shall be sought, offered or permitted.

22. Preliminary Examination of <u>First Envelope</u>

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

In case of non-submission of bid in the portal (soft copy part of the bid) within the stipulated deadline, then even if the bidder has submitted the specific documents in hard copy part in original within the stipulated deadline pursuant to ITB 17.1, its bid shall be considered as incomplete bid, which shall be summarily rejected.

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

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

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

22.3.1 Bids containing deviations from critical provisions relating to GCC & SCC Clauses i.e Clause No-5(i)(b) of GCC (Governing Law), 7(i) of GCC (Contractor's Responsibilities), 9.0 of GCC (Performance Security), 27.0 of GCC (Liquidity Damage), 31 (i) (a) of GCC (Defect Liability Period), 33.0 of GCC (Payment Terms), 39.0 of GCC (Limitations of Liability), 47.0 of GCC (Settlement of Disputes), 48.0 of GCC (Arbitration), 14.0 of SCC (Taxes and Duties), and Appendix 2 to the Form of Contract Agreement (Price Adjustment) will be considered as non-responsive

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

I. Bid Form
II. Attachment-6 : Deviations
III. Technical Data Sheet
IV. Any other part of the bid

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

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

23. Qualification

23.1 The Employer will ascertain to its satisfaction whether Bidders determined having submitted substantially responsive bids are qualified, as per the Qualification Requirement specified in Section-III of Vol-I to satisfactorily perform the contract. The Employer shall be the sole judge in this regard and the Employer's interpretation of the Qualification Requirement shall be final and binding.

23.2 The determination will take into account the Bidder's financial, technical capabilities including production capabilities, in particular the Bidder's contract work in hand, future commitments & current

litigation and past performance including fatal accidents during execution of contracts. It will be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder in Attachment 3 to the bid, as well as such other information as the Employer deems necessary and appropriate. This shall, however, be subject to assessment that may be carried out, if required, by the Employer as per the provisions of Qualification Requirement.

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

23.4 An affirmative determination will be a prerequisite for the Employer to evaluate the Techno - Commercial Part and open the Second Envelope of the Bidder. A negative determination will result in rejection of the Bidder's bid.

24. Evaluation of Techno - Commercial Part (First Envelope)

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

(a) overall completeness and compliance with the Technical Specifications and Drawings; deviations from the Technical Specifications as identified in Attachment 6 to the bid and those deviations not so identified; suitability of the facilities offered in relation to the environmental and climatic conditions prevailing

at the site; and quality, function and operation of any process control concept included

in the bid. The bid that does not meet minimum acceptable standards of completeness, consistency and detail will be rejected for non-responsiveness.

(b) achievement of specified performance criteria by the facilities

(c) compliance with the time schedule called for in the corresponding Appendix to the Form of Contract Agreement and evidenced as needed in a milestone schedule provided in the bid;

Time schedule (program of performance)

The plant and equipment covered by this bidding shall have the
"Taking Over" by the Employer after successful Completion within the period specified in **IFB**. Bidders are required to base their prices on the time schedule given in Appendix 4 to the Form of Contract Agreement (Time Schedule) or, where no time schedule is given in Appendix 4, on the Completion date(s) given above. No credit will be given to earlier completion. Bids offering completion beyond the specified period are liable to be rejected.

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

(e) any other relevant technical factors that the Employer deems necessary or prudent to take into consideration.

(f) any deviations to the commercial and contractual provisions stipulated in the Bidding Documents.

(g) details furnished by the bidder in response to the requirements specified in Volume-II of the Bidding Documents.

(h) The acceptability of the vendors and subcontractors proposed in Attachment 5 to be used by the Bidder will be evaluated. Should a vendor or subcontractor, for the items other than those covered under Section-III of Vol-I, 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.

24.2 Where alternative technical solutions have been permitted and offered in Attachment 7 to the bid, the Employer will make a 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.

25. Opening of <u>Second Envelope</u> by Employer

25.1 The <u>Second Envelope</u> i.e., Price Part of only those Bidders shall be opened who are determined as having submitted substantially responsive bids and are ascertained to be qualified to satisfactorily perform the Contract, pursuant to ITB Clause 23 and 24. A negative determination of the bids pursuant to ITB Clause 23 and 24, shall be notified by the Employer to such Bidders and the <u>Second Envelope</u> submitted by them shall be sent to archive unopened and Bid Security shall be returned.

25.2 The Employer will open Second Envelope i.e., Price Part at the specified time and date in the presence of bidders designated representatives who choose to attend, at the time, date, and location stipulated in the intimation for opening of Second Envelope. The bidder's representatives who are present shall sign a register evidencing their attendance. Bidders who have submitted their bid and found qualified as mentioned at para 25.1 above may view online tender opening on the portal from their end.

25.3 The bidder's names, the Bid Prices, including any discounts, and any such other details as per Electronic form filled in by the bidder on the portal will become viewable at the time of opening of bids. The prices and details as filled up in Electronic Form/Template by the bidder and opened during the bid opening and recorded in the Bid Opening Statement would not be construed to determine the relative ranking amongst the Bidders, or the successful Bidder, and would not confer any right or claim whatsoever on any Bidder. The successful Bidder (also referred to as the L1 Bidder) shall be determined as per the provisions of this Section – II and considered for award of contract as provided in ITB Clause 31.

25.4 The Employer shall prepare minutes of the bid opening, including the information disclosed to those present in accordance with ITB Sub-Clause 25.3.

25.5 Bids not opened and read out at bid opening shall not be considered further for evaluation, irrespective of the circumstances.

26. Conversion to Single Currency

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

27. Evaluation of Second Envelope (Price Part)

27.1 The Employer will examine the Price Parts (Second Envelopes) to determine whether they are complete, whether any computational errors have been made, whether the documents have been properly signed, and whether the bids are generally in order.

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

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

If there is a discrepancy between the quantity specified by the Employer and the quantity indicated by the bidder in any price schedules, the quantity specified by the Employer shall prevail and shall be corrected accordingly.

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

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

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

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

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

27.3 The comparison shall be on the total price in Price Schedule No. 6 (After Discount) and considering applicable discount offered by the bidder in different manner at s. no. 6 of "Letter of Discount", if applicable.

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

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

27.4 The Employer's evaluation of a bid will take into account, in addition to the bid prices indicated in Price Schedule Nos. 1 through 5 (Second Envelope), the following costs and factors that will be added to each Bidder's bid price in the evaluation using pricing information available to the Employer, in the manner and to the extent indicated in ITB Sub-Clause 27.5 and in the Technical Specifications:

(a) the cost of all quantifiable deviations and omissions from the contractual and commercial conditions and the Technical Specifications as identified in the evaluation of First Envelope, and other deviations and omissions not so identified;

(b) the functional guarantees of the facilities offered (not applicable);Bidders shall state the functional guarantees (e.g., performance, efficiency, consumption) of the proposed facilities in response to the Technical Specifications. Plant and equipment offered shall have a minimum (or a maximum, as the case may be) level of functional guarantees specified in the Technical Specifications to be considered responsive. Bids offering plant and equipment with functional guarantees less (or more) than the minimum (or maximum) specified shall be rejected.

(c) the performance of the equipment offered;

Bidder shall state the guaranteed performance or efficiency of the Equipments, in response to the Technical Specifications. Equipment offered shall have a minimum (or

a maximum, as the case may be) level of guarantees specified in the Technical Specifications to be considered responsive. Bids offering plant and equipment with guarantees less (or more) than the minimum (or maximum) specified shall be rejected.

(d) the extra cost of work, services, facilities, etc., required to be provided by the Employer or third parties;

(e) any other relevant factors listed in **bidding document**

The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the contract, shall not be taken into account in bid evaluation.

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

(a) Contractual and commercial deviations

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

(b) Functional Guarantees of the facilities

(Not Applicable).

(c) Performance Guarantees of the Equipments

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

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

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

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

28. Purchase/ Domestic Preference

28.1 No purchase preference is presently applicable for the Plant and Equipment to be supplied under the Contract.

No margin of domestic preference will be allowed in evaluation and comparison of bids.

29. e-Reverse Auction (e-RA)

29.1. Employer reserve the right to conduct the electronic Reverse Auction (e-RA) as per the requirement and e-RA if required, shall be carried out in the manner as indicated herein below.

29.2. Based on "Evaluated Bid Price" determined pursuant to ITB Sub Clause27.6, the Bidders shall be ranked in an ascending order. Basis such ranking, the lowest ranked N/2 bidders (in case "N is even) or (N+1)/2 bidders (in case „N is odd), subject to minimum of three (03) bidders, shall be invited to participate in the e-Reverse Auction (e-RA), where „N" is the number of bidders whose bids have been found to be responsive and their "Evaluated Bid Price" has been determined in accordance with ITB Sub Clause 27.6.

29.3. However, in case only bids of two bidders are found to be responsive whose "Evaluated Bid Price" has been determined in accordance with ITB Sub Clause 27.6, the e-RA would be carried out with both the parties.

29.4. The Applicable Ceiling Price for e-RA for bidders shall be "Evaluated Bid Price" determined in accordance with ITB Sub Clause27.6. During e-RA, these Bidders shall be permitted to place their prices lower than the Applicable Celling Price.

29.5. The e-RA shall be conducted on a designated electronic platform of any Application Service Provider (hereinafter referred to as "ASP"), for and on behalf of the Employer.

29.6. The Qualified Bidders shall be permitted to place their Final Offer on the electronic bidding platform, which is lower than zero point zero five (0.05) % of the prevailing bid price.

29.7. The initial period for conducting the e-reverse bidding should be at least 30 minutes which will be extended by 10 minutes from the last received bid time, if the bid is received during the last 10 minutes of the scheduled or extended bid time. Subsequently, it will be extended again by 10 minutes from the latest received bid time.

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

29.9. In the event of identical evaluated bid price from the Initial Offer having been arrived for one or more Bidders, all such Bidders shall be assigned the same rank for the purposes of determination of Qualified Bidders.

29.10. The Employer shall be the sole judge in this regard

30. Confidentiality and Contacting the Employer

30.1 After the public opening of bids, information relating to the examination, clarification, and evaluation of bids and recommendations concerning awards shall not be disclosed to Bidders or other persons not officially concerned with this process until the publication of contract award. From the time of bid opening to the time of contract award, if any Bidder wishes to contact the Employer on any matter related to its bid, it should do so in writing.

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

F. Award of Contract

31. Award Criteria

31.1 Subject to ITB Clause 32, the Employer will award the contract to the successful Bidder (also referred to as the L1 Bidder) whose bid has been determined to be substantially responsive and to be the lowest evaluated bid, further provided that the Bidder is determined to be qualified, as per the Qualification Requirement specified in Qualification Requirement, (Section-III of Vol-I) to perform the contract satisfactorily.

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

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

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

31.3 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.

31.4 The mode of contracting with the successful bidder will be as per stipulation outlined in ITB Sub-Clause 31.4.1 which is briefly indicated below:

31.4.1 The Contracts to be entered into with the successful Bidder shall be as under:

(i) First Contract: For Ex works supply of all equipments and materials including mandatory spares and Type Test to be conducted (whether in India or abroad) (***Supply of Goods*** Contract)

(ii) Second Contract: For providing all services i.e. inland transportation for delivery at site, **In-transit** insurance, unloading, ~~storage~~, handling at site, installation, Testing and Commissioning including performance testing in respect of all the equipments supplied under the "First Contract", Training to be imparted (whether in India or abroad) and any other services specified in the Contract Documents (***Supply of Services*** Contract).

(iii) The award of two separate Contracts shall not in any way dilute the responsibility of the Contractor for the successful completion of the facilities as per Specification and a breach in one Contract shall automatically be construed as a breach of the other Contract(s) which will confer a right on the Employer to terminate the other Contract(s) also at the risk and the cost of the Contractor.

(iv) The Contract will be signed in two originals and the Contractor shall be provided with one signed original and the rest will be retained by the Employer.

(v) 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.

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

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

32.1 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.

33. Notification of Award

33.1 Prior to the expiration of the period of bid validity, the Employer will notify the successful Bidder in writing, that its bid has been accepted. The notification of award will constitute the formation of the contract.

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

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

33.3 Upon the successful Bidder's furnishing of the performance security pursuant to ITB Clause 35, the Employer will promptly discharge the bid securities, pursuant to ITB Sub-Clause 13.4 & 13.5.

34. Signing the Contract Agreement

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

34.2 The Contract Agreement shall be executed within Fifteen (15) days of the Notification of Award and the successful Bidder and the Employer shall sign and date the Contract Agreement immediately thereafter.

35. Performance Security

35.1 Within Fifteen (15) days after receipt of the Letter of Award, the successful Bidder shall furnish the performance security for 10% (Ten percent) of the contract price plus additional performance securities, if any, in line with the requirement of Qualification Requirements, in the amount given in the bidding document and in the form provided in Section IX, Sample

Forms and Procedures, of the Bidding Documents. The performance security of a joint venture shall be in the name of joint venture.

35.2 Failure of the successful Bidder to comply with the requirements of ITB Clause 34 or Clause 35 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.

36. Fraud and Corruption

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

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

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

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

(iii) "collusive practice" is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;

(iv) "coercive practice" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(v) "obstructive practice" is

(aa) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Employer's investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation;

or

(bb) acts intended to materially impede the exercise of the Employer's inspection and audit rights.

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

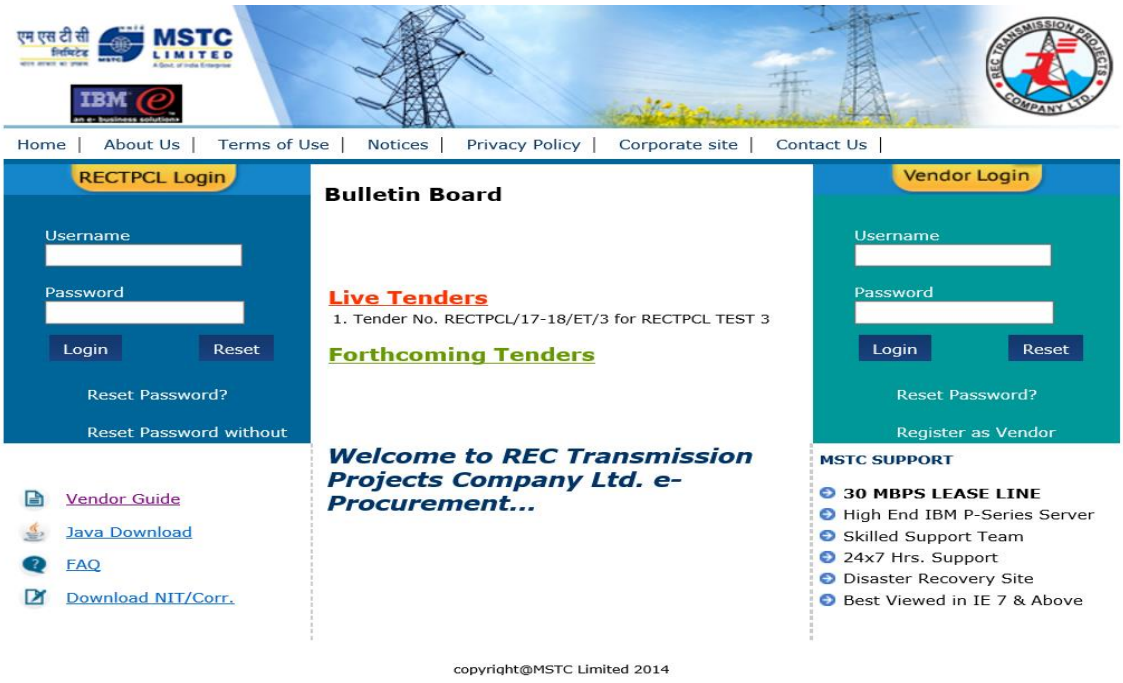
(c) will sanction a firm or individual, including declaring ineligible, either indefinitely or for a stated period of time, to be awarded a contract if it at any time determines that the firm has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for, or in executing, a contract; and

(d) will have the right to require that the provision be included in Bidding Documents and in contracts, requiring Bidders, suppliers, and contractors and their sub-contractors to permit the Employer to inspect their accounts and records and other documents relating to bid submission and contract performance and to have them audited by auditors appointed by the Employer.

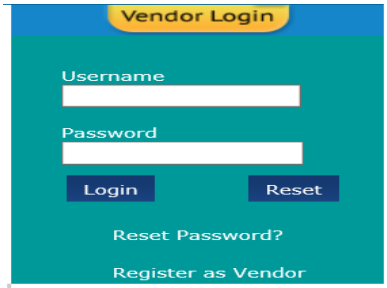
-- End of Section-II (ITB) --

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

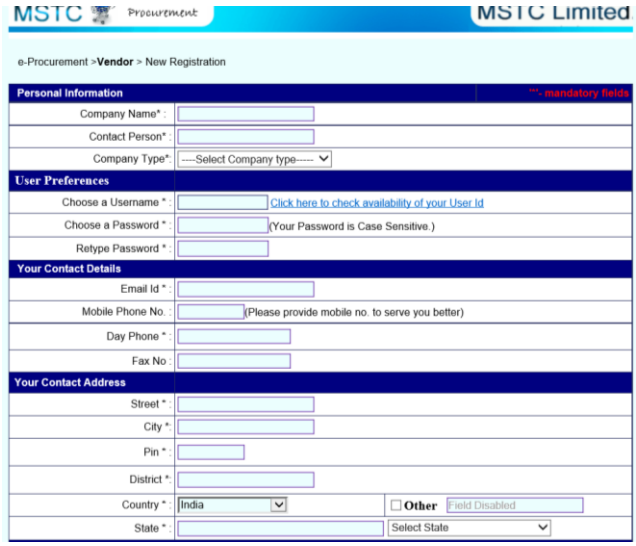
1. Use Internet Explorer to go to https://www.mstcecommerce.com/eprochome/rectpcl/buyer_login.jsp



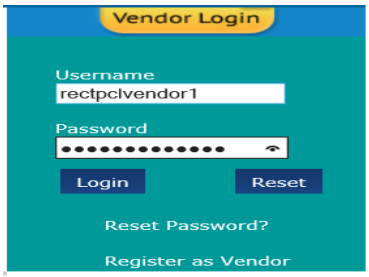
2. On the right side of the page click on Register as a Vendor:



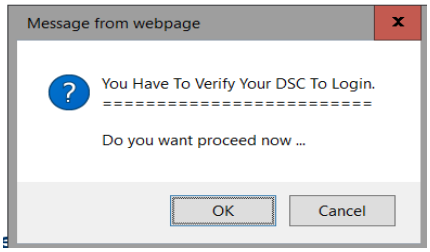
3. Fill the form that appears to create username and password.



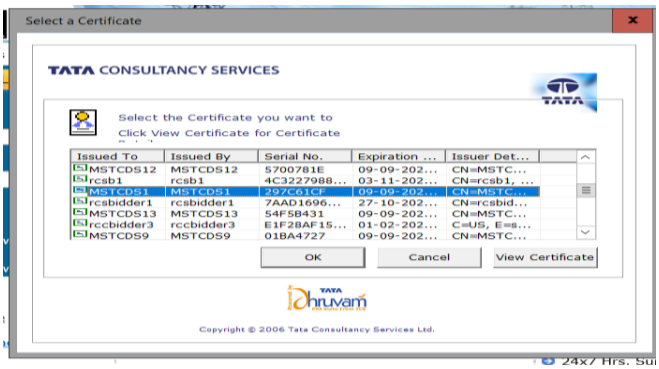
4. Once the registration is done, login with your user name and password:



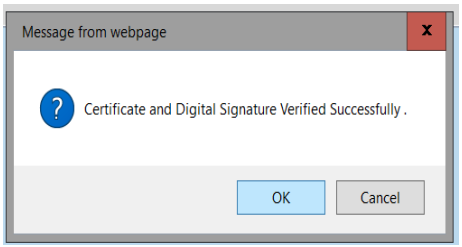
5. System will ask you to verify your digital signature



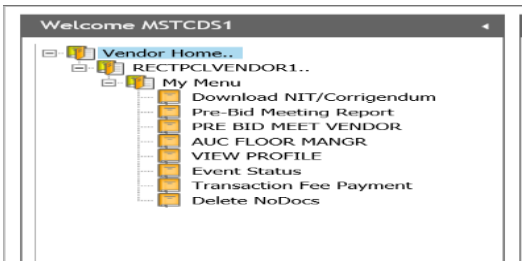
6. Press Ok and select your digital signature from the List:



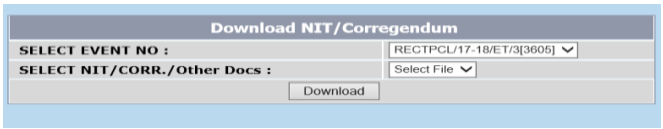
7. Your digital signature will be verified



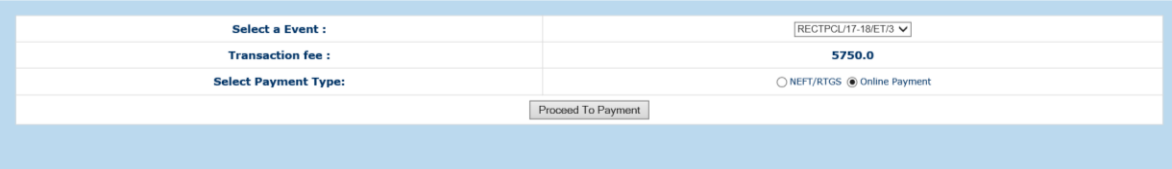
8. Once login is complete, a bidder can access My Menu through the left side of the page:



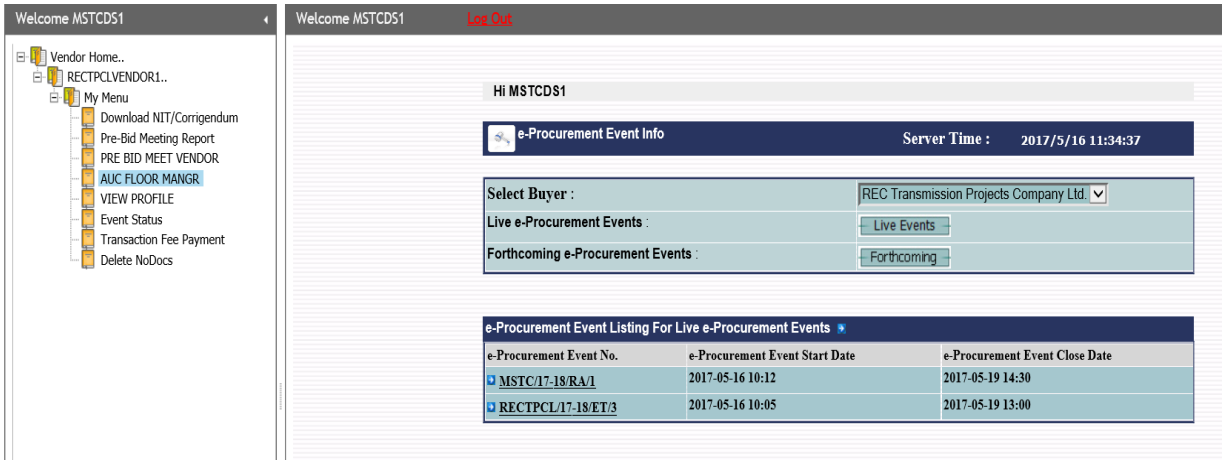
9. Here click on Download NIT/Corrigendum button to download the NIT/Corrigendums. Select Event number and click on download to download the files:



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

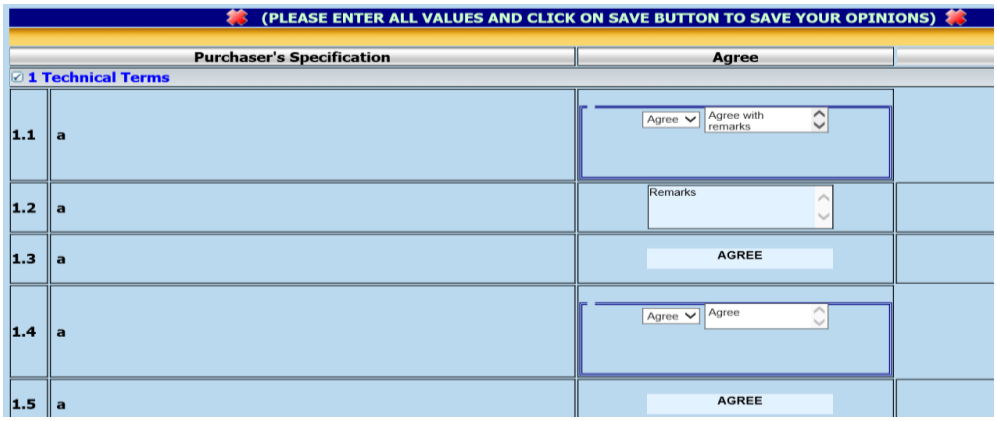


11. After the transaction fee is paid a bidder can proceed to Auc-Floor Manager through the left side My menu. In Auc floor manager click on live events to view a list of Live events. In live events select the tender number where you wish to submit a bid. (tenders have the the denotation ET while e-Reverse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

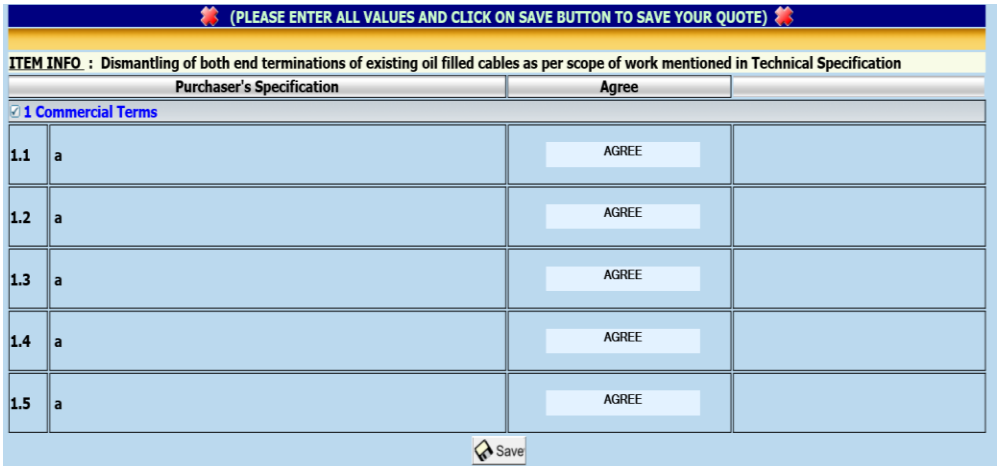


12. On clicking the tender number following screen will appear:

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

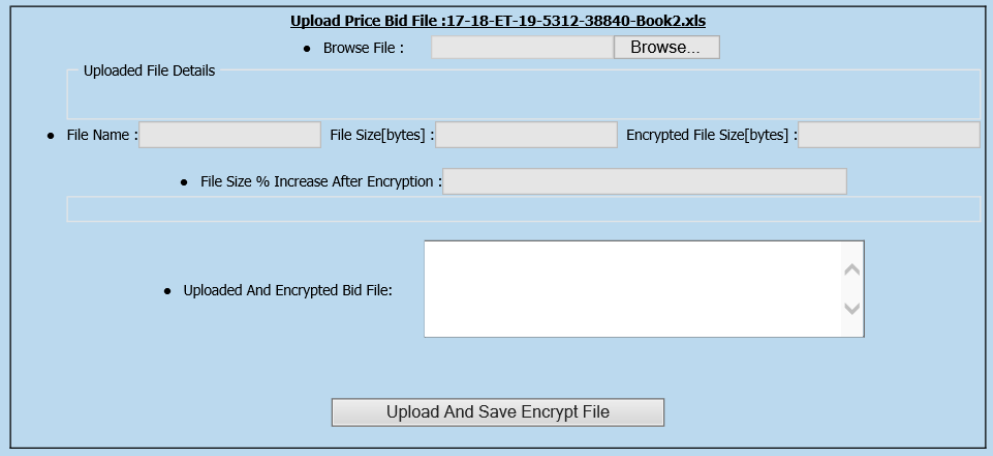


14. After the common terms are saved, a bidder can proceed to saving the Cover 2. To fill Cover 2 form click on cover 2 and fill the form therein.

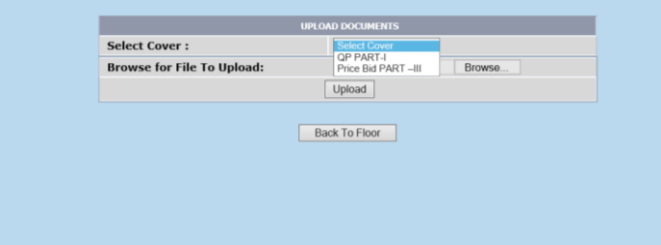


15. Once Cover 2 are saved, proceed with submitting the price bid. Click on Download button to download the Excel sheet for Price Bid.

16. Fill up the excel sheet as per the details given therein and tender document.
17. To upload the filled up excel click on Upload Price Button, click on browse to select the file and then click on Upload and Save encrypt file.



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



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

E-Reverse Auction:

20. The Financial Bid will comprise of two rounds. In the first round, the total Initial Price Offer (submitted online along with the Cover 1 and 2) of the Technically Qualified bidders shall be opened and total Initial Price Offer shall be ranked on the basis of ascending order for determination of the L-1 bid. This L-1 Bid shall become the ceiling price for start of e-reverse auction. The qualified bidders shall be permitted to place their Final Price Offer on the electronic bidding platform which must be lower than 0.05% of prevailing L-1 Price. Prevailing L-1 price will be displayed to all the bidders up to the point no other bidder out bids that offer by quoting a lower price. All bidders may reduce their bids by any amount in the multiples of 0.05% of prevailing L-1 bid (rounded to the nearest whole number) by bidding any number of times for the duration of the auction. The initial period for conducting e-reverse auction shall be 30 minutes which will be extended by 10 minutes from the last received bid time if the bid is received during the last 10 minutes of the scheduled or extended bid time. Subsequently, it will be extended again by 10 minutes from the latest received bid time.

21. At the close of the e-Reverse auction the successful bidder will be notified by email that their bid amount _____ received in the system is the lowest amount in the system. They will be required to give a break up of the bid quoted by them. The break up should be pro rata reduced (without disturbing amount of taxes) from their initial price offer at Tender stage.

SECTION-III, VOL-I
QUALIFICATION REQUIREMENT

Qualification Requirement of the Bidder

Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15

QUALIFICATION OF THE BIDDER

Qualification of Bidder will be based on meeting the minimum pass/fail criteria specified below regarding the Bidder's Technical Experience and Financial Position as demonstrated by the Bidder's responses in the corresponding Bid Schedules. Technical experience and financial resources of any proposed subcontractor 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 (specific requirements for Joint Ventures are given under Para 3.0 below).

The Employer **may** assess the capacity and capability of the bidder, to successfully execute the scope of work covered under the package within stipulated completion period. This assessment **shall** inter-alia include (i) document verification; (ii) bidders work/manufacturing facilities visit; (iii) manufacturing capacity, details of works executed , works in hand, anticipated in future & the balance capacity available for present scope of works; (iv) details of plant and machinery, manufacturing and testing facilities, manpower and financial resources; (v) details of quality systems in place; (vi) past experience and performance; (vii) customer feedback; (viii) banker's feedback etc.

1.0 Technical Experience

1.1 The Bidder must have Designed, Manufactured, Type Tested (As per IEC or equivalent standard), Supplied, Erected, Tested & commissioned of atleast two (2) number of GIS substations having cumulatively atleast 12 (Twelve) circuit breaker bays* of 220kV or above in **India only**. The two (2) nos. GIS substations above should have been in satisfactory operation# for atleast two (2) years as on the originally scheduled date of bid opening i.e. **xx.xx.2017**. Further, at least one (1) number of above GIS substation must have been commissioned within last seven (7) years as on the date of bid opening.

(#) Satisfactory operation – means certificate issued by the employer certifying the operation without any adverse remark.

1.2 Alternatively, in case the bidder is an Indian entity (subsidiary or affiliate) of a foreign Company and if such foreign company meets all the qualification criteria stated at para 1.1 except Manufacturing in India and desires that the contract be entered into with its Indian entity, then the following is necessarily to be met by the Indian arm,

a. The bidder must have manufactured at least one (1) 220kV or above voltage level GIS Circuit Breaker bay* based on the technological support of the Collaborator(s) and the bidder should have supplied and it should have been in satisfactory operation# for at least 01 (One) year as on the originally scheduled date of bid opening provided that the Collaborator(s) of the bidder meets the qualification requirements as stated in para 1.1 above.

b. The bidder shall enter into a valid Technical Collaboration agreement with the aforesaid foreign firm for technology transfer / license to design, manufacture, test and supply of 220 kV or above voltage class GIS equipment in India.
c. Such bidder 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.
d. The bidder 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.
e. The Collaborator /Parent Company /Principal should undertake backup support for 5 years for successful operation of the offered GIS.
f. 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 value of Supply portion as quoted by the bidder of such GIS equipment(s). This performance guarantee shall be to guarantee their obligations toward the owner as referred hereinbefore or else wherein the NIT conditions. This performance guarantee shall be in addition to the Contract Performance Guarantee to be submitted by the bidder.

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

(#) Satisfactory operation – means certificate issued by the employer certifying the operation without any adverse remark.

Note:

i. (*) For the purpose of qualification requirement, one no. of circuit breaker bay shall be considered as a bay used for controlling a line or a transformer or a reactor or a bus section or a bus coupler and comprising of at least one circuit breaker, one disconnector and three nos. of single phase CTs / Bushing CTs.

2.0 FINANCIAL POSITION:

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

a) Net Worth for last 3 financial years should be positive

b) Minimum Average Annual Turnover* (MAAT) of the bidder for best three years i.e. 36 months out of last five financial years **as annualised should be** Rs. **54.38** Crore **or**

equivalent for the Package.

*** Note- Annual total income as incorporated in the profit & loss account except non-recurring income e.g. sale of fixed assets**

c) Bidder shall have Liquid Assets (LA) and/or evidence of access to or availability of credit facilities of not less than Rs**. 09.06 Crore** or equivalent for the subject Package.

In case bidder is a holding company, the Financial Position criteria referred to in clause 2.0 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, the Financial Position criteria referred to in clause 2.0 above shall be that of subsidiary company only (i.e. excluding its holding company).

3.0 JOINT VENTURE BIDS:

In case a bid is submitted by a Joint Venture (JV) of two or more firms as partners, the JV shall meet collectively the complete requirements mentioned **at clause no. 1.0** and 2.0 (b) & (c) above. Further, the partners of Joint Venture shall meet the following requirements:

a) All the partners of the JV shall meet individually the Financial Position criteria given at 2.0 (a) above.

b) The lead partner shall meet not less than 40% of the Financial Position minimum criteria given at para 2.0 (b) & (c)

c) Each of the other partner(s) individually shall meet not less than 25% of the minimum Financial Position criteria given at para 2.0 (b) & (c)

The figure of average annual turnover and liquid assets/credit facilities for each of the partners of the JV shall be added together to determine the JV's compliance with the minimum qualifying criteria set out in para 2.0 (b) & (c)above

4.0 The bidder shall furnish documentary evidence in support of the qualifying requirement stipulated as above.

SECTION-IV, VOL-I

GENERAL CONDITIONS OF CONTRACT (GCC)

SECTION - IV

GENERAL CONDITIONS OF CONTRACT

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SECTION-IV
GENERAL CONDITIONS OF CONTRACT

CLAUSE-1: DEFINITIONS:

In the Contract, as hereinafter defined, the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires:

i) 'RECTPCL'/ 'Purchaser'/'Implementing Agency' means the REC Transmission Project Company Ltd. and the legal successor in title to the RECTPCL, who will employ the contractor. 'Owner' means the State Government of concerned state where the works are to be executed.

ii) 'Contractor/Supplier' means the person or persons, firm or company, group of firms or Joint Venture, who has been awarded the work by the RECTPCL and includes the Contractor's personnel, representatives, successors and permitted assigns.

iii) 'Engineer-in-Charge' means the Additional Chief Executive Officer of RECTPCL.

(a) 'Engineer-in-Charge's Representative' means the Chief Project Manager and Project Engineers of the project. The Site in-charge will assist the Engineer-in-charge's representatives to perform the duties set forth in Clause-2 hereof, whose authority shall be notified in writing to the Contractor by the Engineer-in-Charge.

(b) The responsibilities assigned herewith as above in iii (a) to various officers does not absolve them from taking the approval from the competent authority under various state laws/rules/regulations and book of financial powers.

iv) "Works" shall include both permanent Works and Temporary Works or either of them as appropriate and shall mean supply of Goods and Services.

v) "Temporary Works" means all temporary Works of every kind other than Contractor's plant, equipment and machinery required in or about the execution and completion of the Works and remedying of any defects --therein.

vi) "Permanent Works" means the permanent Works to be executed in accordance with the Contract.

vii) The 'Goods' means all the equipment, machinery and/or other materials which the Contractor is required to supply to RECTPCL under the Contract.

viii) 'Services' means services ancillary to the supply of Goods such as but not limited to transportation and insurance from ex-works till defect liability period, handling, storage and preservation at store/site, erection, testing, painting, commissioning of goods, training and other such obligations of the Contractor covered under the Contract.

ix) 'Contract' means the agreement entered into between RECTPCL and the Contractor as recorded in the Form of Agreement, signed by both the parties including all attachments and appendices thereto and all documents incorporated by reference their in.

x) 'Contract Price' means the sum as stated in the Letter of Award payable to the Contractor under the contract for full and proper performance of his contractual obligations i.e. providing goods and services and remedying any defects therein in accordance with the provisions of the Contract.

xi) 'Plant' and 'Equipment' or 'Machinery' means and include plant, equipment, machinery, tools, appliances, other implements of all description or things of whatsoever nature other than the Temporary Works required in or about the execution and completion of the Works and remedying of any defects therein but does not include materials or other things intended to form or forming part of the Permanent Works.

xii) 'Specifications' means the specifications of Works included in the Contract and any modification thereof or addition thereto or deduction there from as may, from time to time, decided by RECTPCL and/or submitted by the Contractor and approved in writing by the Additional Chief Executive Officer, RECTPCL**.**

xiii) 'Drawings' means the drawings referred to in the Contract and any modification of such drawings approved in writing by the Engineer-in-Charge and such drawings, as may , from time to time, be furnished by RECTPCL and/or the Contractor and approved in writing by the Additional Chief Executive Officer, RECTPCL.

xiv) 'Site' means the places where the Works are to be executed and any other places as may be specifically designated in the Contract as forming part of Site.

xv) 'Store' means the place where the goods supplied under this Contract are stored by the Contractor near to the Project site. Such place will be treated as forming part of site.

xvi) 'Approved' means approved in writing, including subsequent written confirmation of previous verbal approval and 'approval' means approval in writing, including as aforesaid.

xvii) 'Consultant' means company/individual as appointed by owner/employer .

xviii) Chief Engineer means Chief Manager (Technical), RECTPCL.

xix) Development Commissioner (Power) means Representative of the Owner of the Project.

xx) 'GoI' means The Government of India.

xxi) 'Sub-Contractor' means the party or parties having direct contract with the Contractor and to whom any part of the Works has been sublet by the Contractor with the consent, in writing, of the Engineer-in-Charge and the legal successors in title to such person, but not any assignee of any such person.

xxii) 'Manufacturer' means the party proposing to design and/or manufacture the Goods as specified, complete or in part.

xxiii) 'Letter of Award' means the letter from RECTPCL conveying award of Works subject to such reservations as may have been stated therein.

xxiv) 'Tests on Completion' means the tests specified in the Contract or otherwise agreed to by RECTPCL and the Contractor to be performed before the Works are taken over by RECTPCL.

xxv) 'Day' means a day from midnight to midnight.

xxvi) 'Month' means from the beginning of a given date of a calendar month to the end of the preceding date of the next calendar month.

xxvii) 'Week' means seven consecutive days.

xxviii) 'Quarter' means a period of three consecutive months starting from January, April, July and October i.e. January to March, April to June, July to September and October to December.

xxix) 'C.E.A.' means Central Electricity Authority.

xxx) 'Near Relative' means wife/husband, parents and grandparents, children, first cousins, brothers-in-law, sisters-in-law and parents-in-law.

xxxi) 'Rupees' means Rupees in Indian Currency.

xxxii) Words in singular number shall include the plural number and vice-versa where the context so requires. 'He' shall include 'She' and vice – versa.

xxxiii) 'IS' Means Indian Standard specifications with latest amendments or revision as currently in force at the time of execution of the Works.

xxxiv) 'Bill of Quantities'/ 'Price Schedule' means the priced and completed bill of quantities.

xxxv) 'Project Manager' means the person appointed from time to time by the Contractor and notified in writing to the RECTPCL to act as the in-charge for the purpose of the Contract. The Project Manager shall have a minimum of 12 years' experience in the related field, out of which at least 5 years' experience shall be at executive level in "transmission works at 220 KV level"

CLAUSE-2 DUTIES AND POWERS OF ENGINEER-IN-CHARGE AND ENGINEER-IN-CHARGE'S REPRESENTATIVE:

i) The Engineer-in-Charge shall carry out the duties specified in the Contract.

ii) The Engineer-in-Charge may exercise the authority specified in or necessarily to be implied from the Contract, provided however, that if the Engineer-in-Charge is required to obtain the specific approval from a Competent Authority before exercising any such authority, he will do so and convey the decision to the Contractor.

iii) The Engineer-in-Charge's Representative will be appointed by and be responsible to the Engineer-in-Charge and will carry out such duties and exercise such authority as may be delegated to him by the Engineer-in-Charge under Sub Clause (iv) of this Clause. He shall have no authority to relieve the Contractor of any of his duties or obligations under the Contract nor, except as expressly provided hereunder or elsewhere in the Contract, to order any work

involving delay or any extra payment by the RECTPCL, nor to make any variation in the Works.

iv) The Engineer-in-Charge may, from time to time delegate to the Engineer-in-Charge's Representative any of the powers and authorities vested in the Engineer-in-Charge and he may at any time revoke such delegation. Any communication issued by the Engineer-in-Charge's Representative to the Contractor in accordance with such delegation shall have the same effect as though it had been issued by the Engineer-in-Charge. Provided that:

a. any failure of the Engineer-in-Charge's Representative to disapprove any work or materials shall not prejudice the authority of the Engineer-in-Charge thereafter to disapprove such work or materials and to give instructions for the removal or for the rectification thereof.

b. If the Contractor questions any communication of the Engineer-in-Charge's Representative, he may refer the matter to the Engineer-in-Charge who will confirm, reverse or vary the contents of such communication.

v) The Engineer-in-Charge may have any number of persons to assist the Engineer-in-Charge's Representative in carrying out of his duties. Such assistants shall have no authority to issue any instructions to the Contractor, except in so far as such instructions may be necessary to enable them to carry out their duties and to secure their acceptance of materials, plant, equipment and machinery or workmanship as being in accordance with the Contract, and any instructions given by any of them for those purposes shall be deemed to have been given by the Engineer-in-Charge's Representative.

vi) Instructions given by the Engineer-in-charge shall be in writing, provided that if for any reason the Engineer-in-charge considers it necessary to give any such instruction orally, the contractor shall comply with such instruction. Confirmation in writing of such oral instruction given by the Engineer-in-Charge, whether before or after carrying out of the instruction, shall be deemed to be an instruction within the meaning of this sub-clause. Provided further that if the Contractor, within seven days, confirms in writing to the Engineer-in-Charge any oral instructions of the Engineer-in-Charge and such confirmation is not contradicted in writing within seven days by the Engineer-in-Charge, it shall be deemed to be an instruction of the Engineer-in-Charge. The provisions of this sub-Clause shall equally apply to instructions given by the Engineer-in-Charge's Representative and any assistants of the Engineer-in-Charge or the Engineer-in-Charge's Representative pursuant to Sub-Clause (v).

CLAUSE-3 ASSIGNMENT OF CONTRACT

The Contractor shall not, without the prior consent of the RECTPCL, assign the Contract or any part thereof, or any benefit or interest therein or there under, otherwise than by:

(i) A charge in favour of the Contractor's bankers of any monies due or to become due under the Contract, or

(ii) Assignment to the Contractor's insurers (in cases where the insurers have discharged the Contractor's loss or liability) of the Contractor's right to obtain relief against any other party liable.

CLAUSE-4 SUBLETTING:

(i) The Contractor shall not sublet the whole of the Works except where otherwise provided by the Contract, the Contractor shall not sublet any part of the Works without the prior written consent of the Engineer-in-charge. However, any such consent shall not relieve the Contractor from any liability or obligation under the Contract and he shall be responsible for the acts, defaults and neglects of any sub-contractor, his agents, servants or workmen as fully as if they were the acts, defaults or neglects of the Contractor, his own agents, servants or workmen. Provided that the Contractor shall not be required to obtain such consent for:

a) The provision of labour, or
b) The purchase of materials which are in accordance with the standards specified in the Contract, or
c) The subletting of any part of the Works for which the sub-contractor is named in the Contract.

(ii) The Contractor shall furnish un-priced copies of the major sub-contracts (costing more than Rs. 5.0 million) to RECTPCL wherever these are executed. This action would, however, not involve RECTPCL in any complications arising between the Contractor and his sub-contractor(s) or any other liabilities. This action would also be without prejudice to the provision under this Clause.

(iii) In the event of a sub-contractor having under taken the Contract in respect of the work executed or the goods, materials, plant, equipment and machinery or services supplied by such sub-contractor, any continuing obligation extending for a period exceeding that of the Defects Liability Period or its extension under the Contract, the Contractor shall at any time, after the expiration of such period, assign to the RECTPCL, the benefit of such obligation for the unexpired duration thereof.

CLAUSE-5: LANGUAGE(S) AND LAW:

i a) The Contract Documents shall be drawn up in English. All correspondence and documents relating to the Contract, exchanged by the Contractor and RECTPCL shall be submitted in the prescribed form in English. All supporting documents and printed literature in connection with the Contract shall be in English. In case the supporting documents and printed literature are in any other language, these shall be accompanied by an appropriate translation in English and in that case, for the purpose of interpretation, the English translation shall govern.

b) **Governing Law & its Jurisdiction:**
The Contract shall be governed by and interpreted in accordance with laws of Union of India and the Courts of New Delhi shall have exclusive jurisdiction in all maters arising under this Contract.

ii Documents Mutually Explanatory

Several documents forming the Contract are to be taken as mutually explanatory of one another, but in case of ambiguities or discrepancies, the documents shall

take precedence in the order in which they are set out in the proforma of Contract Agreement (attached in Sample Forms & Procedures, Section-IX, Vol-I).

CLAUSE-6: DRAWINGS:

i) After the award of Contract, the supplier & purchaser will hold design co-ordination meetings to finalize steps to be taken to implement the Contract including procedure for submission of drawings, design details & approval thereof in such a manner & procedures which would bring out workable solution to step by step process. At least seven print copies of all the drawings for any part of the Work and seven copies of complete design calculations shall be submitted by the Contractor for approval, at least ninety days prior to the date on which such drawings are required to ensure that the work is carried out in accordance with the approved program Work. The Engineer-in-charge shall accord and convey the approval to the design calculation and drawings, if found in order, within 30(thirty) days from the receipt of the drawings from the Contractor. Otherwise he shall apprise the Contractor of his comments on such design calculations and drawings within the above mentioned period.

ii) Where such comments are communicated to the Contractor, the Contractor shall be bound to ensure that 7 print copies of all the revised drawings and 7 copies of revised design calculations, in view of these comments, are submitted to the **Additional Chief Executive Officer, RECTPCL, New Delhi.** (Engineer-in-charge) within fifteen days of receipt of these comments. Similar course of action, as aforesaid, shall be taken by the **Additional Chief Executive Officer, RECTPCL, New Delhi** on the revised designs calculation and drawings. On receipt of approval of drawings/design processes/design calculation etc. The Contractor shall furnish seven print copies (Five copies of A1 or higher size and 2 copies of A3 size) and two (2) nos. paper type reproducible copies of approved drawings and ten copies of approved design calculation to **Additional Chief Executive Officer, RECTPCL, New Delhi** within 30 days of such approval. In addition, 2 sets of CDs of computer/AutoCAD drawings of such approved drawings shall also be supplied.

iii) Notwithstanding the approval of the **Additional Chief Executive Officer, RECTPCL, New Delhi** to the Contractor's design and drawings, the Contractor shall be responsible for the stability of Works in accordance with the provisions of the Contract and the approval accorded shall not absolve him of his responsibility for meeting all requirements of specifications.

iv) One copy of the approved drawings shall be kept by the Contractor on the site and the same shall, at all reasonable times, be available for inspection and use by the Engineer-in-Charge and the Engineer-in-Charge's Representative and by any other person authorized by the Engineer-in-Charge.

v) **Additional Chief Executive Officer, RECTPCL, New Delhi** shall, however, have full power and authority to modify, from time to time, during the progress of Works, the drawings approved previously in consultation with the contractor, as shall be necessary for the purpose of proper and adequate execution and completion of Works. The Contractor, shall carry out and be bound by such modification.

vi) Final Drawings

After completion of the erection work the Contractor shall furnish 5 copies (3 copies of A1 or higher size and 2 copies of A3 size duly bound in folder) and one copy on reproducible tracing cloth or velograph of final as built drawings of work. For computer/AutoCAD drawn drawings, two sets of CDs containing such drawings shall be supplied. Each set shall include an index showing the drawing number, Revision No. & titles.

vii) Record Drawings

Prior to shipment of the equipment, the Contractor shall furnish to Purchaser one complete set of full size permanent reproducible cloth or film copies of approved quality and type and one full size set of prints of all supplier's drawings of structures, foundations, material etc. as finally built, including any suggested modification. In addition, five (5) bound sets of half-size prints of all Contractor's drawings shall be furnished. Each set shall include an index showing the drawing numbers and titles and shall be bound for permanent reference.

viii) Instructions/ Procedures for Storage & Preservation, Installation/Erection, Testing & Commissioning at Site and Operation & Maintenance of Goods.

The Contractor shall submit 7 sets of written detailed Instructions/Procedures in English language, for Storage & Preservation, Installation/Erection, Testing & Commissioning at site and Operation and Maintenance manual for each component of Transmission Line. The instructions/procedures shall be submitted as early as possible so that final reviewed copies can be made available to the field for use in planning the work well in advance of actual installation and operation. After review, seven (7) durable bound copies of the final instructions shall be furnished. Each of these copies shall have a presentation similar to a hard-bound book resistant to wear and tear and firmly holding each of the pages. A book shall contain a maximum of approximately 240 pages to offer easy handling; if the material requires more space, the manual shall be divided into two (2) or more volumes. Each volume shall have its title, printed on the front of the binding and on the back of the book. The paper used, the reproduction technique, the binding, and the presentation shall be of an approved quality and type. 2 sets of CDs containing final Instructions/Procedures shall also be furnished.

ix) The RECTPCL specification drawings, specifications and other information to the Contractor shall remain the property of the RECTPCL. They shall not, without the consent of the RECTPCL, be used, copied or communicated to a third party by the Contractor unless necessary for the purposes of this Contract.

x) The Contractor shall be responsible for any errors or omissions in the Contractor's drawings unless they are due to incorrect RECTPCL specification drawings or other written information supplied by the RECTPCL. Errors, if any, noticed by the Contractor in the RECTPCL drawings, specification and other information shall, however, be promptly pointed out by the Contractor to the RECTPCL. Approval by the Additional Chief Executive Officer, RECTPCL, New Delhi of the Contractor's drawings shall not relieve the Contractor from any responsibility under this Sub-Clause.

xi) The Contractor shall bear all costs which he may incur as a result of delay in providing drawings and other information or as a result of errors or omissions therein, for which he is responsible.

xii) The Contractor shall, at his own cost, carry out any alterations or remedial work necessitated by such errors or omissions for which he is responsible and modify the drawings and such other information accordingly.

CLAUSE-7: CONTRACTOR'S GENERAL RESPONSIBILITIES:

(i) Contractor to carry out Work with care and diligence.

The Contractor shall, in accordance with the Contract and with due care and diligence, design, manufacture, assemble, test at manufacturer's Works before dispatch, transport to site, store and preserve, assemble and erect, test and commission the Goods and carry out the Works within the Time for Completion. The Contractor shall also provide all necessary plant, equipment and machinery, superintendence, labor and all necessary facilities required for completion of works thereof.

(ii) Contractor Responsible for Stability and Safety of Site Operations.

The Contractor shall take full responsibility for the adequacy, stability and safety of all site operations and methods of execution, notwithstanding any approval by the Engineer-in-Charge. The Contractor shall provide, at his cost sufficient illumination, firefighting equipment in and around the place of work to the satisfaction of Engineer-in-Charge. Further, Contractor shall follow the safety precautions as covered in Section-7 of this Document.

(iii) Instructions and Orders in Site Order Book.

All instructions and orders given by the Engineer-in-Charge or his Representative at site are to be maintained in the Site Order Book and shall be taken to have been conveyed to the Contractor for his compliance.

(iv) Contractor's Site Office.

The Contractor must have a site office to receive normal correspondence between 10 AM and 5 PM on working days and urgent correspondence at any time on all days.

(v) Shift Works

To achieve the required progress, the Work, may be required to be carried out round the clock. The time for completion and number of working days shall not be affected by the number of shifts each day. No extra amount on account of any shift work is payable to the Contractor.
Whenever the work is carried out in shifts, notice to this effect shall be given by the Contractor to the Engineer-in-Charge regarding the details of Works he intends to carry out in shifts so that necessary supervision arrangements can be made.

(vi) Contractor to keep Site Clean

a) During the progress of the Works, the Contractor shall keep the site reasonably free from all unnecessary obstructions and shall remove from site any of his plant, equipment and machinery, surplus material or temporary works, no longer required. The Contractor

shall also keep the site clean, tidy and orderly at all times and remove from site any wreckage, rubbish, scrap, packing material etc. promptly.

b) In case the Contractor does not keep the area clean and if found necessary to get the area cleaned, the Engineer-in-Charge shall issue a notice of forty-eight hours to the Contractor. In the event of non-compliance by the Contractor, the Engineer-in-charge shall get the area cleaned by some other agency. The cost of such cleaning shall be borne by the Contractor. In case of rubbish, accumulating due to deposition by more than one Contractor, the share of charges to be borne by the Contractors as indicated by the Engineer-in-Charge shall be final.

(vii) Clearance of Site on Completion

On the completion of the Works, the contractor shall clear away and remove from the Site all his plant, equipment and machinery, surplus materials, rubbish and Temporary Works of every kind, and leave the whole of the Site and Works clean and in a workman like condition to the satisfaction of the Engineer-in-Charge

(viii) Giving of Notices, Payment of Fees and Compliance with Statutes and Regulations etc.

a) Giving of Notices and Payment of Fees

The Contractor shall give all notices and pay all fees required to be given or paid under any National or State Statute, Ordinance, or other Law, or any regulation, or bye-law of any local or other duly constituted authority in relation to the execution of Works and by the rules and regulations of all public bodies and companies whose property or rights are affected or may be affected in any way by the Works.

b) Compliance with Statutes, Regulations etc.

The Contractor shall conform, in all respects, with the provisions of any such Statute, Ordinance or Law as aforesaid and the regulation or bye-law of any local or other duly constituted authority which may be applicable to the Works and with such rules and regulations of public bodies and companies as aforesaid and shall keep the RECTPCL indemnified against all penalties and liability of every kind for breach of any such Statute, Ordinance or Law, regulation or bye-law.

c) Statutory Obligations

If the cost to Contractor in the performance of the Contract shall be increased or reduced by reasons of the making, passing or promulgation of any law after 30 days prior to the latest date of submission of bids, any order, regulation or by-law having the force of the law, the amount of such an increase or reduction shall be added to or deducted from the Contract Price as the case may be.

(ix) Opportunities for Other Contractors

(a) The Contractor shall, in accordance with the requirements of the Engineer-in-Charge, afford all reasonable opportunities for carrying out their Works to:

- any other Contractors employed by the RECTPCL, and workmen, and
- the workmen of the RECTPCL, and
- the workmen of any duly constituted authorities who may be employed in the execution on or near the Site of any work not included in the Contract or of any Contract which the RECTPCL may enter into in connection with or ancillary to the Works.

(b) The Contractor shall jointly use with other Contractors and the RECTPCL, approach roads, access roads and adits, drainage and other facilities. The use of other Contractor's facilities shall be coordinated by the Engineer-in-Charge between the Contractors, if required, for execution of the Works connected with the project. (Cost, if any, on this account shall be settled between the Contractors concerned).

The use of common facilities shall be coordinated by the Engineer-in-Charge through meetings of various parties. In case of any conflict, the decision of the Engineer-in-Charge in the matter shall be binding on all the parties.

(c) If any part of the Contractor's work depends, for proper execution or results, upon the work of any other Contractor, the Contractor shall inspect and promptly report in writing to the Engineer-in-Charge, any defects in such work that render it unsuitable for such proper execution and results. His failure to inspect and report shall constitute an acceptance of other Contractor's work as fit and proper for the reception of his own work, except as to defects, which may develop in the other Contractor's work after the proper execution of his own work.

(x) Patent Rights and Royalties.

(a) The Contractor shall indemnify the RECTPCL from and against all claims and proceedings for or on account of infringement of any patent rights, designs, trademark or name or other protected rights in respect of any of his plant, equipment and machinery or materials used for or in connection with the Works or any of them and from and against all claims, proceedings, damages, costs, charges and expenses, whatsoever, in respect thereof or in relation thereto.

Except where otherwise specified, the Contractor shall pay all royalties, rent and other payments or compensation, if any, for getting any materials required for the Works.

(b) In the event of any claims made under or action brought against RECTPCL in respect of any such matters, as aforesaid, the Contractor shall be immediately, notified thereof and the Contractor shall be at liberty, at his own expense, to settle any disputes or to conduct any litigation that may arise there from, provided that the Contractor

shall not be liable to indemnify the RECTPCL if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the Engineer-in-Charge in this behalf.

(xi) Packing

a) The Contractor shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit to the 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, humid and salt laden climate (where applicable) and precipitation during transit and open storage. Packing case size and weights shall take into consideration, the remoteness of the Goods' final destination, the existing road condition and the absence of heavy handling facilities at all points in transit.

b) **Project storage site**

The Contractor shall submit instructions for packing, handling, marking, storage code and documentation within and outside the package for approval by the Engineer-in-Charge. The packing, handling, marking, storage code and documentation within and outside the package shall comply strictly with such instructions. These instructions can be modified/changed at any time during the execution of works by the Engineer-in-Charge and Contractor shall comply with such instructions.

(xii) Delivery and Documents

a) Delivery of the Goods shall be made by the Contractor in accordance with the terms specified in the Contract. The Contractor shall warrant that the goods supplied under the Contract are new, unused, of most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the Contract. The Contractor further warrants that the goods supplied under this Contract shall have no defect arising from design, materials workmanship, installation or erection or from any act of omission of the supplier that may develop under normal use of supplied goods in conditions available at site.

b) The Contractor shall carryout all the required tests at his works as per approved Quality Assurance Plan. No material/goods shall be dispatched unless required shop tests have been performed and Material Dispatch Clearance Certificate (MDCC) has been issued by the Engineer-in-Charge after witnessing the tests.

c) The Contractor shall request the Engineer-in-Charge for issue of MDCC as under:

i) In case tests at works are not to be witnessed by RECTPCL, Contractor shall carryout these tests through reputed and recognized test houses of India and submit the test certificates to Engineer-in-Charge along with request for issue of MDDC for that component.

ii) In case test at works are to be witnessed by RECTPCL, Contractor shall submit test certificates to the Engineer-in-Charge after such inspection along with a request for issue of MDCC for that component.

iii) MDCC shall be issued within 15 (fifteen) days after the approval of test certificates.

The Contractor shall be responsible for arranging Import License and Customs clearance (wherever required). The RECTPCL will assist the Contractor where required, in arranging Import License and Import Duty exemption certificate and obtaining clearance through the Customs. Any assistance that the RECTPCL can give to the Contractor shall be provided on a "no responsibility basis".

(xiii) Communication and Transport

Jammu Tawi is the largest railway station in Jammu and Kashmir state. It is a major railhead for other places in the state and for tourists heading towards the Kashmir Valley. Jammu–Baramulla line project starts northwards from here. Administratively, it is in the Firozpur division of Northern Railways.

Jammu Tawi is well connected to major Indian cities by Indian railways trains.

With the commencement of the Jammu–Baramulla line, all trains to the Kashmir Valley will pass through Jammu Tawi. A part of the Jammu–Baramulla project has been executed and the track has been extended to Katra. Jalandhar - Pathankot - Jammu Tawi section has been doubled and electrified.

National Highway 1A which passes through Jammu connects it to the Kashmir valley. National Highway 1B connects Jammu with Poonch town. Jammu is just 80 kilometres (50 mi) from Kathua town, while it is 68 kilometres (42 mi) from Udhampur city. Katra is also 49 kilometres (30 mi) away.

Jammu Airport is in the middle of Jammu. It has direct flights to Srinagar, Delhi, Amritsar, Chandigarh, Leh and Mumbai and Bengaluru. Jammu Airport operate daily 30 arrival and departure flights which is Goair, Air India, Spicejet and Indigo running daily flights.

The city has JKSRTC city buses under and mini buses for local transport which run on some defined routes. These mini buses are called "Matadors". Besides this auto-rickshaw and cycle-rickshaw service is also available. Local taxis are also available.

Bidder may visit the site prior to bidding and make sure about Transportation of Material to site.

(xiv) Transportation and Storage/Preservation

(a) The Contractor is required under the Contract to undertake transportation of goods from Ex-works to Project Site including clearing, forwarding and handling, storage and preservation at site, intermediate location (if any) and further transportation to work site, including handling wherever required. All necessary transportation equipment including lifting and handling equipment shall be provided and/or hired by the Contractor at his own cost.

(b) Where the Contractor is required to effect delivery under any other terms, for example, by post or to another address, the Contractor shall be required to meet all the expenses until delivery on the site.

(xv) Spares

(a) The Contractor shall carry sufficient inventories to assure ex-stock supply of spares and same shall be supplied as promptly as possible but in any case within six months of placement of order.

(b) It shall be mandatory for the Contractor to specify the unit rates and prices for the spares as specified in the Schedule of Prices. The RECTPCL, however, reserve the right, during the execution of Contract, to vary the quantity of spares specified in the Schedule of Prices.

(xvi) Quality Assurance

In order to ensure that the Goods to be supplied under this Contract and the civil works to be executed meet the specification requirements, the Contractor shall prepare a comprehensive quality assurance plan and submit the same within 30 days after commencement date of the Contract to the Engineer-in-charge (**Additional Chief Executive Officer, RECTPCL, New Delhi**) for approval. Any national or International quality assurance certificates such as IS: 14000 series/ISO 9000 series obtained by the Contractor along with its validity period shall be stated.

CLAUSE-8: CONTRACT AGREEMENT:

The Contractor shall, when called upon to do so, enter into and execute a Contract Agreement in the Proforma (attached in Section-IX, VOL-I) of Bidding Document, with such modification as may be necessary.

CLAUSE-9: PERFORMANCE SECURITY:

(i) For the due performance of the Contract, the Contractor shall, within 15 (fifteen) days of receipt of notification of award but not later than the date of signing of the Contract Agreement, furnish to the RECTPCL, a performance security for an amount equivalent to 10 (ten) percent of the Contract Price. The cost of complying with the requirements of this Clause shall be borne by the Contractor, unless the Contract otherwise provides.

(ii) The performance security shall be in the form of an irrevocable Bank Guarantee on the Proforma (attached in Section-IX, VOL-I). The Bank Guarantee shall be in favour of the Accounts Officer with **Additional Chief Executive Officer, RECTPCL, New Delhi,** issued by any Nationalized /Scheduled Indian Bank.

(iii) The proceeds of the performance security shall be payable to RECTPCL as compensation for any loss, resulting from Contractor's failure to complete his obligation under the Contract.

(iv) The performance security shall be valid until 30 days after the date of issue of Defects Liability Certificate. No claim shall be made against the performance security after the issue of the Defects Liability Certificate and the performance

security will be discharged and returned to the Contractor thirty days after the Defects Liability Period.

(v) If the completion of last Defects Liability Period is extended due to the delays attributable to the Contractor, he shall, at his own cost, get the validity period of Bank Guarantee extended. The Contractor shall furnish the extended revised Bank Guarantee one month before the expiry date of the Original Bank Guarantee or any extension thereof. In case the extended/revised Bank Guarantee is not received by RECTPCL within the specified period, the RECTPCL, entirely at its discretion, shall be at liberty to encash the aforesaid Bank Guarantee.

CLAUSE 10: INSPECTION OF SITE:

(i) The Contractor shall be deemed to have inspected and examined the Site and its surroundings and information available in connection therewith and to have satisfied himself, as to

(a) the form and nature thereof

(b) the hydrological and climatic conditions

(c) the extent and nature of work, materials and water for construction necessary for the execution and completion of the Works and remedying of any defects therein, and

(d) the means of access to the Site and the accommodation he may require and, in general, shall be deemed to have obtained all necessary information as to risks, contingencies and all other circumstances.

(ii) The Contractor shall be responsible for the interpretation of any data supplied by the RECTPCL.

CLAUSE-11: SUFFICIENCY OF BID:

The Contractor shall be deemed to have satisfied himself as to the correctness of the rates and prices stated in the Schedule of Prices, all of which shall, except in so far as it is otherwise provided in the Contract, cover all his obligations under the Contract and all matters and things necessary for the proper execution and completion of the Works and remedying of any defects therein.

CLAUSE-12: WORK TO BE IN ACCORDANCE WITH THE CONTRACT:

The Contractor shall execute and complete the Works and remedy any defects therein in strict accordance with the Contract to the satisfaction of the Engineer-in-Charge and shall comply with and adhere strictly to the Engineer-in-Charge's instructions and directions on any matter whether mentioned in the Contract or not, touching or concerning the Works. The Contractor shall take instructions and directions only from the Engineer-in-Charge, or, subject to the limitations referred to in Clause-2 hereof, from the Engineer-in-charge's Representative.

CLAUSE-13: PROGRAMME TO BE FURNISHED:

(i) The Contractor shall within 30 days after the Commencement Date, submit to the Engineer-in-Charge, for his approval a detailed work programme in Primavera along with 2 sets of CDs of same indicating the following:

(a) The order in which the Contractor proposes to carry-out the Works (including design, manufacture, supply, erection, testing and commissioning) so as to complete the works within specified time schedule.

(b) The times when submission and approval of the Contractor's drawings are required (time frame for this shall conform to that set out under Clause-6 hereof).

(c) The times by which the Contractor requires the RECTPCL

- to furnish data/specification drawings, if any
- to have completed any other associated Works

The approval by the Engineer-in-charge of the programme shall not relieve the Contractor from any of his obligations under the Contract.

(ii) The programme shall cover activities on the site and procurement and delivery activities and no material alteration to such programme shall be made without prior approval of Additional Chief Executive Officer, RECTPCL, New Delhi

(iii) The programme shall be in the form of a network diagram which shall show in detail and in orderly sequence all activities, their descriptions, duration, and dependencies or precedencies, necessary to the completion of the Works.

(iv) The Contractor shall base his programme on the completion times and periods and other relevant Contract requirements and shall co-ordinate his programme with information given to him by the Engineer-in-Charge concerning the project programme and programme of other Contractors to be engaged on the site to the extent that this can be done within the framework of the periods and information available at the time.

(v) The Contractor shall, supply to the Engineer-in-Charge, at such times as he may direct during the progress of the Works, such written particulars, photographs and information as are reasonably required by the Engineer-in Charge to enable a progress record to be maintained in respect of the Works.

(vi) The Contractor shall also submit a narrative report periodically with updated analysis which shall include but not be limited to the description of the problem areas, current and anticipated, delaying factors and their impact and an explanation of the corrective actions taken or proposed.

CLAUSE-14: CONTRACTOR'S SUPERINTENDENCE:

The Contractor shall provide all necessary superintendence during the execution of the Works and as long thereafter as the Engineer-in-Charge may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor, or a competent and authorized representative approved of in writing by the Engineer-in-Charge, which approval may at any time be withdrawn, shall give his whole time to the superintendence of the

Works. Such authorized representative shall receive on behalf of the Contractor, instructions from the Engineer-in-Charge or subject to the provisions of Clause-2 hereof the Engineer-in-Charge's Representative. If approval of the representative is withdrawn by the Engineer-in-Charge, the Contractor shall, as soon as is practicable, having regard to the requirement of replacing him as herein after mentioned, after receiving notice of such withdrawal, remove the representative from the Works and shall not thereafter employ him again on the Works in any capacity and shall replace him by another representative approved by the Engineer-in-Charge.

CLAUSE-15: CONTRACTOR'S EMPLOYEES:

(i) The Contractor shall provide on the Site in connection with the execution and the completion of the Works and the remedying of any defects therein;

(a) only such technical assistants as are skilled and experienced in their respective trades and such foremen and leading hands as are competent to give proper superintendence of the Works; and

(b) such skilled, semi-skilled and unskilled labour as is necessary for the proper and timely fulfilling of the Contractor's obligations under the Contract.

(ii) The Engineer-in-Charge shall be at liberty to object to and require the Contractor to remove forthwith from the Works any person provided by the Contractor who in the opinion of the Engineer-in- Charge, misconducts himself, or is incompetent or negligent in the proper performance of his duties, or whose presence on the site is otherwise considered by the Engineer-in-Charge to be undesirable and such persons shall not be again allowed upon the Works without the written consent of the Engineer-in-Charge. Any person so removed from the Works shall be replaced as soon as possible by a competent substitute approved by the Engineer-in-Charge.

CLAUSE-16: EXTRAORDINARY TRAFFIC:

Protection of Highways and Bridges

The Contractor shall use every reasonable means to prevent any of the highways or bridges communicating with or on the routes to the site from being damaged by any traffic of the Contractor or any of his subcontractors and, in particular, shall select routes, choose and use vehicles and restrict and distribute loads so that any such extraordinary traffic, as will inevitably arise from the moving of Goods or his plant, equipment and machinery and materials from and to the site, shall be limited, as far as reasonably possible, and so that no unnecessary damage may be occasioned to such highways and bridges. In case, however, highways and bridges are damaged on account of movement of any traffic of the Contractor, he shall be liable to restore the highways and bridges to their original condition at his expense.

CLAUSE-17: SAFETY, SECURITY AND PROTECTION OF THE ENVIRONMENT:

The Contractor shall, throughout the execution and completion of the Works and the remedying of any defects therein;

(i) have all the regard for the safety of all persons entitled to be on the site and keep the site (so far as the same is under his control) and the Works (so far as the same are not completed or taken over by the RECTPCL) in an orderly state appropriate to the avoidance of danger to such persons, and

(ii) provide and maintain, at his own cost all lights, guards, fencing, warning signs and watching, when and where necessary or required by the Engineer-in-Charge or his representative or by any duly constituted authority, for the protection of the machines, equipment, Works or for the safety and convenience of the public or others, and

(iii) 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 a consequence of his methods of operation, and shall preserve and protect all existing vegetation such as trees on or adjacent to the site which do not unreasonably interfere with the execution of the Works. The Contractor shall be held responsible for all unauthorized cutting of and damage to trees, by careless operation of his plant, equipment and machinery and stockpiling of materials etc. and the RECTPCL shall have no responsibility on this account.

CLAUSE-18: OBLIGATIONS OF THE RECTPCL:

Access to and Possession of the Site

The RECTPCL shall, in reasonable time grant the Contractor access to and possession of the site, which may, however, not be exclusive to the Contractor.

CLAUSE-19: LABOUR:

(i) Engagement of Labour

The Contractor shall make his own arrangements for the engagement of all labour, local or otherwise, for the transport, housing, food, medical care etc. at his own expenses. The contractor shall not employ in connection with the Works any person who has not completed 18 years of age. No female labour shall be employed in the night shift. The Contractor shall not recruit or attempt to recruit his staff and labour from amongst persons in the service of RECTPCL.

The labour force, technical, administrative and other personnel engaged by the Contractor shall be confined to the nationals of India.

(ii) Supply of Water

The Contractor shall, so far as is reasonably practicable, provide on the site, to the satisfaction of the Engineer-in-charge or Engineer-in-Charge's Representative, an adequate supply of drinking and other water for the use of his staff and workmen.

The contractor shall arrange, at his cost, water for construction purposes at site.

(iii) Alcohol Liquor or Drugs

The Contractor shall not, otherwise than in accordance with the Statutes, Ordinances and Govt. Regulations or Orders for the time being in force, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or suffer any such importation, sale, gift, barter or disposal by his subcontractors, agents or staff or labour.

(iv) Epidemics

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulation, orders and requirements as may be made by the Government, or the local medical or sanitary authorities for the purpose of dealing with and overcoming the same.

(v) Disorderly Conduct etc.

The Contractor shall, at all times, take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst his staff and labour and for the preservation of peace and protection, of persons and property in the neighborhood of the Works.

(vi) Contractor to follow Labour Laws

The Contractor shall, in respect of labour employed by him, comply with the provision of the various Labour Laws, Minimum Wages Act as per Rules and Regulation as applicable and shall indemnify the RECTPCL in respect of all claims that may be made against the RECTPCL for non-compliance thereof by the Contractor. In case of noncompliance by the contractor, the Engineer-in-Charge may take such actions as may be necessary for compliance of the various Labour Laws and recover the costs thereof from the Contractor.

(vii) Housing for Labour

So far as the Contract otherwise provides, the Contractor shall provide and maintain such accommodation and amenities as he may consider necessary for all his staff and labour, employed for the purpose of or in connection with the Contract, including all fencing, water supply (both for drinking and other purposes), electricity supply, sanitation, cook houses, fire prevention and firefighting equipment, and other requirements in connection with such accommodation or amenities. On completion of the Contract, unless otherwise agreed with the RECTPCL, the temporary camps/housing provided by the Contractor shall be removed and the Site reinstated to its original condition, to the satisfaction of the Engineer-in-Charge.

(viii) Accident Prevention Officer

The Contractor shall have on his staff on Site an officer dealing only with questions regarding the safety and protection against accidents of all staff and labour. This officer shall be qualified for this work and shall have the authority to issue instructions and shall take protective measures to prevent accidents.

(ix) Health and Safety

Due precautions shall be taken by the Contractor, and at his own cost, to ensure the safety of his staff and labour and, in collaboration with and to the requirements of the local health authorities, to ensure that medical staff, first aid

equipment and stores, sick bay and suitable ambulance service are available at the camps, housing and on the Site at all times throughout the period of the Contract and that suitable arrangements are made for the prevention of epidemics and for all necessary welfare and hygiene requirements.

(x) Observance by Sub-Contractors

The Contractor shall be responsible for observance by his sub-contractors of the aforesaid provisions.

CLAUSE-20: RETURNS OF LABOUR:

The Contractor shall, deliver to the Engineer-in-Charge or Engineer-in-Charge's Representative or at his office, a return in detail in such form and at such intervals as the Engineer-in-Charge may prescribe showing the supervisory staff and the number of the several classes of labour from time to time employed by the Contractor on the site and such information in respect of the Contractor's plant, equipment and machinery as the Engineer-in-Charge may require.

CLAUSE-21: WORKMANSHIP AND MATERIALS:

(i) Manner of execution

The goods to be supplied shall be manufactured and all Works to be done shall be executed in the manner set out in the Contract.

Where the manner of manufacture and execution is not set out in the Contract, the Work shall be executed in a proper and workman like manner in accordance with recognised good practice and relevant standards.

(ii) Covering up work

The Contractor shall give the Engineer-in-Charge full opportunity to examine, measure and test any work on site which is about to be covered up or put out of view.

The Contractor shall give due notice to the Engineer-in-Charge whenever such work is ready for examination, measurement or testing.

The Engineer-in-Charge shall then, unless otherwise, notifies the Contractor that he considers it unnecessary, without unreasonable delay carry out the examination, measurement or testing

(iii) Uncovering work

If so instructed by the Engineer-in-Charge, the Contractor shall expose any parts of the works. The Contractor shall reinstate and make good such works to the satisfaction of the Engineer-in-Charge.

CLAUSE-22: INSPECTION AND TESTING:

(i) Independent Inspection

The Engineer-in-Charge shall have the right to inspect and/or to test the goods to confirm their conformity to the Contract specifications at no extra cost to the Purchaser. The Technical Specifications shall specify the inspection and tests required by Engineer-in-Charge. The Engineer-in-Charge may, delegate inspection and testing of contracted equipment or a part thereof to an independent Inspector and such independent Inspector shall be considered as the Engineer-in-Charge's Representative. Notice of such appointment shall be given by the Engineer-in-Charge to the Contractor.

(ii) Inspection and Testing During Fabrication/Manufacture

Any departmental representative or independent inspector nominated by Engineer-in-charge shall be entitled during fabrication/manufacture to inspect, examine and test the materials and workmanship and check the progress of fabrication/manufacture of the Goods to be supplied under the Contract. This shall take place on the Contractor's premises. If the Goods are being fabricated/manufactured on other premises, the Contractor shall obtain permission for the Engineer-in-charge to carry out such inspection, examination and testing on those premises.

The contractor shall certify that his persons conducting the tests are qualified specialist on the subject matter of relevant tests.

No such inspection, examination or testing shall release the Contractor from any obligation under the Contract.

(iii) Dates for Inspection and Testing

The Contractor shall give at least 15 days' notice to the Additional Chief Executive Officer, RECTPCL, New Delhi regarding his intention to carry out the tests. The Contractor shall agree with the Additional Chief Executive Officer, RECTPCL, New Delhi about the time and place for the testing of the Goods as provided in the Contract. The inspector nominated by Additional Chief Executive Officer, RECTPCL, New Delhi shall give the Contractor at least 24 hours' notice of his intention to attend the tests.

(iv) Facilities for Testing

Where the Contract provides for tests on the premises of the Contractor or of any sub-contractor, the Contractor shall provide such assistance, documents, labour, materials, electricity, fuel, apparatus and instruments as may be necessary to carry out the tests efficiently.

(v) Certificate of Testing

When the Goods have passed the tests referred to in this Contract, the Additional Chief Executive Officer, RECTPCL, New Delhi shall furnish to the Contractor a certificate within 15 days.

(vi) Rejection

If, as a result of the inspection, examination or testing, the Engineer–in-Charge decides that any work is defective or otherwise not in accordance with the Contract, he may reject such work and shall notify the Contractor thereof

immediately. The notice shall state the Engineer-in-Charge's objections with reasons.

The Contractor shall then, with all speed, make good the defect or ensure that any rejected work complies with the Contract.

If the Engineer-in-Charge requires such Works to be re-tested, the tests shall be repeated under the same terms and conditions. All costs incurred for the repetition of the tests shall be borne by the Contractor.

CLAUSE-23: SUSPENSION OF WORKS, TRANSPORTATION OR ERECTION:

(i) Order to Suspend

The Engineer-in-Charge or his representative may, at any time instruct the Contractor to:

(a) Suspend progress of the Works, or

(b) Suspend transportation of the Goods, if fabricated/ manufactured at a place other than on the site, which are ready for transportation to the site at the time specified in the programme, or if no time is specified, at the time appropriate for it to be transported, or

(c) Suspend the erection of the Goods which have been delivered to the site

The Contractor shall, during suspension, protect and secure the Works or Goods affected at the Contractor's Works or elsewhere or on the site, as the case may be, against any deterioration, loss or damage.

(ii) Cost of Suspension

The additional cost, if any, incurred by the Contractor in protecting, securing and insuring the Works or the Goods in following the Engineer-in-Charge or his representative's instructions under Sub-clause (i) of this Clause and in resumption of the Work, shall be added to the Contract Price.

The Contractor shall not be entitled to be paid any additional costs if such suspension is necessary by reason of some default on the part of Contractor.

The Contractor shall not be entitled to additional costs unless he notifies the Engineer-in-Charge or his representative of his intention to make such claim, within 30 days after receipt of the order to suspend progress or transportation or erection.

(iii) Suspension Lasting more than 90 days

If suspension under Sub-Clause (i) of this clause has continued for more than 90 days, and the suspension is not due to Contractor's default, the Contractor may, by written notice to the Engineer- in-Charge, request for permission within 30 days after the expiry of the above period to proceed with the Works.

If permission is not granted within that time, the Contractor may treat the suspension as an omission under Clause-32 hereof, of the section it affects or if

the suspension affects the whole of the Works, as an abandonment of the Contract by the RECTPCL.

CLAUSE-24: TIME FOR COMPLETION, EFFECTIVE DATE AND COMMENCEMENT DATE:

The Contract shall become effective on the date of signing of Contract Agreement between RECTPCL & successful bidder. The effective date shall be considered as commencement date.

The time for completion shall be reckoned from Commencement Date i.e. the date of signing of Contract Agreement between RECTPCL & successful bidder. The work i.e. **"Construction of 160 MVA, 220/33 kV Lassipora (GIS) Grid Substation under PMDP Sceme-15"** on Turnkey basis is to be completed within **24 months** of date of Award of Contract. The bidder shall submit a bar chart along with the bid giving schedule for completion of entire works covering supply as well as services indicating commencement and completion of each activity and foundation work considering zero date as the date of signing of Contract Agreement between RECTPCL & successful bidder.

The Works shall be completed and shall have passed the tests as per the prevalent Regulations/Act on completion within the time indicated above.

CLAUSE-25: EXTENSION OF TIME FOR COMPLETION:

The Contractor may claim an extension of the Time for Completion, if the completion of the Works is delayed by any of the following causes:

(i) Extra or additional work ordered in writing under Clause-32 hereof.
(ii) Delay by any other Contractor engaged by the RECTPCL, which affects this contract materially.
(iii) Any suspension of the works under Clause-23 hereof except when due to the Contractor's default.
(iv) Any force majeure conditions.

The Contractor shall give to the Engineer-in-charge**,** notice of his intention to make a claim for an extension of time within 14 days of the circumstances for becoming known to the Contractor for such an extension. The notice shall be followed as soon as possible with full supporting details.

The Engineer-in-charge will evaluate such details and grant the Contractor from time to time, either prospectively or retrospectively; such extension of Time for Completion as may be justified provided always that, the circumstances leading to the extension of Time for completion are other than through a default of the Contractor. The Engineer-in-charge shall notify the Contractor accordingly.

CLAUSE-26: RATE OF PROGRESS:

If for any reason, which does not entitle the Contractor to an extension of Time for Completion, the rate of progress of the Works or any section at any time is not commensurate with the time for completion set out under clause 24 here of and in the opinion of the Engineer-in-Charge does not ensure completion by the prescribed Time or extended Time for Completion, the Engineer-in-Charge shall so notify the Contractor in writing and the Contractor shall thereupon take such steps as are necessary and the Engineer-in-Charge may approve to expedite

progress so as to complete the Works or such section by the prescribed time or extended time. The Contractor shall not be entitled to any additional payment for taking such steps.

CLAUSE-27: LIQUIDATED DAMAGES FOR DELAY:

If the Contractor fails to complete the Work as specified in Clause 24 hereof, the purchaser shall, without prejudice to its other remedies under the Contract, deduct the amount from any monies in its hands, due or which may become due to the Contractor, as liquidated damages (which is a genuine pre-estimate agreed by the parties hereto of the loss or damage which the purchaser would have suffered on account of delay without giving any proof of the loss or damages) a sum equivalent to 1.0% of the Contract price plus GST payable thereon per week of delay or part thereof subject to a maximum of 10% of the Contract price plus GST payable thereon.

The payment or deduction of such damages shall not relieve the Contractor from his obligations to complete the works or from any of his obligations and liabilities under the Contract.

CLAUSE-28: PROLONGED DELAY:

If at any time it appears to the Engineer-in-Charge that the Contractor is unable to adhere to the prescribed time schedule and the delay is not due to a cause for which the RECTPCL or some other Contractor employed by it is responsible or if the aggregate of the liquidated damages levied in terms of the provisions under Clause-27 hereof has reached a maximum of ten percent of the Contract Price, then the RECTPCL may at its discretion, by further notice to the Contractor either:

i) require the Contractor to complete, or
ii) may itself complete at the Contractor's risk and cost, provided that it does so in a reasonable manner, or
iii) terminate the Contract.

If the RECTPCL terminates the Contract, it shall be entitled to recover from the Contractor any loss it has suffered.

CLAUSE-29: TESTS ON COMPLETION:

(i) Notice of Tests

The Contractor shall give to the Engineer-in-Charge, fifteen days' notice of the date after which he will be ready to make the Tests on completion hereinafter called the Tests. Unless otherwise agreed, the Tests shall take place within fifteen days after the said date, on such day or days as the Engineer-in-Charge notifies the Contractor.

(ii) Time for Tests

If the Engineer-in-Charge fails to notify a time after having been asked to do so, or does not attend at the time and place notified, the Contractor shall be entitled to proceed with the Test in his absence and such tests shall be deemed to have been carried out in the presence of Engineer-in-charge.

(iii) Delayed Tests

If the Tests are being unduly delayed by Contractor, the Engineer-in-Charge may, by a notice, require the Contractor to make the Tests within twenty-one days after the receipt of such notice. The Contractor shall make the Tests on such days within that period as the Contractor may fix and of which he shall give notice to the Engineer-in-charge.

If the Contractor fails to make the Tests within twenty-one days, the Engineer-in-Charge may himself proceed with the Tests. All Tests so made by the Engineer-in-Charge shall be at the risk and cost of the Contractor and the cost thereof shall be deducted from the Contract Price. The Tests shall then be deemed to have been made in the presence of the Contractor and the results of the Tests shall be accepted as accurate.

(iv) Facilities for Tests on Completion

Except where otherwise specified, the Contractor shall provide, at his cost, such labour, materials, electricity, fuel, apparatus, and other necessary equipment as may be required to carry out the Tests.

(v) Re-Testing

If the Works or any section fails to pass the Tests, the Engineer-in-Charge may require such Tests to be repeated on the same terms and conditions. The costs on account of repetition of the Tests under this Sub-Clause or under Sub-Clause-31 (vii) hereof shall be borne by the Contractor.

(vi) Disagreement as to Results of Tests

If the Engineer-in-Charge and the Contractor disagree on the interpretation of the Test results, each shall give a statement of his views to the other within fourteen days after such disagreement arises. The statement shall be accompanied by all relevant evidence. In case of such disagreement, the decision of Additional Chief Executive Officer, RECTPCL, New Delhi shall be final.

(vii) Consequences of Failure to Pass Tests on Completion

If the Works or any section fails to pass the Tests on the repetition thereof under Sub-Clause (v) of this Clause, the Engineer-in-Charge Shall be entitled to:

(a) order one further repetition of the Tests under the conditions of Sub-Clause (v) of this Clause, or

(b) reject the Works or section in which event the contractor shall replace that part of work or section without any cost to the purchaser within reasonable time without affecting the completion schedule. Testing on this part of work or section shall be performed in the presence of Engineer-in charge or his representative as per procedure specified above.

(viii) Test Certificate

As soon as the Works or any section thereof has passed the Tests, a joint protocol shall be signed based upon which the Engineer-in-Charge shall issue a

Certificate to the Contractor to that effect within seven days of signing the protocol and submission of all relevant documents.

CLAUSE-30: TAKING OVER:

(i) Taking over

The Works shall be taken over by the RECTPCL when they have been completed in accordance with the Contract and duly inspected & cleared for energisation by **Electrical Inspection Agency of the employer/Owner**, except in minor respects that do not affect the use of the Works for their intended purpose, have passed the Tests on Completion and a Taking Over Certificate has been issued in accordance with Sub-Clause (ii) of this Clause.

(ii) Taking Over Certificate

The Contractor may apply to the Engineer-in-Charge for issue of a Taking Over Certificate not earlier than fourteen days before he proposes to carry out commissioning and acceptance tests on each equipment of the substation.

The Engineer-in-Charge shall, within thirty days after the receipt of the Contractor's application either:

(a) Issue the Taking Over Certificate to the Contractor stating the date on which the Works were complete and ready for taking over, or

(b) Reject the application giving his reasons and specifying the work required to be done by the Contractor to enable the Taking Over Certificate to be issued.

(iii) Use before Taking Over

The RECTPCL shall not use any part of the Works unless a Taking Over Certificate has been issued in respect thereof.

If nevertheless, the RECTPCL uses any part of the Works, that part which is used shall be deemed to have been taken over at the date of such use. The Engineer-in-Charge shall, on request of the Contractor, issue a Taking Over Certificate accordingly. If the RECTPCL uses any part of the Works before taking over, the Contractor shall be given the earliest opportunity of taking such steps as may be necessary to carry out the Test on Completion.

The Works shall not be deemed to have been taken over if they are not substantially in accordance with the Contract.

The provisions set out under Clauses-29 and 31 hereof shall apply as if the part had been taken over on the date it was taken into use.

(iv) Interference with Tests on Completion

If the Contractor is prevented from carrying out the tests on completion by a cause for which the Engineer-in-charge or other Contractors employed by the RECTPCL are responsible, the RECTPCL shall be deemed to have taken over the Works on the date when the Tests on Completion would have been completed

but for such prevention, the Engineer-in-Charge shall issue a Taking Over Certificate accordingly.

The Works shall not be deemed to have been taken over if they are not substantially in accordance with the Contract.

If the Works are taken over under this Clause, the Contractor shall, nevertheless, carry out the Tests on Completion during the Defects Liability Period. The Engineer-in-Charge shall require the Tests on Completion to be carried out by fourteen days' notice and in accordance with the relevant provisions of Clause-29 hereof.

CLAUSE -31: DEFECTS AFTER TAKING OVER:

(i) Defects Liability Period

a) The expression "Defects Liability Period" shall mean a period of Twelve months from the date the Works are taken over under Clause-30 (i) hereof and the Taking Over Certificate is issued in accordance with Clause-30 (ii) hereof or 36 months from the date of delivery of each unit described under Clause 24 hereof, whichever is earlier.

Where any part of the Works is taken over separately, the Defects Liability Period for that part shall commence on the date it was taken over.

(ii) Notice of Defects

If any defect appears or damage occurs during the defect liability period, the Engineer-in-Charge shall forthwith notify the Contractor thereof. However, delay or failure of the Engineer-in-Charge in notifying shall not relieve the Contractor from his liability for remedying the defects at his own cost.

(iii) Making Good Defects

Upon the receipt of such notice the Contractor shall be responsible for making good any defect in or damage to any part of the Works which may appear or occur during the Defects Liability Period and which arises from either;

(a) any defective materials, workmanship or design, or

(b) any act or omission of the Contractor during the Defects Liability Period.

The Contractor shall make good the defect or damage as soon as practicable and at his own cost.

(iv) Extension of Defects Liability Period

The provisions of this Clause shall apply to all replacements or renewals carried out by the Contractor as if the replacement and renewals had been taken over on the date they were completed.

The Defects Liability Period for the Works shall be extended by a period equal to the period during which the Works cannot be used by reasons of a defect or

damage. If only a part of the Works is affected, the Defect Liability Period shall be extended only for that part.

In neither case shall the Defects Liability Period be extended by more than twelve months.

(v) Failure to Remedy Defects

If the Contractor fails to remedy a defect or damage within a reasonable time, the Engineer-in-Charge may fix a final time for remedying the defect or damage.

(a) If the Contractor fails to do so, the Engineer-in-Charge may carry out the work himself or by others at the Contractor's risk and cost. The costs actually incurred by the Engineer-in-Charge in remedying the defect or damage shall be recovered from any payments due or which may become due to the Contractor.

(vi) Removal of Defective Work

If the defect or damage is such that repairs cannot be expeditiously carried out on the site, the Contractor may, with the consent of the Engineer-in-Charge and after furnishing a proper security acceptable to the RECTPCL in case the item is paid for, remove from the site, for the purposes of repair, any part of the Works which is defective or damaged.

(vii) Further Tests on Completion

If the replacements or renewals are such that they may affect the performance of the Works, the Engineer-in-Charge may request that the Tests on Completion be repeated to the extent necessary. The request shall be made by notice **within thirty days** after the replacement of renewal. The Tests shall be carried out in accordance with Clause-29 hereof.

(viii) Right of Access

Until the Final Certificate of Payment has been issued, the Contractor shall have the right of access to all parts of the Works and to records of the working and performance of the Works.

Such right of access shall be during the RECTPCL normal working hours at the Contractor's risk and cost. Access shall also be granted to any duly authorised representative of the Contractor, whose name has been communicated in writing to the Engineer-in-Charge.

Subject to the Engineer-in-Charge's approval, the Contractor may also, at his own risk and cost, make any tests which he considers desirable.

(ix) Defects Liability Certificate

When the Defect, Liability Period for the Works or any part thereof has expired and the Contractor has fulfilled all his obligations under the Contract for defects in the Works or that part, the Engineer-in-Charge shall issue, within thirty days**,** to the Contractor, a Defects Liability Certificate to that effect.

No certificate other than the Defects Liability Certificate referred to herein above shall be deemed to constitute approval of the Works.

(x) Exclusive Remedies

The RECTPCL remedies under this Clause shall be in place of and to the exclusion of any other remedy in relation to defects whatsoever.

CLAUSE-32: VARIATIONS:

(i) The RECTPCL may make any variation in the form, quality or quantity of the Works or any part thereof or substitution for original specifications, design, drawings and instructions that may, in his opinion be necessary and for that purpose, or if for any other reason it shall, in his opinion be desirable, he shall have power to order the Contractor to do the following and the Contractor shall do the same;

a) increase or decrease the quantity of any work included in the Contract,

b) omit or substitute any such work,

c) change the drawings, designs specifications, character or quality or kind of any such work,

d) change the levels, lines, positions and dimensions of any part of the Works,

e) execute additional work of any kind necessary for the completion of the Works,

f) change any specified sequence, method or timing of construction of any part of the Works,

g) change method of dispatch or packing, and

h) change the place of delivery.

No such variations shall in any way vitiate or invalidate the Contract. Any altered, additional or substituted work which the Contractor may be directed to do in the manner above specified as part of the Work, shall be carried out by the Contractor on the same conditions in all respects on which he agreed to do the main Work.

The contractor may also at any time propose variations of the Works to the Engineer-in-Charge.

(ii) Procedure to order variation

The Engineer-in-Charge shall notify the Contractor of the nature and form of the variation considered necessary. After having received such notice, the Contractor shall submit to the Engineer-in-Charge.

a) a description of work, if any, to be performed and a programme for its execution, and

b) the Contractor's proposal for any modifications to the programme, if considered necessary, according to Clause-25 hereof or to any of the Contractor's obligations under the Contract, and

c) the Contractor's proposals for adjustment to the Contract Price.

Following the receipt of the Contractor's submission, the Engineer-in-Charge shall, decide as soon as possible whether or not the variation shall be carried out.

If the Engineer-in-Charge decides that the variation shall be carried out, he shall notify the Contractor to proceed with the variations. If the Engineer-in-Charge and the Contractor are unable to agree the adjustment of the Contract Price, the provisions of Sub-Clause (iii) of this Clause shall apply.

(iii) Disagreement on Adjustment of the Contract Price

If the Contractor and the Engineer-in-Charge are unable to agree on the adjustment of the Contract Price, the adjustment shall be determined in accordance with the rates specified in the Schedule of Prices.

No payment shall be made for the items of Work ordered to be omitted.

Varied items and additional items of Work which are not provided in the Schedule of Prices, shall be paid on the basis of actual expenditure relating to that item including cost of materials, fabrication/machinery handling and installation at site plus 25% (twenty-five percent) towards overheads including profits.

The price of varied items determined by the Engineer-in-Charge and approved by Additional Chief Executive Officer, RECTPCL, New Delhi shall be final and binding on the Contractor. No claim of the Contractor shall be entertained by RECTPCL in this regard.

(iv) Contractor to Proceed

On receipt of the notification to proceed with the variations, the Contractor shall forthwith proceed to carry out the variation and be bound to these conditions in doing so as if such variation was stated in the Contract.

The work shall not be delayed pending the granting of an extension of the time for completion or an adjustment to the Contract Price under Sub-Clause (iii) of this Clause and the Contractor shall execute the varied work at the same terms and conditions provided in the Contract.

(v) Records of costs

In any case where the Contractor is instructed to proceed with a variation prior to the determination of the adjustment to the Contract Price in respect thereof, the Contractor shall keep records of the cost of undertaking the variation and of time expended thereon. Such records shall be open to inspection by the Engineer-in-Charge at all reasonable times.

CLAUSE-33: TERMS OF PAYMENT

a. The Contract Price shall be paid as specified in the corresponding 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.

b. Except otherwise stated in Appendix-1 (Terms and Procedure of Payment) to the Contract Agreement, the payments under the Contract shall be made in the currency or currencies in which the Contract Price has been stated in Contract Agreement, subject to the general principle that payments will be made in the currency or currencies in which the Contract Price has been stated in the Contractor‟s bid.

33.1 Securities

33.1.1 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.

33.1.2 Advance Payment Security

33.1.2.1 The Contractor shall, within fifteen (15) days of the notification of contract award, provide a security in an amount equal to 110% (one hundred ten percent) of the advance payment calculated in accordance with the corresponding Appendix - 1 (Terms and Procedures of Payment) to the Contract Agreement, and in the same currency(ies) with initial validity of up to ninety (90) days beyond the date of Completion of the Facilities in accordance with GCC Clause 30. The same shall be extended by the Contractor time to time till ninety (90) days beyond the actual date of Completion of the Facilities, as may be required under the Contract.

33.1.2.2 The security shall be in the Form of unconditional Bank Guarantee attached hereto in Section IX - Sample Forms and Procedures. The security shall be discharged after completion of the facilities or relevant part thereof.

- Procedure for effective reduction in the Advance Payment Security

  The Advance Payment Security shall be allowed to be reduced every six (06) months after First Running Account Bill/Stage payment under the Contract if the validity of the Bank Guarantee is more than one year. 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 advance Bank Guarantee 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.

CLAUSE-34: CLAIMS

i) Pursuant to the provisions under the Contract, the procedure for submitting claims by the Contractor shall be as under;

a) the Contractor shall give to the Engineer-in-Charge a notice of his intention to make such claim within thirty days after such claim arises stating the reasons for his claim and

b) as soon as reasonably practical after the date of such notice, submit to the Engineer-in-Charge full and detailed particulars of his claim, but not later than 90 days after such notice, unless otherwise agreed by the Engineer-in-Charge . The Contractor shall thereafter promptly submit such further particulars as the Engineer-in-Charge may require assessing the validity of the claim.

ii) Assessment

When the Engineer-in-Charge of project has received full and detailed particulars of the Contractor's claim in accordance with Sub-Clause (i) of this Clause and such further particulars as he may have required, he shall determine whether the Contractor is entitled to additional payment and notify him accordingly.

The Engineer-in-Charge project may reject any claim for additional payment which does not comply with the requirements of Sub-Clause (i) of this clause and the decision of the said Engineer-in-charge shall be final and binding on the Contractor.

CLAUSE-35: CURRENCIES FOR PAYMENTS:

The Payments shall be made in Indian Rupees.

CLAUSE-36: RISK AND RESPONSIBILITY:

i Allocation of Risks and Responsibility

The Risks of loss of or damage to physical property and of death and personal injury, which arise in consequence of the performance of the Contract shall be allocated between the RECTPCL and the Contractor as follows:

(a) The RECTPCL: the RECTPCL Risks as specified in Sub-Clause (ii) below.
(b) the contractor: The Contractor's Risks specified in Sub-Clause (iii) below.

ii RECTPCL's Risks

The RECTPCL's Risks are:

(a) loss or damage due to the use or occupation of the Works or any part thereof by the RECTPCL; except as may be provided for in the Contract;

(b) loss or damage to the extent that it is due to the design of any part of the Works by the RECTPCL or those for whom the RECTPCL is responsible.

iii Contractor's Risks:

The Contractor's Risks are all risks other than those identified as the RECTPCL's Risks.

CLAUSE-37: CARE OF THE WORKS AND PASSING OF RISK:

(i) Contractor's Responsibility for the Care of the Works.

The Contractor shall be responsible for the care of the Works or any section thereof from the Commencement Date until the Risk Transfer Date applicable thereto under Sub-Clause (ii) of this Clause.

The Contractor shall also be responsible for the care of any part of the Works upon which any outstanding work is being performed by the Contractor during the Defects Liability Period until completion of such outstanding work.

(ii) Risk Transfer Date

The Risk Transfer Date in relation to the Works or a section thereof is the earliest of either:

(a) the date of issue of the Taking Over Certificate, or

(b) the date when the Works are deemed to have been taken over in accordance with **Clause-30** hereof, or

(c) the date of expiry of the notice of termination when the Contract is terminated by the RECTPCL in accordance with these Conditions.

(iii) Passing of Risk of Loss or of Damage to the Works

The risk of loss or of damage to the Works or any section thereof shall pass from the Contractor to the RECTPCL on the Risk Transfer Date applicable thereto.

(iv) Loss or Damage Before Risk Transfer Date

Loss of or damage to the Works or any section thereof occurring before the Risk Transfer Date shall:

(a) to the extent caused by any of the Contractor's risks, be made good forthwith by the Contractor at his own cost, and

(b) to the extent caused by any of the RECTPCL's Risks, be made good by the Contractor at the RECTPCL's expense if so required by the Engineer-in-Charge within thirty days of the occurrence of the loss or damage. The price for making good such loss and damage shall be in all circumstances reasonable and shall be agreed by the RECTPCL and the Contractor, or in the absence of agreement, the RECTPCL shall fix a reasonable price which shall be final and binding.

(v) Loss or Damage after Risk Transfer Date

After the Risk Transfer Date, the Contractor's liability in respect of loss of or damage to any part of the Works shall, except in the case of gross misconduct, be limited:

(a) to the fulfillment of the Contractor's obligations under **Clause-31** hereof in respect of defects therein, and
(b) to making good forthwith loss or damage caused by the Contractor during the Defects Liability Period.

CLAUSE-38: DAMAGE TO PROPERTY AND INJURY TO PERSONS:

(i) Contractor's Liability

Except as provided under Sub-Clause (iii) of this Clause, the Contractor shall be liable for and shall indemnify the RECTPCL against all losses, expenses and claims in respect of any loss of or damage to physical property, death or personal injury occurring before the issue of the last Defects Liability Certificate to the extent caused by;

(a) defective design, material or workmanship of the Contractor.
(b) negligence or breach of statutory duty of the Contractor, his sub-contractors or their respective employees and agents.

(ii) RECTPCL's Liability

The RECTPCL shall be liable for and shall indemnify the Contractor against all losses, expenses or claims in respect of loss of or damage to any physical property or of death or personal injury whenever occurring, to the extent caused by any of the RECTPCL's Risks.

(iii) Accidents

The Contractor shall be liable for and shall indemnify the RECTPCL against all losses, expenses or claims arising in connection with the death of or injury to any person employed by the Contractor or his sub-contractors for the purposes of the Works, unless caused by any defaults of the Engineer-in-Charge or other Contractors engaged by the RECTPCL or by their respective employees or agents and in such cases the RECTPCL shall be liable for and shall indemnify the Contractor against all losses, expenses and claims arising in connection therewith.

CLAUSE-39: LIMITATIONS OF LIABILITY:

(i) Liability after expiration of Defects Liability Period

The Contractor shall have no liability to the RECTPCL for any loss of or damage to the RECTPCL's physical property which occurs after the expiration of the Defects Liability Period unless caused by gross misconduct of the Contractor.

(ii) Exclusive Remedies

The RECTPCL and the Contractor intend that their respective rights, obligations and liabilities as provided for in these conditions shall alone govern their rights under the Contract and in relation to the Works.
Accordingly, the remedies provided under the Contract in respect of or in consequence of:

a) any breach of Contract, or
b) any negligent act or omission, or

c) death or personal injury, or
d) loss or damage to any property

are to be to the exclusion of any other remedy that either may have against the other under the law governing the Contract or otherwise.

(iii) Mitigation of Loss or Damage

In all cases the party claiming a breach of Contract or a right to be indemnified in accordance with the Contract shall be obliged to take all reasonable measures to mitigate the loss or damage.

CLAUSE-40: INSURANCE

Refer Appendix-III, Insurance Requirement, Section-IX, Vol-I,

CLAUSE-41: FORCE MAJEURE:

(i) Definition of Force Majeure

Force Majeure means any circumstances beyond the control of the parties, including but not limited to:

a) war and other hostilities, (whether war be declared or not), invasion, act of foreign enemies, requisition or embargo;

b) rebellion, revolution, insurrection, military or usurped power and civil war;

c) ionising radiation or contamination by radio activity from any nuclear fuel or from any nuclear waste from the combustion of nuclear fuel, radio-active toxic explosives, or other hazardous properties of any explosive nuclear assembly or nuclear components thereof;

d) riot, commotion or disorder, except where solely restricted to employees of the Contractor or of his sub-contractors.

e) Earthquake affecting Contractor's work.

(ii) Effect of Force Majeure

Neither party shall be considered to be in default or in breach of his obligations under the Contract to the extent that performance of such obligations is prevented by any circumstances of Force Majeure which arise after the date of the Letter of Award or the date when the Contract becomes effective, whichever is the earlier.

(iii) Notice of Occurrence

If either party considers that any circumstances of Force Majeure have occurred which may affect performance of his obligations, he shall promptly notify the other party.

(iv) Performance to Continue

Upon the occurrence of any situation of Force Majeure, the Contractor shall endeavor to continue to perform his obligations under the Contract so far as reasonably practicable. The Contractor shall notify the Engineer-in-Charge of the steps he proposes to take including any reasonable alternative means for performance which is not prevented by Force Majeure. The Contractor shall not take any such steps unless directed so to do by the Engineer-in-Charge.

(v) Additional Costs caused by Force Majeure

If the Force Majeure events exceed a period of six months and if the Contractor incurs additional costs in complying with the Engineer-in-Charge's directions under Sub-Clause (iv) of this Clause then, the Contractor shall be compensated for the additional costs and expenses during the period of Force Majeure exceeding six months and for the costs and expenses to be incurred for the continuation of execution of the Contract.

(vi) Termination in Consequence of Force Majeure

If circumstances of Forces Majeure have occurred and shall continue for a **period of twelve months** then, notwithstanding that the Contractor may by reason thereof has been granted an extension of Time for Completion of the Works, either party shall be entitled to serve upon the other 30 days' notice to terminate the Contract. If at the expiry of the period of 30 days, Force Majeure shall still continue, the Contract shall be terminated.

(vii) Payment on Termination for Force Majeure

If the Contract is terminated under Sub-Clause (vi) of this Clause, the Contractor shall be paid the value of the work done.

The Contractor shall also be entitled to receive;

a) the amounts payable in respect of any preliminary items so far as the work or service comprised therein has been carried out and a proper proportion, as certified by the Engineer-in-Charge, of any such item in which the work or service comprised has only been partially carried out,

b) the cost of materials or goods reasonably ordered for the Works or for use in connection with the Works which have been delivered to the Contractor or of which the Contractor is legally liable to accept delivery. Such materials or goods shall become the property of RECTPCL when paid for by it and the Contractor shall place the same at the RECTPCL's disposal,

c) the amount certified by the Engineer-in-Charge, being the amount of any expenditures which in the circumstances was reasonably incurred by the Contractor in the expectation of completing the whole of the Works insofar as such expenditure shall not have been covered by any other payments referred to in this Sub-Clause.

CLAUSE-42: DEFAULT:

(i) Notice of Default

If the Contractor is not executing the Works in accordance with the Contract or is neglecting to perform his obligations there under so as to seriously affect the carrying out of the Works, the Engineer-in-Charge or his representative may give notice to the Contractor requiring him to make good such failure or neglect.

(ii) Contractor's Default

If the Contractor;

(a) has failed to comply, within a reasonable time, with a notice under Sub-Clause (i) of this Clause, or

(b) assigns the Contract or subcontracts the whole or part of the Works without the RECTPCL's written consent, or

(c) becomes bankrupt or insolvent, has a receiving order made against him or compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors or goes into liquidation.

The RECTPCL may, after having given seven days' notice to the Contractor, terminate the Contract and expel the Contractor form the site. Any such expulsion and termination shall be without prejudice to any other rights or powers of the RECTPCL under the Contract. The RECTPCL may upon such termination, complete the Works itself or by any other Contractor.

(iii) Valuation at Date of Termination

The Engineer-in-Charge shall, as soon as possible after such termination, certify the value of the Works and all sums then due to the Contractor as at the date of termination in accordance with Clause-33 hereof.

(iv) Payment after Termination

The RECTPCL shall not be liable to make any further payments to the Contractor until the Works have been completed and the Defects Liability Period is over. The RECTPCL shall be entitled to recover from the Contractor the extra costs, if any, of completing the Works after allowing for any sum due to the Contractor under Sub-Clause (iii) of this Clause. If there is no such extra cost, the RECTPCL shall pay any balance due to the Contractor.

(v) Effect on Liability for Delay

The Contractor's liability under Clauses-27 and 28 hereof shall immediately cease when the RECTPCL expels him from the site without prejudice to any liability thereunder that may have already occurred.

CLAUSE 43- INCREASE OR DECREASE OF COSTS

-Deleted-

CLAUSE-44: TAXES AND DUTIES:

(i) For Supply of Goods:

The prices shall include all duties, levies and taxes in India that may be levied according to the Laws and regulation, save, as provided under para 1.13 of 'Information & Instructions' and clause 33 (ii) of the General Conditions of the Contract. Nothing in the contract shall relieve the contractor from his responsibility to pay any tax that may be levied in India on profits made by him in respect of the Contract.

(ii) Income Taxes on Staff

The Contractor's staff, personnel and labour will be liable to pay personal income tax in respect of such of their salaries and wages as are chargeable under the laws and regulations for the time being in force and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such laws and regulations.

CLAUSE-45: OWNERSHIP:

Ownership of goods shall pass from the Contractor to the RECTPCL on arrival of the goods at site. However, such passing of ownership shall not in any way dilute the responsibility of the Contractor to insure the goods as per Clause-40 hereof and shall not absolve the Contractor of his obligations and liabilities under the Contract. The goods shall be handed over back to the Contractor for performance of services under the Contract for which Contractor shall submit an Indemnity Bond to the purchaser as per proforma attached at SECTION-IX, VOLUME-I.

CLAUSE-46: NOTICES:

(i) Service of Notices on Contractor

All notices or written orders to be given by the RECTPCL or by the Engineer-in-Charge or his representative to the Contractor under the terms of the Contract shall be served either by sending by post to or delivering the same to the Contractor's office on site or his principal place of business, or such other address as the Contractor shall nominate for this purpose.

(ii) Service of Notices

All notices to be given to the Engineer-in-Charge under the terms of Contract shall be served by sending by post or delivering the same to the respective address given below.

Additional Chief Executive Officer
RECTPCL, ECE House, 3rd Floor, Annexe - II, 28A, KG Marg, New Delhi - 110001

(iii) Change of Address

Either party may change a nominated address to another address by prior written notice to the other party.

CLAUSE-47: SETTLEMENT OF DISPUTE:

i. If any dispute of any kind whatsoever shall arise between the Employer and the Contractor in connection with or arising out of the Contract, including without prejudice to the generality of the foregoing, any question regarding its existence, validity or termination, or the execution of the Facilities, whether during the progress of the Facilities or after their completion and whether before or after the termination,

abandonment or breach of the Contract, the parties shall seek to resolve any such dispute or difference, to the extent possible, amicably by mutual consultation.

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

   a. The decision/instruction of the Project Manager shall be deemed to have been accepted by the Contractor unless notified by the Contractor of his intention to refer the matter for Arbitration within thirty (30) days of such decision/instruction.
   b. In the event the Project Manager fails to notify his decision as aforesaid within thirty (30) days, the Contractor, if he intends to go for Arbitration, shall notify his intention to the Project Manager within 30 days of expiry of the first mentioned period of thirty days failing which it shall be deemed that there are no dispute or difference between the Employer and the Contractor.

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

CLAUSE-48: ARBITRATION:

i. All disputes or differences in respect of which the decision, if any, of the Project Manager and/or the Head of the Implementing Authority has not become final or binding as aforesaid shall be settled by arbitration in the manner provided herein below:
ii. The arbitration shall be conducted by three arbitrators, one each to be nominated by the Contractor and the Employer and the third to be appointed by both the arbitrators in accordance with the Indian Arbitration Act. If either of the parties fails to appoint its arbitrator within sixty (60) days after receipt of a notice from the other party invoking the Arbitration clause, the arbitrator appointed by the party invoking the arbitration clause shall become the sole arbitrator to conduct the arbitration.
iii. The language of the arbitration proceedings and that of the documents and communications between the parties shall be English. The arbitration shall be conducted in accordance with the provisions of the Indian Arbitration and Conciliation Act, 1996 or any statutory modification thereof. The venue of arbitration shall be New Delhi.
iv. The decision of the majority of the arbitrators shall be final and binding upon the parties. In the event of any of the aforesaid arbitrators dying, neglecting, resigning or being unable to act for any reason, it will be lawful for the party concerned to nominate another arbitrator in place of the outgoing arbitrator.
v. During settlement of disputes and arbitration proceedings, both parties shall be obliged to carry out their respective obligations under the Contract.

CLAUSE-49: TERMINATION OF CONTRACT FOR RECTPCL's CONVENIENCE:

(i) The Engineer-in-Charge of RECTPCL shall be entitled to terminate this Contract at any time for the RECTPCL's convenience after recording sufficient reasons and getting approval from the relevant contract committee after providing the contractor an opportunity of being heard for which 30 days' prior notice shall be given to the contractor by the Executive Engineer, in-charge project with a copy to the Engineer, in-charge.

(ii) In the event of such termination, the Contractor shall be paid by the RECTPCL as provided in Sub-Clause – 41 (vii) hereof.

CLAUSE-50: JOINT VENTURES:

If the Contractor is a joint venture or consortium, all partners of the joint venture shall be jointly and severally liable to the RECTPCL for the execution of the entire Contract in accordance with its terms.

SECTION-V, VOL-I

SPECIAL CONDITIONS OF CONTRACT (SCC)

SPECIAL CONDTIONS OF CONTRACT

Preamble

This Section of the Bidding Documents shall be named as Special Conditions of Contract (SCC). If there is a conflict between the Section of the bid document namely General Terms & Conditions for Supply and works, the provisions of this section shall prevail.

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
1	**New Clause**	**Addition of New Clause :** **Severability:** If any provision or condition of the Contract is prohibited or rendered invalid or unenforceable, such prohibition, invalidity or unenforceability shall not affect the validity or enforceability of any other provisions and conditions of the Contract.
2	**New Clause**	**Addition of New Clause :** **Country of Origin** "Origin" means the place where the materials, equipment and other supplies for the Facilities are mined, grown, produced or manufactured, and from which the services are provided. Plant and equipment are produced when, through manufacturing, processing or substantial and major assembling of components, a commercially recognized product results that is substantially different in basic characteristics or in purpose or utility from its components.
3	**Clause no. 31 (i) (a)**	**Replacing sub-clause no. 31 (i) (a)** The expression " Defects Liability Period" shall mean a period of as provided below from the date the Works are taken over under Clause-30 (i) hereof and the Taking Over Certificate is issued in accordance with Clause-30 (ii) hereof . "The Defect Liability Period: (i) **Forty Eight (48) months** from the date of Taking Over/Completion of Facilities for 220kV and 33kV voltage level GIS Circuit Breaker bay* to be supplied by the manufacturer who have established manufacturing/testing facilities for 220kV or above voltage level Gas Insulated Switchgear (GIS) in India based on technological support of Parent Company (Principals) or Collaborator(s) or Subsidiary Company as per the provision of bid document. (ii) **Sixty (60) months** from the date of Taking Over/Completion of Facilities for 220kV and 33kV voltage level GIS Circuit Breaker bay* to be supplied by the bidder from their Subsidiary or Group Company or a Joint Venture Company as per the provision of bid document. (iii) **Sixty (60) months** for (132kV/220kV/400kV Class) Transformer from the date of Taking Over/Completion of Facilities (or part thereof). For the purpose of this clause, the Measurable Defects as per the Technical Specifications

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		shall also be considered for Transformer. (iv) Twelve (12) months from the date of Taking Over/Completion of Facilities for all equipment/materials other than those specified at (i), (ii) and (iii) above". * *One no. of Circuit Breaker bay shall be considered as a bay used for controlling a line or a transformer or a reactor or a bus section or a bus coupler and comprising of at least one circuit breaker, one disconnector and three nos. of single phase CTs / Bushing CTs.* Where any part of the Works is taken over separately, the Defects Liability Period for that part shall commence on the date it was taken over.
4	**New Clause**	**Addition of New Clause :** **Indemnity:** ● 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 materials at Site and execute an Indemnity Bond and obtain authorisation letter from Employer as per proforma enclosed at Section-IX of Vol-I (Sample Forms and Procedures), in favour of the Employer against loss, damage and any risks involved for the full value of the materials. This Indemnity Bond shall be furnished by the Contractor before commencement of the supplies and shall be valid till the scheduled date of Taking Over of the equipment by the Employer. ● In case of divisible Contracts, where the Employer hands over his equipment to the Contractor for executing the Contract, then the Contractor shall, at the time of taking delivery of the equipment through Bill of Lading or other despatch documents, furnish trust Receipt for Plant, Equipment and Materials and also execute an Indemnity Bond in favour of the Employer in the form acceptable to the Employer for keeping the equipment in safe custody and to utilize the same exclusively for the purpose of the said Contract. Samples of proforma for the Trust receipt and Indemnity Bond are enclosed under Section-IX of Vol-I (Sample Forms and Procedures). The Employer shall also issue a separate Authorization Letter to the Contractor to enable him to take physical delivery of plant, equipment and materials from the Employer as per proforma enclosed under Section IX of Vol-I (Sample Forms and Procedures).
5	**New Clause**	**Addition of New Clause :** **Intellectual Property** **Copy Right** ● 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.

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		The Employer shall however be free to reproduce all drawings, documents and other material furnished to the Employer for the purpose of the Contract including, if required, for operation and maintenance. • The copyright in all drawings, documents and other materials containing data and information furnished to the Contractor by the Employer herein shall remain vested in the Employer. **Confidential Information** • 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 Clause. • 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. • The above provisions of this Clause 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. • The provisions of this Clause shall survive termination, for whatever reason, of the Contract.
6	**New Clause**	**Addition of New Clause :** **Contractor's Organization Chart:** • 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 curricular 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. In case of RECTPCL Project Manager is Engineer –in- Charge

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
7	**Clause Ref No-17**	**Supplementary Clauses may be read out with GCC Clause no-17 for SAFETY, SECURITY and PROTECTION OF THE ENVIRONMENT:** 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 Employers 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. **Compliance with Labour Regulations:** • 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 byelaws 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 no case shall be treated as the employees of the Employer at any point of time. • 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. • If the Employer is caused to pay under any law as principal employer such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/ byelaws/Acts/ Rules/regulations including amendments, if any, on the part of the Contractor, the Employer shall have the right to deduct any money due to the Contractor under this contract or any other contract with the 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. Notwithstanding the above, the Contractor shall furnish to the Employer the details/documents evidencing the Contractors compliance to the laws applicable to establishments engaged in building and other construction works, as may be sought by the Employer. In particular the Contractor shall submit quarterly certificate regarding compliance in respect of provisions of Employees‟ Provident Fund and Misc. Provisions Act 1952 to the Employer. For this purpose, the Contractor as well as its Sub-Contractor(s) should have Provident Fund Code Number and all the workers deployed by the Contractor or Sub-Contractor must be enrolled as members of Provident Fund having an Universal

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		Account Number (UAN). **Salient features of some major laws applicable to establishments engaged in building and other construction works:** • Workmen Compensation Act 1923: The Act provides for compensation in case of injury by accident arising out of and during the course of employment. • 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 at the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees. • 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: ✓ Pension or family pension on retirement or death, as the case may be. ✓ Deposit linked insurance on death in harness of the worker. ✓ Payment of P.F. accumulation on retirement/death etc. • **Maternity Benefit Act 1951:** The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc. • **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. • 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. • Payment of Wages Act 1936: It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers. • 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. • 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

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		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 20to 10 for the purpose of applicability of this Act. • 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. • 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. • 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. • Child Labour (Prohibition & Regulation) Act 1986: The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry. • 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, travelling expenses from home upto the establishment and back, etc. • 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.

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		• **Factories Act 1948:** The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process. **Following law be added against Environment Protection:** 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 or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms. • The Air (Prevention and Control of Pollution) Act, 1981, 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 for matters connected herewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under Environment (Protection) Act, 1986, and exceeding such quantity as may be specified by notification by the Central Government. **Safety Precautions** • The Contractor shall observe all applicable regulations regarding safety on the Site. Unless otherwise agreed, the Contractor shall, from the commencement of work on Site until Taking Over, provide:

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		• fencing, lighting, guarding and watching of the Works, and • Temporary roadways, footways, guards and fences which may be necessary for the accommodation and protection of Employer / his representatives and occupiers of adjacent property, the public and others. • The Contractor shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to Employer or to others, working at the Site. The Contractor shall also be responsible for provision of all safety notices and safety equipment required both by the relevant legislations and the Project Manager, as he may deem necessary. • The Contractor will notify well in advance to the Project Manager of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. The Project Manager shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contractor shall strictly adhere to and comply with such instructions. The Project Manager shall have the right at his sole discretion to inspect any such container or such construction plant/equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by the Employer and the Employer shall not entertain any claim of the Contractor towards additional safety provisions/conditions to be provided for/constructed as per the Project Manager's instructions. Further, any such decision of the Project Manager shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by the Project Manager, the Contractor shall use alternative methods with the approval of the Project Manager without any cost implication to the Employer or extension of work schedule. • Where it is necessary to provide and/or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and/or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act, 1948 and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Project Manager. In case, any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same. • All equipment used in construction and erection by Contractor shall meet Indian/International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipment shall be strictly operated and maintained by the Contractor in accordance with manufacturer's Operation Manual and safety instructions and as per Guidelines/rules of Employer in this regard. • Periodical examinations and all tests for all lifting/hoisting

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		equipment & tackles shall be carried-out in accordance with the relevant provisions of Factories Act 1948, Indian Electricity Act 1910 and associated Laws/Rules in force from time to time. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Project Manager or by the person authorised by him. • The Contractor shall be fully responsible for the safe storage of his and his Sub-Contractors radioactive sources in accordance with BARC/DAE Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, storage and handling of such material will be taken by the Contractor. • The Contractor shall provide suitable safety equipment of prescribed standard to all employees and workmen according to the need, as may be directed by the Project Manager who will also have right to examine these safety equipment to determine their suitability, reliability, acceptability and adaptability. The Contractor shall also provide Reflective Jackets to all workmen working on the site including different coloured such Jackets to the persons working at height. • Where explosives are to be used, the same shall be used under the direct control and supervision of an expert, experienced, qualified and competent person strictly in accordance with the Code of Practice/Rules framed under Indian Explosives Act pertaining to handling, storage and use of explosives. • The Contractor shall provide safe working conditions to all workmen and employees at the Site including safe means of access, railings, stairs, ladders, scaffoldings etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection, good and standard quality of material only shall be used by the Contractor. • The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other Contractors under any circumstances, whatsoever, unless expressly permitted in writing by Employer to handle such fuses, wiring or electrical equipment • Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Employer, he shall: a. Satisfy the Project Manager that the appliance is in good working condition; b. Inform the Project Manager of the maximum current rating, voltage and phases of the appliances; c. Obtain permission of the Project Manager detailing the sockets to which the appliances may be connected. The Project Manager will not grant permission to connect until he is satisfied that; a. The appliance is in good condition and is fitted with suitable plug; b. The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthed metal sheath

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		surrounding the cores. • No electric cable in use by the Contractor/Employer will be disturbed without prior permission. No weight of any description will be imposed on any cable and no ladder or similar equipment will rest against or attached to it. • No repair work shall be carried out on any live equipment. The equipment must be declared safe by the Project Manager and a permit to work shall be issued by the Project Manager before any repair work is carried out by the Contractor. While working on electric lines/equipment, whether live or dead, suitable type and sufficient quantity of tools will have to he provided by the Contractor to electricians/workmen/officers. • The Contractors shall employ necessary number of qualified, full time electricians/electrical supervisors to maintain his temporary electrical installation. • The Contractor employing more than 250 workmen whether temporary, casual, probationer, regular or permanent or on contract, shall employ at least one full time officer exclusively as safety officer to supervise safety aspects of the equipment and workmen, who will coordinate with the Project Safety Officer. In case of work being carried out through Sub-Contractors, the Sub-Contractor's workmen/employees will also be considered as the Contractor's employees/workmen for the above purpose. The Contractor shall deploy one dedicated Safety Staff(s) for every 200 kms of a Transmission Line Project. In case, the Contractor fails to deploy Qualified Safety Officer(s)/Safety Staff(s) under each Contract, as specified, then the Contractor shall be responsible for payment of a sum of Rs. 15,00,000/- per quarter till the Safety Officer(s)/Safety Staff(s) is deployed, to be deposited with the Employer, which will be retained in the Safety Corpus Fund. • The name and address of such Safety Officers of the Contractor will be promptly informed in writing to Project Manager with a copy to Safety Officer-In charge before he starts work or immediately after any change of the incumbent is made during currency of the Contract. In case any accident occurs during the construction/ erection or other associated activities undertaken by the Contractor thereby causing any minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform but no later than 24 hrs. of the occurrence of the same, to the Project Manager in prescribed form and also to all the authorities envisaged under the applicable laws. Notwithstanding above, in case of any fatal accident, the Board of Directors of Contractor shall review the incidence and a copy of Board's resolution signed by the Director/Company Secretary of the firm along with action plan for avoidance of such incidences in future shall be furnished promptly but no later than 60 days, to the

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		Employer. Besides above, the CEO of the Contractor shall meet and apprise RECTPCL along with the Board's resolution of the cause of the fatal accident occurred and their future action plan/safety preparedness to prevent recurrence of such accidents in future within 60 days of the occurrence of the fatal accident. • The Project Manager shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and/or property, and/or equipment. In such cases, the Contractor shall be informed in writing about the nature of hazards and possible injury/accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary, appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor. • The Contractor shall not be entitled for any damages/compensation for stoppage of work due to safety reasons as provided above and the period of such stoppage of work will not be taken as an extension of time for completion of work and will not be the ground for waiver of levy of liquidated damages. • It is mandatory for the Contractor to observe during the execution of the works, requirements of Safety Rules which would generally include but not limited to following: • Safety Rules a. Each employee shall be provided with initial indoctrination regarding safety by the Contractor, so as to enable him to conduct his work in a safe manner. b. No employee shall be given a new assignment of work unfamiliar to him without proper introduction as to the hazards incident thereto, both to himself and his fellow employees. c. Under no circumstances shall an employee hurry or take unnecessary chance when working under hazardous conditions. d. Employees must not leave naked fires unattended. Smoking shall not be permitted around fire prone areas and adequate fire fighting equipment shall be provided at crucial location. e. Employees under the influence of any intoxicating beverage, even to the slightest degree shall not be permitted to remain at work. f. There shall be a suitable arrangement at every work site for rendering prompt and sufficient first aid to the injured. g. The staircases and passageways shall be adequately lighted. h. The employees when working around moving machinery, must not be permitted to wear loose garments. Safety shoes are recommended when working in shops or places where materials or tools are likely to fall. Only experienced workers shall be permitted to go behind guard rails or to clean around energized or moving equipment. i. The employees must use the standard protection equipment intended for each job. Each piece of equipment shall be

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inspected before and after it is used.
j. Requirements of ventilation in underwater working to licensed and experienced divers, use of gum boots for working in slushy or in inundated conditions are essential requirements to be fulfilled.
k. In case of rock excavation, blasting shall invariably be done through licensed blasters and other precautions during blasting and storage/transport of charge material shall be observed strictly.
• The Contractor shall follow and comply with all Employer Safety Rules, relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any demur, protest or contest or reservations. In case of any discrepancy between statutory requirement and Employer Safety Rules referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent.
• If the Contractor fails in providing safe working environment as per Employer Safety Rules or continues the work even after being instructed to stop work by the Project Manager as provided above, the Contractor shall promptly pay to Employer, on demand by the Employer, compensation at the rate of Rs. 10,000/- per day or part thereof to be deposited in Safety Corpus Fund pursuant to clause below, till the instructions are complied with and so certified by the Project Manager. However, in case of accident taking place causing injury to any individual, the provisions contained in Clause below shall also apply in addition to compensation mentioned in this Clause.
• If the Contractor does not take adequate safety precautions and/or fails to comply with the Safety Rules as prescribed by the Employer or under the applicable law for the safety of the equipment and plant
<table>
<tr><td>a</td><td>Fatal injury or accident causing death</td><td>Rs. 15,00,000/- per person</td></tr>
<tr><td>b</td><td>Major injuries or accident causing 25% or more permanent disablement</td><td>Rs. 5,00,000/- per person</td></tr>
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• The amount paid/ recovered from the Contractor on account of non-compliance to Safety measures shall be deposited in the „Safety Corpus Fund", if not specified otherwise, established by the Employer. The „Safety Corpus Fund" shall be used for augmentation of Safety measures in construction works, capacity building of workers, development of working conditions of workers like providing tents/ mobile toilets/ caravans, safety tools & plants etc. and undertaking such other activities which will facilitate in reducing the accidents. However, the Contractor shall have no claim in this regard and the Employer shall be sole judge in this regard.
• If the Contractor observes all the Safety Rules and Codes, Statutory Laws and Rules during the currency of Contract awarded by the
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		Employer and no accident occurs then Employer may consider the performance of the Contractor and award suitable "ACCIDENT FREE SAFETY MERITORIOUS AWARD" as per scheme as may be announced separately from time to time. • The Contractor shall also submit "Safety Plan" as per proforma specified in Section-IX (Sample Forms and Procedures) of the Bidding Documents alongwith all the requisite documents mentioned therein and as per check-list contained therein to the Engineer In-Charge for its approval within 60 days of award of Contract. Further, one of the conditions for release of first progressive payment / subsequent payment towards Services Contract shall be submission of "Safety Plan" alongwith all requisite documents and approval of the same by the Engineer In-Charge.
8	**New Clause**	**Addition of New Clause :** **Emergency Work** • If, by reason of an emergency arising in connection with and during the execution of the Contract, any protective or remedial work is necessary as a matter of urgency to prevent damage to the Facilities, the Contractor shall immediately carry out such work. • If the Contractor is unable or unwilling to do such work immediately, the Employer may do or cause such work to be done as the Employer may determine is necessary in order to prevent damage to the Facilities. In such event the Employer shall, as soon as practicable after the occurrence of any such emergency, notify the Contractor in writing of such emergency, the work done and the reasons therefor. If the work done or caused to be done by the Employer is work that the Contractor was liable to do at its own expense under the Contract, the reasonable costs incurred by the Employer in connection therewith shall be paid by the Contractor to the Employer. In case such work is not in the scope of the Contractor, the cost of such remedial work shall be borne by the Employer.
9	New Clause	**Addition of New Clause :** **Equipment Performance Guarantees:** • The Contractor guarantees that the Equipments, named in the Bid document, shall attain the rating and performance requirements specified in this document, subject to and upon the conditions therein specified. • If the guarantees specified are not established, then the Employer shall, at the Employer's discretion either (a) reject the equipment, or (b) accept the equipment after assessing liquidated damages in accordance with the provision in the bidding document against the Contractor and such amounts shall be deducted from the Contract Price or otherwise recovered from the Contractor. • In case the Employer exercises its option to reject the equipment, the Contractor shall at its cost and expense make such changes, modifications and/or additions to the equipment or any part thereof as may be necessary to meet the specified guarantees. The

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		Contractor shall notify the Employer upon completion of the necessary changes, modifications and/or additions, and shall request the Employer to repeat the Test until the level of the specified guarantee has been met.
10	**New Clause**	**Addition of New Clause :** **Termination** **Termination for Employer's Convenience** • The Employer may at any time terminate the Contract for any reason by giving the Contractor a notice of termination that refers herein below. • Upon receipt of the notice of termination, 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 Subcontractor 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 below, shall (i) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination (ii) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant and Equipment as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors (iii) deliver to the Employer all non-proprietary drawings, specifications and other documents prepared by the Contractor or its Subcontractors as at the date of termination in connection with the Facilities. • In the event of termination of the Contract as specified above, the Employer shall pay to the Contractor the following amounts: (a) the Contract Price, properly attributable to the parts of the Facilities executed by the Contractor as of the date of termination (b) the costs reasonably incurred by the Contractor in the removal of the Contractor's Equipment from the Site and in the repatriation of the Contractor's and its Subcontractors personnel (c) any amounts to be paid by the Contractor to its Subcontractors in connection with the termination of any subcontracts, including any cancellation charges (d) costs incurred by the Contractor in protecting the Facilities

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		and leaving the Site in a clean and safe condition (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. **Termination for Contractor's Default** ● 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: (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. (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"** is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party; **"fraudulent practice"** is any act or omission, including a misrepresentation, that knowingly or recklessly misleads or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation; **"collusive practice"** is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party; **"coercive practice"** is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party; **"obstructive practice"** is (a) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Employer's investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; (b) acts intended to materially impede the exercise of the Employer's inspection and audit rights.

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		In persuasions of its policy, the Employer will sanction a firm or individual, including declaring ineligible, either indefinitely or for a stated period of time, to be awarded a contract if it at any time determines that the firm has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for, or in executing, a contract. ● 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 the progress of Contract performance for more than twenty-eight (28) days after receiving a written instruction from the Employer to proceed. (c) persistently fails to execute the Contract in accordance with the Contract or persistently neglects to carry out its obligations under the Contract without just cause (d) refuses or is unable to provide sufficient materials, services or labor to execute and complete the Facilities in the manner specified in the program furnished 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. ● Upon receipt of the notice of termination, the Contractor shall, either immediately or upon such date as is specified in the notice of termination, (a) cease all further work, except for such work as the Employer may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition (b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) below (c) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination (d) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant and Equipment as of the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors (e) deliver to the Employer all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as of the date of termination in connection with the Facilities. ● The Employer may enter upon the Site, expel the Contractor, and complete the Facilities itself or by employing any third party. The

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<tr><td></td><td></td><td>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.
• Subject to provision provide below, the Contractor shall be entitled to be paid the Contract Price attributable to the Facilities executed as of the date of termination, the value of any unused or partially used Plant and Equipment on the Site, and the costs, if any, incurred in protecting the Facilities and in leaving the Site in a clean and safe condition pursuant to paragraph (a) above. Any sums due to the Employer from the Contractor accruing prior to the date of termination shall be deducted from the amount to be paid to the Contractor under this Contract.

• 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 above, plus the reasonable costs incurred by the Employer in completing the Facilities, exceeds the Contract Price or the entire Facilities if entire Facilities have been completed or the price for part of the Facilities if part of the Facilities have been completed, the Contractor shall be liable for such excess. If such excess is greater than the sums due the Contractor, the Contractor shall pay the balance to the Employer, and if such excess is less than the sums due, the Employer shall pay the balance to the Contractor. For facilitating such payment the Employer shall encash the Bank Guarantees of the Contractor available with the Employer and retain such other payments due to the Contractor under the Contract in question or any other Contract that the Employer may have with the Contractor. The Employer and the Contractor shall agree, in writing, on the computation described above and the manner in which any sums shall be paid.
• In this clause , the expression "Facilities executed" shall include all work executed, Installation Services provided, and all Plant and Equipment acquired (or subject to a legally binding obligation to purchase) by the Contractor and used or intended to be used for the purpose of the Facilities, up to and including the date of termination.</td></tr>
<tr><td>11</td><td>New Clause</td><td>Time for completion of project:
<table>
<tr><th>Sl.</th><th>Activities</th><th>Duration in</th></tr>
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</td></tr>
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<table>
<tr><th>SCC Clause No</th><th>GCC Clause Ref No</th><th>Additional Point in RECTPCL GCC</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>No.</th><th>Taking over by the Employer upon successful completion of:</th><th>months from the effective date of contract</th></tr>
<tr><td>01</td><td>Turnkey project including Supply, Transportation, Erection, Testing and Commissioning of following work in Jammu & Kashmir :-

“Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15”</td><td>24 (Twenty Four) Months</td></tr>
</table>
</td></tr>
<tr><td>12</td><td>Clause no. 44</td><td>
Supplementary Clauses may be read out with GCC Clause no-44 for Taxes and Duties or any other clause of the document as applicable

TAXES & DUTIES:

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 Employer and a certificate for the same shall be issued to the Contractor.
The Contractor shall be solely responsible for the taxes that may be levied on the Contractor's persons or on earnings of any of his employees and shall hold the Employer indemnified and harmless against any claims that may be made against the Employer. The Employer does not take any responsibility whatsoever regarding taxes under Indian Income Tax Act, for the Contractor or his personnel. If it is obligatory under the provisions of the Indian Income Tax Act, deduction of Income Tax at source shall be made by the Employer.
In respect of supply of goods to the Employer by the Contractor, the EXW price is inclusive of all cost as well as duties and tax (viz., custom duties & levies, duties, GST etc.) paid or payable on components, raw materials and any other items used for their consumption incorporated or to be incorporated in the Plant & Equipment.
Further, the EXW price of (i) imported Equipments/items offered as ‘Off the Shelf’ or dispatched directly from the Indian Port of disembarkation are inclusive of all cost as well as any duties paid/payable in relation to import of such goods (viz., Customs duties, GST & levies etc.) and no separate

</td></tr>
</table>

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		claim on this behalf will be entertained by the Employer. If any tax exemptions, reductions, allowances or privileges may be available to the Contractor in the Country where the site is located and the Contractor has declared the same in its bid, the Employer shall use its best endeavors to enable the Contractor to benefit from such tax savings to the maximum allowable extent. **The Input Tax Credit (ITC) available, if any, under GST as per the relevant Government laws wherever applicable has been taken into account by the Contractor.** • **Ex-works price for the supply of goods viz. Equipment/items by the Contractor is excluding GST, if any, payable. The GST will be reimbursable (along with subsequent variation if any), by the Employer on the supplies made by the Contractor but limited to the tax liability on the transaction between the Employer and the Contractor.** **Type test charges, if applicable, are excluding GST, if any, payable. Type test shall be considered an incidental expense incurred prior to the supply of goods viz. Equipment/items and would be added to the value of goods viz. Equipment/items for GST purposes and GST for Type Test shall be reimbursed at the rate applicable for such Equipment/items.** **Further the price for supply of services viz. Installation and training are excluding GST, if any, payable. The GST will be reimbursable (along with subsequent variation if any), by the Employer on the supplies made by the Contractor but limited to the tax liability on the transaction between the Employer and the Contractor.** **It is the Employer's understanding that as per extant provisions, on the charges for supply of services related to Inland transportation, In-transit insurance, loading and unloading by the Contractor to the Employer, GST is not payable. The Contractor is, however, advised to check the position from their own sources. If payable, the same shall be to the Contractor's account and Employer shall not reimburse any GST on this account.** • **Employer would not bear any liability on account of any other taxes, duties, levies applicable locally.** • **Employer shall, deduct taxes at source as per the applicable laws/rules, if any, and issue Tax Deduction at Source (TDS) Certificate to the Contractor.** • **Reimbursement of GST by the Employer shall be at the rate applicable on the HSN/SAC of the goods/ services supplied by the Contractor to the Employer. The**

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		reimbursement of GST shall be against Invoice/Debit Note containing particulars specified under the GST Act and related Rules, Notifications, etc as notified by the Government in this regard. In the event that the Contractor fails to provide the invoice in the form and manner prescribed under the GST Act and Rules, the Employer shall not be liable to make any payment against such invoice. **If there is difference in HSN/SAC classification and corresponding rate of GST of an item as confirmed/deemed confirmed by the bidder in its bid and HSN/SAC and corresponding rate of GST as interpreted under any interpretation/ judgment/ Notification/ Circular issued under the GST law before or after the award of contract, GST reimbursable to the bidder/Contractor shall be lower of the GST applicable at the rate as confirmed/deemed confirmed in the bid or actual GST paid/payable by the bidder for that item.** • **The Contractor shall comply with all tax laws in force in India. The Contractor shall indemnify and hold harmless the Employer from and against any and all liabilities, interest, damages, claims, fines, penalties and expenses of whatever nature arising or resulting from the violation of such tax laws by the Contractor or its personnel, including the Subcontractors and their personnel.** • **Owner's GSTIN number will be provided to bidder on request. While raising invoice/proforma invoice for Supply of Goods, Contactor shall bill to and ship to the address of the Owner in the State/UT where the Goods or part thereof is to be Supplied and mention GSTIN of Owner in of the same state/UT. #In case of Supply of Services, the Contractor shall invoice the Owner using the GSTIN of Owner in the state/UT in which the service or part thereof is to be rendered.** • **Notwithstanding anything above or elsewhere in the Contract, in the event that the input tax credit of the GST charged by the Contractor is denied by the tax authorities to the Employer for reasons associated with non-compliance/ incorrect compliance by the Contractor, the Employer shall be entitled to recover such amount from the Contractor by way of adjustment from any of the subsequent invoices submitted by the Contractor to the Employer. In addition to the amount of GST, the Employer shall also be entitled to recover interest and penalty, in case any interest and/or penalty are imposed by the tax authorities on the Employer for incorrect/wrong availment**

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		of Input Tax Credit. The Employer shall determine whether the denial of credit is linked to the non-compliance/ incorrect compliance of the Contractor and the said determination shall be binding on the Contractor For the purpose of the Contract, it is agreed that the Contract Price specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement is based on the taxes, duties, levies and charges prevailing at the date seven (07) days prior to the last date of bid submission (hereinafter called "Tax"). If any rates of Tax are increased or decreased, a new Tax is introduced, an existing Tax is abolished, or any change in interpretation **except for classification related purpose,** or application of any Tax occurs in the course of the performance of the Contract, which was or will be assessed on the Contractor in connection with performance of the Contract, an equitable adjustment of the Contract price shall be made to fully take into account any such change by addition to the Contract price or deduction therefrom, as the case may be, in accordance with GCC Clause 31 (Changes in Laws and Regulations) hereof. **These adjustments shall be applicable for all transactions between the Employer and the Contractor for supply of goods and services under the Contract but shall not be applicable on procurement of raw materials, intermediary components etc. by the Contractor and on account of variation in taxes, duties & levies applicable locally.** **In respect of raw materials, intermediary components etc and the taxes, duties & levies applicable locally, neither the Employer nor the Contractor shall be entitled to any claim arising due to increase or decrease in the rate of Tax, introduction of a new Tax or abolition of an existing Tax in the course of the performance of the Contract**.
13	**New Clause**	**Addition of New Clause :** **Approach Roads** Access to the Site of Works shall be available before commencement of works. While efforts will be made to keep the approach roads open through-out the year, REC Transmission Projects Company Limited(RECTPCL) shall not be responsible for any damage or loss suffered by the Contractor due to closure of the road(s) on account of landslides, weather conditions or any other reasons whatsoever
14	**New Clause**	**Addition of New Clause :** **LAND** The purchaser shall acquire only such piece of land as is actually required for each type of tower foundation. Any extra land required by the contractor for storage of tower material, conductor, line material etc. shall be the responsibility of the contractor.

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
15	**New Clause**	**Addition of New Clause :** **Training of the RECTPCL's & Consultant's Personnel** The Contractor shall in pursuance of provisions of technical specification or as specified elsewhere, provide free of charge adequate facilities for training any of employees of RECTPCL in the manufacturing works / at site.
16	**New Clause**	**Addition of New Clause :** **SITE ORDER BOOK** The Engineer-in-Charge shall maintain the site order book systematically and securely till completion of the Works. The site order book shall be available at the site during working hours. Orders regarding the Work as and when necessary shall be entered in this book by the Engineer-in-Charge or his representative with dated signatures in exercise of the powers vested in him, which orders shall be duly noted by the Contractor or his authorized agent with his dated signature. Order entered in this book and noted by the Contractor's agent shall be considered to have been duly given to the Contractor.
17	**New Clause**	**Addition of New Clause :** **FLOODS** • In case of floods resulting in flooding of the work areas, the Contractor shall make his own arrangements, at his own cost, to shift goods, all his plant, equipment and machinery, materials including if any, supplied / issued by the RECTPCL and labour to safe place. The work shall be resumed after receding of floods and dewatering the area. • The RECTPCL shall not be liable for any loss of or damage to the men, Contractor's plant, equipment, machinery works or materials on account of these floods and no compensation whatsoever, in this regard shall be paid to the Contractor.
18	**New Clause**	**Change in Laws and Regulations** If, after the date seven (07) days prior to the date of Bid Opening, any law, regulation, ordinance, order or by-law having the force of law is enacted, promulgated, abrogated or changed in India (which shall be deemed to include any change in interpretation or application by the competent authorities) that subsequently affects the costs and expenses of the Contractor and/or the Time for Completion, the Contract Price shall be correspondingly increased or decreased, and/or the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been affected in the performance of any of its obligations under the Contract. These adjustments shall be applicable for all transactions between the employer and contractor for supply of goods & services under the contract but shall not be applicable on procurement of raw material, intermediary component etc. by the contractor for which employer shall be the sole judge. Notwithstanding the foregoing, such additional or reduced costs shall not be separately paid or credited if the same has already been accounted for in the price

SCC Clause No	GCC Clause Ref No	Additional Point in RECTPCL GCC
		adjustment provisions where applicable.

SECTION-VI, VOL-I
MODEL RULE FOR HEALTH & SANITARY ARRANGEMENTS FOR CONTRACTOR'S WORKMEN

SECTION - VI
MODEL RULES FOR HEALTH AND SANITARY ARRANGEMENTS FOR

CONTRACTOR'S WORKMEN

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SECTION-VI

MODEL RULES FOR HEALTH AND SANITARY ARRANGEMENTS FOR CONTRACTOR'S WORKMEN

1 APPLICATION

These rules shall apply to all buildings and erection works of REC Transmission Projects Company Limited(RECTPCL).

2 DEFINITIONS

(i) "Work place"/or work site means a place at which, at an average 50 or more workers are employed, in connection with construction work.

(ii)"Large work place" or large work site means a place at which at an average 500 or more workers are employed in connection with construction work.

3 FIRST AID

(i) At every work place, there shall be maintained in a readily accessible place first aid appliance including an adequate supply of sterilized dressings and sterilized cotton wool. The appliances shall be placed in good order and in a large work place. They shall be placed under the charge of a responsible person who shall be readily available during working hours.

(ii) At large work places, where hospital facilities are not available within easy distance of the work, First Aid posts shall be established and run by trained compounders.

(iii) Where large work places are remote from regular hospitals, an indoor ward shall be provided with one bed for every 250 employees.

(iv) Where large work places are situated in cities/towns or in their suburbs and no beds are considered necessary owing to the proximity of city or town hospitals, suitable transport will be provided to facilitate removal of emergent cases to the hospitals. At other work places, some conveyance facilities such as car shall be kept readily available to take injured person(s) or person(s) suddenly taken seriously ill, to the nearest hospital.

4 DRINKING WATER

(i) In every work place, there shall be provided and maintained at suitable places, easily accessible to labour, a sufficient supply of cold water fit for drinking.

(ii) Where drinking water is obtained from an intermittent public water supply, each work place shall be provided with storage where such drinking water shall be stored.

(iii) Every water supply storage shall be at distance of not less than 15 metres from latrine, drain or any other source of pollution. Where water has to be drawn from an existing

well which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed in and be provided with trap door which shall be dust and water proof.

(iv) A reliable pump shall be fitted to each covered well, the trap door shall be kept locked and opened only for cleaning or inspection which shall be done at least once in a month.

5 WASHING AND BATHING PLACES

i) Adequate washing and bathing places shall be provided, separately for men & women.

ii) Such places shall be kept in a clean and drained condition.

6 LATRINES AND URINALS

There shall be provided within the precincts of every work place adequate number of latrines and urinals in an accessible place. If women are employed, separate urinals and latrines shall be provided for them. All these shall be cleaned regularly and kept in a sanitary condition.

7 DISPOSAL OF EXCRETA

Unless otherwise arranged for by the local sanitary authority, arrangements for proper disposal of excreta by incineration at the work place shall be made by means of a suitable incinerator approved by the local health officer or Engineer-in-Charge. Alternatively, excreta may be disposed of by putting a layer of night soil at the bottom of pucca tank prepared for the purpose and covering it with a 150mm layer of waste or refuse and then covering it up with a layer of earth for a fortnight (when it will turn into manure).

8 PROVISION OF SHELTER DURING REST

At every work place there shall be provided free of cost for the use of labour, two suitable sheds, one for meals and the other for rest.

9 CRECHES

At every work place, at which 50 or more women workers are ordinarily employed, there shall be provided a crèche for the use of children, belonging to such women.

10 CANTEEN

A cooked food canteen on a moderate scale shall be provided for the benefit of workers wherever it is considered expedient.

The above rules shall form an integral part of the contract.

SECTION-VII, VOL-I

CONTRACTOR'S LABOUR REGULATION

SECTION –VII

CONTRACTOR'S LABOUR REGULATIONS

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SECTION - V

CONTRACTOR'S LABOUR REGULATIONS

1 SHORT TITLE

These regulations may be called the "REC Transmission Projects Company Limited", Contractor's Labour Regulations".

2 DEFINITIONS

In these regulations, unless otherwise expressed or indicated, the following words and expressions shall have the meaning hereby assigned to them respectively, that is to say:-

(i) "Labour" means workers employed by RECTPCL Contractor directly or indirectly through a sub-contractor or other persons or by an agent on his behalf but will not include supervisory staff like section officers, etc.

(ii) "Fair Wage" means wage whether for time or piece work notified at the time of inviting tenders for the work and where such wages have not been so notified, the wages prescribed by the RECTPCL for the area in which the work is done. Such wages will not be less than the minimum wages fixed by the Government of India for that class of employee engaged on the same type of work in the same area.

(iii) "Contractor" shall include every person whether a sub-contractor or head-man or agent, employing labour on the work taken on contract.

Normally working hours of a worker should not exceed 9 (Nine) hours a day. The working day shall be so arranged that inclusive of interval for rest, if any, it shall not spread over more than 12 (twelve)hours on any day.

3 DISPLAY OF NOTICE REGARDING WAGES, ETC.

The Contractor shall

(i) before he commences his work on Contract, display and correctly maintain and continue to display and correctly maintain in a clean and legible condition in conspicuous place on the work, notices in English and in Hindi and local language spoken by the majority of the workers, giving the rate of wages which have been certified by the Engineer-in-Charge as fair wage and the hours of work for which such wage are earned, and

(ii) Send a copy of such notices to the certifying office.

4 PAYMENT OF WAGES

(i) Wages due to every worker shall be paid to him direct.

(ii) Arrears claimed after 3 months after the completion of the Work shall not be entertained.

(iii) All wages shall be paid in current coin or currency or in both.

5 FIXATION OF WAGE PERIODS

(i) The Contractor shall fix the wage periods in respect of which the wages shall be payable.

(ii) No wage period shall exceed one month.

(iii) Wages of every worker employed on the contract shall be paid; (a) in the case of establishment in which wage period is one week within 3 days from the end of the wage period and (b) in the case of other establishments before the expiry of the 7th day or 10th day from the end of the wage period for the number of workers employed in such establishment not exceeding 1000 and exceeding 1000 respectively.

(iv) When the employment to any worker is terminated by or on behalf of the Contractor, the wages earned by him shall be paid before the expiry of the day succeeding the one on which his employment is terminated.

(v) All payments of wages shall be made on a working day except when the work is completed before the expiry of the wage period in which case final payment shall be made within 48 hours of the last working day at work site and during the working time.

6 WAGE BOOK AND WAGE SLIPS ETC

(i) The Contractor shall maintain a Wage Book of each worker in such forms as may be convenient at the place of works, but the same shall include the following particulars:

a Name of the worker.
b Rate of daily or monthly wages.
c Nature of work on which employed.
d Total number of days worked during each wage period.
e Dates and periods for which worked overtime.
f Gross wages payable for the work during each wage period.
g All deductions made from the wage with an indication in each case of the ground on account of which the deduction is made.
h Wages actually paid for each wage period
i Signature or thumb impression of the worker.

(ii) The Contractor shall also issue a wage slip containing the aforesaid particulars to each worker employed by him on the work at least a day prior to the day of disbursement of wages.

(iii) The Contractor shall also issue an "Employment Card" in the prescribed 'Form I' (attached) to each worker on the day of work or entry into his employment.

(iv) The Contractor shall issue an 'Attendance cum Wage Card' as per 'Form II' to each worker on the day of entry into his employment.

7 REGISTER OF UNPAID WAGES

The Contractor shall maintain a register of unpaid wages in such form as may be convenient at the place of work but the same shall include the following particulars.

i) Full particulars of the labourers whose wages have not been paid.
ii) Reference number of the muster roll and wage register.
iii) Rate of Wages.
iv) Wage period.
v) Total amount not paid.
vi) Reasons for not making payment.
vii) How the amount of unpaid wages was utilised.
viii) Acquaintance with dates.

8 REGISTER OF ACCIDENTS

The Contractor shall maintain a register of accidents in such form as may be convenient at the work place, but the same should include the following particulars.

i) Full particulars of the Worker(s) who met with accident.
ii) Rate of wages.
iii) Sex.
iv) Age.
v) Nature of accident and cause of accident.
vi) Time and date of accident.
vii) Date and time when admitted in hospital.
viii) Date of discharge from the hospital.
ix) Period of treatment and result of treatment.
x) Percentage of loss of earning capacity and disability assessed by medical officer.
xi) Compensation required to be paid.
xii) Date of payment of compensation.
xiii) Amount paid with details of the person to whom the same was paid.
xiv) Authority by whom the compensation was assessed.
xv) Remarks.

9 FINES AND DEDUCTIONS WHICH MAY BE MADE FROM WAGES

i) The wages of a worker shall be paid to him without any deductions of any kind except the following:
   a) Fines
   b) Deductions for absence from duty i.e. from the place or the places where by the terms of his employment he is required to work. The amount of deduction shall be in proportion to the period for which he was absent.
   c) Deduction for damage to or loss of goods expressly entrusted to the employed person for custody, or for loss of money or any other deduction which he is required to account, where such damage or loss is directly attributable to his neglect or default.
   d) Deduction for recovery of advance or for adjustment of over payment of wages, advances granted shall be entered in a register.
   e) Any other deduction which the Jammu & Kashmir Power Development Department may from time to time allow.

ii) No fine shall be imposed on any worker except in respect of such acts and omissions on his part as have been approved of by the Engineer-in-Charge.

iii) No fine should be imposed on a worker and no deduction for damage or loss shall be made good from his wages until the worker has been given an opportunity of showing cause against such fines or deductions.

10 REGISTER OF FINES

i) The Contractor shall maintain a 'Register of Fines' and a 'Register of Deductions for Damages or Loss' in 'Form Nos. III & IV' respectively which should be kept at the places of work.

ii) The Contractor shall maintain both English and in the local language, a list approved by the Engineer-in-Charge clearly stating the acts and omissions for which penalty or fine may be imposed on a workman and display it in a good condition in a conspicuous place on the work.

11 PRESERVATION OF REGISTER

The wage book, the wage slips, register of unpaid wages, the register of accidents, the register of fines, deduction required to be maintained under these regulations shall be preserved for 12 months after the date of last entry made in them and shall be made available for

inspection by the Engineer-in-Charge, labour officer or any other officer authorised by the RECTPCL on their behalf.

12 POWERS OF LABOUR WELFARE OFFICERS TO MAKE INVESTIGATION OR ENQUIRY

The Labour Welfare Officer or any other person authorised by the Indian ***Govt.*** on their behalf shall have power to make enquiries with a view to ascertaining and enforcing due and proper observance of the fair wage clause and the provisions of these regulations. He shall investigate into any complaint regarding the default made by the contractor or sub-contractor in regard to such provision.

13 REPORT OF LABOUR WELFARE OFFICER

The labour welfare officer or other persons authorised as aforesaid shall submit a report of result of his investigation or enquiry to the Engineer-in-Charge concerned indicating the extent, if any, to which the default has been committed, with a note that necessary deductions from the contractor's bill be made and the wages and other dues be paid to the labourers concerned. In case an appeal is made by the contractor under **para 14** of these regulations actual payment to labourers will be made by the Engineer-in-charge or authorised agent after RECTPCL has given its decision on such appeal.
The Engineer-in-Charge shall arrange payments to the labourers concerned within 45 days from the receipt of the report form the labour welfare officer.

14 APPEAL AGAINST THE DECISION OF LABOUR WELFARE OFFICER

Any person aggrieved by the decision and recommendations of the Labour Welfare Officer or other person so authorised may appeal such decision to the labour court, within 30 days from the date of decision. The decision of the labour cour***t*** shall be final and binding upon the Contractor and RECTPCL as the case may be.

15 INSPECTION OF BOOKS AND SLIPS

The Contractor shall allow inspection of the wage books and the wage slips, register of unpaid wages, register of accidents, the register of fines and deductions to any of his workers or to his agent at convenient time and place after due notice is received or to the Labour Welfare Officer or any other persons, authorised by Engineer-in-Charge on his behalf.

16 SUBMISSION OF RETURNS

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

17 AMENDMENTS

RECTPCL may from time to time add to or amend the regulations and on any question as to the application, interpretation or affect of those regulations, the decision of the Engineer-in-Charge or of his authorized representative shall be final.

FORM – I
EMPLOYMENT CARD REGULATION

Name & Sex of the worker.

Age or date of birth.

Father's name

Identification marks

.(Particulars of next of kin ,wife and children, if any or of dependent next to kin in case the worker has no wife or child)

Name ……..

Full address of dependents

(Specify village, district and state).

Sl.No	Name and address of employer (Specify whether a contractor or Sub-contractor).	Particulars of location work site and description of work done	Total period for which the worker is employed (From……..to……)	Actual number of days worked	Leave taken (Number of days Should be Specified)
1	2	3	4	5	6

(BACK SIDE OF THE CARD)

Nature of work done by the workers	Wage period	Wage rate (with particulars of unit in case of piece work)	Total wage earned by the worker during the period Shown under column(5)	Remarks	Signature of the employer
7	8	9	10	11	12

FORM – II

ATTENDANCE –CUM-WAGE CARD

Card No. ……..

Name of Contractor……..

Name of work……...

Name of worker……

Address……

Designation……...

Rates of wages ……

Dates	Attendance	Signature of person marking attendance	REMARKS
1. 2. 3. 4. 5. etc.			

(ON THE BACK SIDE OF CARD)

Wage period	Date on which overtime Worked	Gross wage payable	Deductions if any.	Actual Wages paid	Date of payment	Signature of the Worker

FORM – III
REGISTER OF FINES

Sl. No.	Name	Father's/ Husband's Name	Sex	Department	Nature and Date of the offence for which fine imposed	Whether worker showed cause against Fine or not, if so, enter date.	Rate of Wages	Date and amount of fine Imposed	Date on which Fine Realised	Remarks
1	2	3	4	5	6	7	8	9	10	11

FORM – IV

REGISTER OF DEDUCTIONS FOR DAMAGES OR LOSS

Sl. No.	Name	Father's/ Husband's Name	Sex	Department	Damage or loss caused with date	Whether worker showed cause against deduction if so, enter date.	Date and amount of deduction Imposed	Number of install-ment, if any	Date on which total amount Realised	Remarks
1	2	3	4	5	6	7	8	9	10	11

SECTION-VIII, VOL-I

SAFETY REGULATIONS

SECTION - VIII

SAFETY PRECAUTIONS

1 Suitable scaffolds shall be provided for workmen for all Works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used, an extra workman shall be engaged for holding the ladder. If the ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 0.25 to 1 (0.25 horizontal and 1 vertical).

2 Scaffolding or staging more than 3.6 m above the ground or erected floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise secured at least 0.9 m high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of the materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying f**ro**m the structure.

3 Working platform, gangways and stairways shall be so constructed that they do not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6 m above ground level or floor level, they shall be closely boarded, and shall have adequate width and shall be suitably fastened.

4 Every opening in the floor of a structure or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 0.9 m. Employees working on steep slopes or otherwise subject to possible falls from levels not protected by guardrails or safety nets, shall be secured by safety belts.

5 Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9.0 m in length while the width between side rails in hung ladder shall, in no case, be less than 28 cm. for ladder upto and including 3.0 m in length. For longer ladders, this width shall be increased at least by 6 mm for each additional 30 cm of length. Uniform step spacing shall not exceed 30 cm. Adequate precautions shall be taken to

prevent danger f***ro***m electrical equipment. No materials on any of the Sites of Work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.

6 EXCAVATION AND TRENCHING

All trenches, 1.2 m or more in depth, shall, at all times, be supplied with at least one ladder for each 30 metres length or fraction thereof. Ladder shall be extended form bottom of the trench to at least 0.9 m above the surface of the ground. The side of the trenches which are 1.5 m or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated materials shall not be placed within 1.5 m of the edges of the trench or half of the depth by the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.

7 DEMOLITION

Before any demolition work is commenced and also during the process of the work:

(i) All roads and open areas adjacent to the site shall either be closed or suitably protected.

(ii) No electric cable or apparatus which is liable to be a source of danger over a cable or apparatus used by the operator shall remain electrically charged.

(iii) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the structure shall be overloaded with debris or materials as to render it unsafe.

8 All necessary personal safety equipment as considered adequate by the Engineer-in-Charge shall be kept available for the use of the persons employed on the Site and maintained in condition suitable for immediate use, and the Contractor shall take adequate steps to ensure proper use of equipment by those concerned.

(i) The Contractor shall provide rubber gauntlets, gloves, mats, boots and galoshes, insulated platform and stools, safety belts, hand lamps, tower

wagons and other special insulated devices as required for working on electrical equipment and apparatus.

(ii) Workers employed on mixing asphaltic materials, cement mortar and cement concrete shall be provided with protective footwear and protective goggles.

(iii) Those engaged in mixing or stacking of cement bags or any materials which is injurious to eyes shall be provided with protective goggles.

(iv) Those engaged in welding Works shall be provided with welder's protective eye shields.

(v) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

(vi) The Contractor shall not employ any person **below the age of 18 years**. Whenever a person above the age of 18 years is employed on the work of lead painting, the following precautions shall be taken:-

(a) No paint containing lead, sulphate of lead or product containing their pigments shall be used except in the form of paste or readymade paint.

(b) Suitable face masks shall be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

(c) Overalls shall be supplied by the Contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of Work.

(d) Measures shall be taken, whenever required, in order to prevent danger arising from the application of a paint in the form of spray.

(e) Measures shall be taken, whenever practicable, to prevent danger arising out from dust caused by dry rubbing down and scrapping.

(f) Suitable arrangements shall be made to prevent clothing put off during working hours, being spoiled by painting materials.

(g) Cases of lead poisoning and suspected lead poisoning shall be notified and shall be subsequently verified by a medical officer appointed by the competent authority.

(h) The contractor, when necessary, shall arrange for medical examination of workers and same shall be monitored by medical officer appointed by competent authority.

(i) Instructions with regard to special hygienic precautions to be taken in the painting trade shall be distributed to working painters.

(vii) The Contractor shall observe all safety precautions to control the noise on all Sites and also provide all workmen deployed in the affected areas with the necessary equipment for safety against noise.

9 When the Work is done near any place where there is risk of drowning, all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision shall be made for prompt first aid treatment of all injuries likely to be sustained during the course of the Work.

10 Use of hoisting machines and shackle including their attachments, anchorage and supports shall conform to the following standards or conditions:

(i) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defect and shall be kept in good working order.

(ii) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength and free from patent defects.

(iii) Every crane driver or hoisting appliance operator shall be properly qualified for his job.

(iv) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gears referred to above shall be plainly marked with the safe working load.

In case of hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing. The capacity of the hoisting machines shall be periodically checked.

(v) The Contractor shall notify the safe working load of the machines to the Engineer-in-Charge whenever he brings any machinery to Site of work and gets it verified by the Engineer-in-Charge or his representative.

11 Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards.

Hoisting appliances shall be provided with such means as shall reduce to the minimum, the risk of any part of a suspended load becoming accidentally displaced. When workmen are employed on or near electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boot, as may be necessary, shall be provided. The workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

12 All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of Work.

13 These safety provision***s*** shall be brought to the notice of all concerned by display on a notice board at a prominent place on the Site. The person responsible for compliance of the safety code shall be named therein by the Contractor.

14 To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by Contractor shall be open to inspection by the Labour officer /or the Engineer-in-Charge.

15 In addition to above, the Contractor shall take the following specific precautions for the Underground Works.

(i) All precautions regarding safety of personnel working in tunnels/caverns/shafts, in connection with the handling of electrical installations, loading, blasting and seepage water etc. as specified in the relevant stipulations of IS codes shall be taken by the Contractor in order to ensure safe underground working. He shall also provide adequate medical, drinking water, sanitation, lighting and ventilation facilities.

(ii) Emergency material shall be provided at each underground excavation heading

This equipment shall include, but not be limited to the following:

- 3 stretchers
- 3 woolen blankets
- 2 appliances for artificial breathing
- 1 oxygen flask
- 3 explosion-proof lamps
- wound dressing and disinfection material
- anti-pain injections
- gas masks

(iii) At least two members of the Rescue Team as described hereinafter, properly instructed and trained in the rescue procedures, shall be in each crew working underground.

(iv) Prior to the commencement of construction, the Contractor shall organize and train a Rescue Team composed of his employees. This Rescue Team shall be capable to render help after accidents caused by fire, gas explosion and avalanche etc.

(v) The Rescue Team shall be organized in such a way that sufficient numbers of members are ready for action at any time until the Completion of Work.

(vi) The Rescue Team members shall be instructed and trained for their task by a qualified and experience person. If required, the Contractor shall hire an outside specialist to perform such training. A refresher training for all members of the Rescue Team shall be conducted at least every six months.

(vii) Each Rescue Team member shall be skilled in giving the first aid, dealing with the appliances for artificial respiration and fire fighting equipment and shall possess a good local knowledge. Adequate equipment for reaching even the remotest working area shall be at their disposal.

(viii) The Contractor shall submit the details of the proposed Rescue Team organization to the Engineer-in-Charge for approval.

16 The Contractor shall at all times exercise reasonable and proper precautions for the safety of the people on the Works and shall comply with the provisions of current safety law and building and construction codes as may be applicable. All machinery and equipment and other sources of physical hazards shall be properly guarded. The Contractor shall have a full time staff exclusively in charge of securing the safety of the Work ensuring that all safety regulations are followed and in charge of indoctrination and teaching course on safety to the work force.

17 The Contractor shall provided all necessary fencing and lights to protect the public from accidents and shall be bound to bear all the expenses of defence of every suit, action and other proceedings at Law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action and proceedings to any such persons or which may, with the consent of the Contractor, be paid to compromise any claim by any person.

18 About his employees, the Contractor shall ensure as follows:

(i) Each employee shall be provided initial indoctrination regarding safety by the Contractor so as to enable him to conduct his Work in a safe manner.

(ii) No employee shall be given a new assignment of work unfamiliar to him without proper introduction as to the hazardous incident thereto, both to himself and his fellow employees.

(iii) Under no circumstances shall an employee hurry or take unnecessary chances when working under hazardous conditions.

(iv) Employees shall not leave naked fires unattended. Adequate fire fighting equipment shall be provided at crucial locations.

(v) Employees under the influence of any intoxicating beverage, even to the slightest degree, shall not be permitted to remain on Work.

(vi) There shall be suitable arrangement on every site for rendering prompt and sufficient first aid to the injured.

(vii) The stair cases and passage ways shall be adequately lighted.

(viii) The employees, when working around moving machinery, shall not be permitted to wear loose garments. Safety shoes are recommended when working in shops or places where materials or tools are likely to fall.

Only experienced workers shall be permitted to go behind guard rails or to clean around energized or moving equipment.

(ix) The employees shall use the standard protection equipment intended before and after it is used.

19 The following precautions shall be taken for fire prevention:

(i) All construction areas and storage yards shall be kept clean and well arranged.

(ii) A clear space of 15 metres around the outer boundary of saw mill and lumber storage area may be provided. All lumber shall be stored in sections with fire breaks with a distance of 15 metres between consecutive section.

(iii) All combustible waste material, wood scalings and soiled rags etc shall be removed daily and burnt in suitable burning area. The saw mill and lumber yard shall be kept free form accumulation of combustible debris.

(iv) Fires, welding, flame cutting shall in general not be permitted in combustible area. Fires and open flame devices shall not be left unattended.

(v) Smoking shall be prohibited in all fire prone areas, flammable material storages viz. Carpentry, paint shops, garrages, service stations etc. "No smoking" signs shall be pasted on all such areas.

(vi) Accumulations of flammable liquids on floors, walkways etc. should be prohibited. All spills of flammable liquids shall be cleaned up immediately.

(vii) Smoke pipes from Diesel Engines passing through roof of combustible material e.g. in compressor stations on various Sites shall be insulated by asbestos. All joints of smoke pipe shall be riveted, welded or otherwise securely fastened together and supported to prevent accidental displacement or separation. The joints shall not be leaky.

(viii) Flammable liquids, lubricants etc. shall be handled and transported in safety containers and drums which can be kept tightly capped.

(ix) Storage of fuels and other flammable materials and liquids shall be set not less than 100 m away from the Works and permanent installations. All storage installations and tanks shall conform to the regulations set out in relevant Indian Standards.

(x) Petrol or other flammable liquids with a flash point below 100 degrees Centigrade shall not be used for cleaning purpose.

(xi) Oxygen cylinders shall not be stored with combustible materials.

(xii) All electric installation shall be properly earthed. Repairs shall not be made on electrical circuits until the circuit has been de-energized.

20 THE FOLLOWING FIRE FIGHTING ARRANGEMENTS SHALL BE MADE BY THE CONTRACTOR:

(i) Fire extinguishers and fire buckets filled with clean dry sand, painted red, shall be provided at all fire hazardous locations viz. Bathing and Mixing Plant, Winch houses, Workshops, store yards, Saw-mill, Switch Gear Room, Compressor Stations, Office establishments etc. The extinguishers shall be inspected, serviced and maintained in accordance with manufacturer's instructions. The inspection shall be evidenced by notations on tag attached to the extinguisher.

(ii) Full reliance shall never be placed on portable hand extinguishers as all of these have a very limited capacity. Water, in ample quantity and under adequate pressure, shall always be available for fire fighting.

(iii) Where a group of work points are located beyond the range of protection from a public water supply, the installation of a water system for private fire protection shall be warranted.

(iv) Evacuation facilities and fire exit shall be provided at all locations featuring fire hazards.

(v) Siren or other suitable fire alarm arrangement shall be made on all Sites. Warning signs shall be pasted at all locations having fire hazards.

(vi) All staff shall be conversant with the use of all type of fire extinguishing apparatus.

(vii) In the event of fire on electrical mains or apparatus, the effected part shall immediately be completely isolated from its source of supply of electrical energy.

(viii) Demonstrations and training in fire fighting shall be conducted at sufficient intervals to ensure that sufficient personnel are familiar with and are capable of operating fire fighting equipment.

21 When any work is carried on, which is likely to affect the security or stability of an installation or structure or any part thereof and endanger any person employed, all practicable precautions shall be taken by shoring or otherwise to prevent collapse of

structure or fall of any part thereof and thus remove the cause of danger to such structures and the persons employed.

22 For persons engaged in handling of corrosive materials, adequate equipment shall be provided.

23 Where, in connection with any grinding, cleaning, spraying or manipulation of any material, there is emission of dust or fume of such character and to such extent as is likely to be injurious to the health of persons employed, all practical measures shall be taken by securing adequate ventilation or by the provision and use of suitable respirators or otherwise to prevent inhalation of such dust and fume.

24 The Contractor shall strictly follow the safety procedures & practices as mentioned in Indian standard IS5216-1982 "Guide for Safety Procedure & Practices in Electrical Work" during the execution of this Contract. In this regard the under J&K Electricity rules 1978 shall also be applicable to the Contractor to fulfill the safety precaution for workmen and Plant.

25 In addition to instructions contained here-in-above the safety regulations contained in the following IS Codes shall also apply wherever the provisions in the codes are exhaustive in nature.

i)	IS:4756-1978 (Reaffirmed 1991)	Safety Code for Tunneling Work
ii)	IS: 3696-1987 (Part-I) (Reaffirmed 1991)	Safety Code of Scaffolds & Ladders (Pt. I Scaffolds)
iii)	IS: 3696-1991 (Part-II)	Safety Code of Scaffolds & Ladders (Pt. II Ladders)
iv)	IS: 3016-1982 (Reaffirmed 1990)	Fire precaution in welding and cutting operations
v)	IS - 5216-1982 Part 1 & 2 (Reaffirmed 1990)	Guide for Safety procedures and Practices in Electrical work Part 1 – General Part-2 – Life saving techniques

26 Notwithstanding the above provisions, the Engineer-in-Charge may require the Contractor to follow any other Act or Rules in force in J&K in respect of Safety Precautions so as to ensure the safety of the Workmen and the Plant and the Contractor shall promptly comply with such requirements.

SECTION – IX

SAMPLE FORMS AND PROCEDURES (FORMS)

SAMPLE FORMS AND PROCEDURES (FORMS)

Preamble

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

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

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

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

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

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

1. BID FORMS AND PRICE SCHEDULES

1.1 Bid Form

Please see Volume – III.

1.2 Price Schedule

Please see Volume - III

2. BID SECURITY FORM

((To be stamped in accordance with Stamp Act, the Non-Judicial Stamp Paper should be in the name of the issuing Bank. ***For the purpose of verification/confirmation of this Bank Guarantee by the Employer, the Bank shall indicate 2 official email ids of the authorized signatories from Issuing Branch and also of the designated higher office (Corporate Office, Zonal Office etc)in the covering letter of the Bank forwarding the Bank Guarantee.****)*

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

To: *(insert Name and Address of Employer)*

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

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

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

THE CONDITIONS of this obligation are:

(1) If the Bidder withdraws its bid during the period of bid validity specified by the Bidder in the Bid Form; or

(2) In case the Bidder does not withdraw the deviations proposed by him, if any, at the cost of withdrawal stated by him in the bid and/or accept the withdrawals/rectifications pursuant to the declaration/confirmation made by him in Attachment – Declaration of the Bid; or

(3) If the Bidder does not accept the corrections to arithmetical errors identified during preliminary evaluation of his bid pursuant to ITB Clause 27.2; or

(4) If, as per the requirement of Qualification Requirements the Bidder is required to submit a Deed of Joint Undertaking and he fails to submit the same, duly attested by Notary Public of the place(s) of the respective 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

(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 34, or

(ii) To furnish the required performance security, in accordance with ITB Clause 35.

or

(6) In any other case specifically provided for in ITB.

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

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

Notwithstanding anything contained herein:

1. **Our liability under this Bank Guarantee shall not exceed _____ (*value in figures*)_____ [_____ (*value in words*)_____].**

2. **This Bank Guarantee shall be valid upto _____*(validity date)*_____.**

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

For and on behalf of the Bank

[*Signature of the authorised signatory(ies)*]

Signature_____

Name_____

Designation_____

POA Number_____

Contact Number(s): Tel._____Mobile_____

Fax Number_____

email _____

Common Seal of the Bank_____

Witness:

Signature_____

Name_____

Address_____

Contact Number(s): Tel._____Mobile_____

email _____

Note:

1. In case the bid is submitted by a Joint Venture, the bid security shall be in the name of the Joint Venture and not in the name of the Lead Partner or any other Partner(s) of the Joint Venture.

2. The Bank Guarantee should be in accordance with the proforma as provided. However, in case the issuing bank insists for additional paragraph regarding applicability of ICC publication No: 758, the following may be added at the end of the proforma of the Bank Guarantee [*i.e., end paragraph of the Bank Guarantee preceding the signature(s) of the issuing authority(ies) of the Bank Guarantee*]:

   "This Guarantee is subject to Uniform Rules for Demand Guarantee, ICC publication No. 758."

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

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

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

Dear Sirs,

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

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

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

Thanking you,

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

(AUTHORISED SIGNATORY)

Copy to:
…..(Registered Office of the Bank)….

3b. FORM OF NOTIFICATION BY THE EMPLOYER TO THE BANK
(Applicable for conditional claim pending extension of Bank Guarantee by the Bidder)

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

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

Dear Sirs,

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

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

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

Thanking you,

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

(AUTHORISED SIGNATORY)

Copy to:
(insert Name and Address of the Bidder)

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

4. FORM OF CONTRACT AGREEMENT
(On non-judicial stamp paper of appropriate value)

THIS AGREEMENT MADE the……day of……2017, AMONG, Chief Engineer, JKPDD, (herein after called "the owner") and The Addl. CEO, RECTPCL, (herein after called "the Employer") and …… having its registered office at…….. (hereinafter called "the Contractor") of the other part.

WHEREAS the JKPDD is desirous that certain goods and services contained in the Package designated as Turnkey Contract Package No ……..in the bidding document viz. "Turnkey project including **"Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"** at Srinagar province should be provided by a letter of Award no. ……dated…….. and have accepted the offer Submitted by the Contractor for the Supply of Goods and Carrying out the services.

NOW THIS AGREEMENT WITHNESSETH as follows;

In this agreement words and expressions shall have the same meanings as are respectively assigned to them in conditions of Contract hereinafter referred to.

1. The following documents shall be deemed to form and be read and construed as part of this Agreement viz.
   a. The Contract Agreement No. _____
   b. The Letter of Award issued under RECTPCL letter no……..dated…….
   c. Document No. 1 containing price schedule for supply and erection of material.
   d. Document No.2 contain the General technical specification and the specific technical requirements of the project.
   e. Document No. 3 containing invitation for bids, Instruction to Bidders, Introduction and Background, General Terms and Conditions of Contract, Technical Specifications.
   f. Document No. 4 contain forms and schedules

2. The aforesaid documents shall be taken as complementary and mutually explanatory of one another, but in case of ambiguities or discrepancies, shall be take precedence in the order set out above.

3. In consideration of the payments to be made by the RECTPCL to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the RECTPCL to provide goods and services and remedy defects therein conformity, in all respects, with the provisions of the Contract.
4. The RECTPCL hereby covenants to pay the Contractor, in consideration of the provisions of goods and services and remedying defects therein and completion of the Works, the Contract Price at the times and in the manner prescribed by the Contract.
5. The contract price in respect of this contract shall be Rs……..(Rupees……) as detailed in Letter of Award dated……
6. The RECTPCL hereby covenants to pay the contractor, in consideration of the execution and completion of the works, the contract price at the times and in the manner prescribed by the contract.
7. The assets created shall be handed over to the owner after successful completion of the project and all the obligation of the contractor, not only limited to defect and liability shall be transferred to the owner of the project.

IN WITNESS whereof the parties hereto have caused their respective common seals to be hereunto affixed (or have hereunto set their respective hands and seals) the day and the year first above written.

SIGNED, SEALED AND DELIEVERED

By the said…….	**By the said…….**	**By the said…….**
NAME……..	**NAME……..**	**NAME……..**
On behalf of the Owner	**On behalf of the Employer**	**On behalf of the Contractor**
In the presence of:	**In the presence of:**	**In the presence of:**
NAME……..	**NAME……..**	**NAME……..**
ADDRESS	**ADDRESS**	**ADDRESS**

Appendix-1

4.1 PROCEDURES OF PAYMENT

TERMS AND PROCEDURES OF PAYMENT

In accordance with the provisions of GCC Clause 33 (Terms of Payment), the Employer shall pay the Contractor in the following manner and at the following times, on the basis of the Price Breakdown given in the section on price schedules. **Payments will be made in the Indian currencies**. The Contractor may make applications for payment in respect of part deliveries as work proceeds.

1. TERMS OF PAYMENT

In addition to the Conditions stipulated under GCC Clause 33, the following terms & Conditions will apply.

1.1 Supply of Goods Portion:

A. Interest Bearing Advance (Optional*): Ten percent (10%) of the Ex-works price component of Main Equipment/Materials (including Mandatory Spares) shall be paid as an interest bearing initial advance after signing the Contract Agreement and on submission of

(a) **Proforma** invoice(s) (for Ex Works Supplies)/detailed invoice,

(b.) Applicable for Ex Works Supplies: **Advance Bank Guarantee for {110% (one hundred ten percent) of the amount of Advance} plus {amount of GST reimbursable on Advance as per the Proforma invoice}**, in line with GCC Clause 33.1.2;

(c) Requisite Performance Securities in line with GCC Clause 9;

(d) Detailed PERT Network/Bar chart and its approval by the Employer

(e) Incorporation of Subsidiary Company or Group Company or a Joint Venture Company (JVC) in India under the Companies Act 1956 or 2013, and

Provided further that the **Proforma Invoice(s)/detailed invoice(s)** (as applicable) for advance payment along with all supporting documents is submitted by the Contractor to the Employer within 3 months from the date of Notification of Award. In case the contractor does not submit the requisite documents including applicable Bank Guarantee(s)/ Security(ies) within the aforesaid period, the advance shall not be payable. However, in case of foreign contractors where submission of Income Tax Order is also required prior to release of advance, the aforesaid period shall be 6 months instead of 3 months.

In case of advance on Ex-works supply portion, the Contractor shall, within 7 days from the date of receipt of Advance, furnish an Advance Receipt Voucher to the Employer, as prescribed under the GST Law.

Interest rate applicable on advance payment to the Contractor shall be 200 Basis Points (BPS) above the MCLR [One Year Tenor rate p.a] published by State Bank of India prevailing as on the date of drawal of advance. The said interest rate shall remain fixed and shall be applicable till the advance amount is fully repaid. The interest will be charged considering proportionate adjustment of advance against progressive payment as per 1.1 (C.1) below. The interest shall be calculated on the daily progressive balances outstanding as on the date of recovery/adjustment.

It is the Employer's understanding that as per extant provisions, GST is not payable on interest charged on amount of Advance. The Contractor is, however, advised to check the position from their own sources. If payable, the same shall be to the Contractor's account and Employer shall not reimburse any GST on this account.

Further, the Contractor shall submit the certificate of Tax Deduction at Source (TDS) on interest within 3 months from the end of the quarter in which adjustment of advance has been made for claiming refund from Employer. No claim for refund will be entertained after end of the aforesaid period of 3 months. Further, while submitting the TDS Certificate the details of Contract No, Project, Region, Quarter etc to which the TDS certificate pertains, shall also be submitted tallying the amount with the TDS Certificate.

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 not to take interest bearing advance as above, it would be mandatory for him to submit the documents listed at Sl. No. (c), (d) and (e) above within twenty eight (28) days of issuance of NOA.

(The above is to be incorporated in case the Contractor has opted for the interest bearing initial advance, as declared by it in its bid in the relevant Attachment to Bid Form)

B. It would be mandatory for contractor to fulfill the following conditions mentioned at as per terms & conditions of Contract and agreed work schedule:

a) Approval of all designs, drawings & guaranteed technical particulars as identified in Technical Specifications, Volume-II of the Bidding Documents.
b) Approval of all quality plans and sub-vendor list.
c) Approval of type test reports in case type tests are not required to be repeated.

C Progressive Payment

Payment of the Ex-works price of Main Equipment/ materials (including Mandatory Spares) for each consignment shall be made progressively on certification of the Employer and on the basis of work performed using the following guidelines:

C.1 **Sixty percent (60%)^** of the Ex-Works price component of Main Equipment/Materials (including Mandatory Spares) shall be paid progressively after dispatch of the Equipment/Materials and on submission of documents indicated herein under:

(a) Evidence of despatch
(b) Contractor's **GST invoice**, **claim (for Ex-works supplies)**& 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.
(f) Test certificate
(g) the details of items, components, raw materials, services etc. procured/availed from MSEs, if any, for the preceding 6 months, in respect of all the contracts in the respective executing Region of RECTPCL as per format enclosed at Section IX, Forms, Volume-I of the bidding documents
(h) Additional performance securities, if required, as per Technical Specification

^ In case, the Contractor opts not to take interest bearing initial advance or has opted to take interest bearing initial advance but the advance payment has become inadmissible for the reason specified in 1.1 (A) above, then this payment shall be 70% (60%+10%) instead of 60%. However, the requirement stipulated at 1.1 A (e) above must be fulfilled for release of 10% payment.

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C.2 **Twenty percent (20%)** of the Ex-works price of Main Equipment/ materials shall be paid on receipt and storage at site and on physical verification and furnishing of necessary certificate by Employer's representative. For Mandatory Spares, balance **thirty percent (30%)** payment of the Ex-works price component shall be released on receipt & storage of the same at site, physical verification and taking over by the Employer's representative.

D Final Payment:

Balance 10% (Ten Percent) of the Ex-Works Price Component of Main Equipment shall be paid as per the following:

(a) **Five Percent (05%)** on Successful completion of erection, testing and commissioning of <u>individual bay.</u>

(b) **Five Percent (05%)** on Proof of submission of required number of reproducibles, O&M Manuals, approved drawings, data sheets, test report, pamphlets and manuals of mandatory spares, maintenance & testing equipment and on Successful completion of erection, testing and commissioning of <u>Substation</u> and issuance of Taking Over Certificate.

However, in case of delay in testing and commissioning & issuance of taking over certificate by Employer beyond six (6) months from the date of receipt of equipment at site, the last 10% of Ex-Works Price of respective equipment shall be paid after issuance of a certificate by Employer's representative that the equipment have been received in good condition and on submission of a bank guarantee of equivalent amount, which shall be kept valid initially for a period of twelve (12) months or until three (3) months after the expected date of commissioning (in case it is possible to anticipate the same), whichever is earlier, provided all other conditions as per para (i) & (ii) above are

complied with by the contractor. If the commissioning does not take place within the validity period of BG, the validity of BG shall be extended from time to time. The bank guarantee shall, however, be released within one month of successful commissioning of the respective equipment by the Employer.

1.2 **Type Test Charges**

Not Applicable

Supply of Services Portion:

1.3 <u>Inland Transportation, In-transit Insurance, Loading & unloading Charges:</u>

Inland transportation, In-transit insurance charges, loading and unloading charges shall be paid to the Contractor on pro-rata basis, as per the unit rates indicated in the Contract Agreement, after receipt of materials/items at site and on presentation of the **commercial invoices, Bill of supply or any other documents prescribed under GST Law** alongwith supporting documents by the Contractor. However, these charges will be subject to a limitation that the aggregate of all invoices does not exceed the total amount indicated in the Contract Agreement.

It is the Employer understanding that as per extant provisions, on the charges for supply of services related to Inland transportation, in transit insurance charges, Loading and unloading charges by the Contractor to the Employer, GST is not payable. **The Contractor is, however, advised to check the position from their own sources. If payable, the same shall be to the Contractor's account and Employer shall not reimburse any GST on this account.**

1.4 **Price Component for Installation (including Civil Works)**

A. Interest Bearing Initial Advance (Optional ^^) Ten percent (10%):

A.1 **1st Installment of 05% (Five)** of the total Installation price component shall be paid on Establishment of Contractor's site offices for preparatory to mobilisation for Installation establishment and on submission of

(a) **Proforma** invoice(s),
(b) Advance Bank Guarantee for **{110% (one hundred ten percent) of the amount of Advance} Plus {amount of GST reimbursable on Advance as per the Proforma invoice}** in line with GCC Clause 33.1.2 and
(c) Performance Securities in line with GCC Clause 9.

A.2 2nd Installment of 05% (Five)^^^ of the total Installation price component shall be paid after start of equipment erection and on certification by Employer's representative at site and on submission of

(a) **Proforma** invoice(s),
(b) Advance Bank Guarantee for **{110% (one hundred ten percent) of the amount of Advance} Plus {amount of GST reimbursable on Advance as per the Proforma invoice}** in line with GCC Clause 33.1.2 and
(c) Performance Securities in line with GCC Clause 9.

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

Note: ^^^ After release of 2nd Installment, the rate of recovery of the advance shall be re-adjusted.

Provided further that the **Proforma** Invoice(s) for advance payment along with all supporting documents is submitted by the Contractor to the Employer within 3 months from the date of fulfillment of the requisite activities, as per the L2 network. In case the Contractor does not submit the requisite documents including applicable Bank Guarantee(s)/ Security(ies) within the aforesaid period, the advance shall not be payable. However, in case of foreign contractors where submission of Income Tax Order is also required prior to release of advance, the aforesaid period shall be 6 months instead of 3 months.

The Contractor, shall, within 7 days from the date of receipt of Advance, furnish an Advance Receipt Voucher to the Employer, as prescribed under the GST Law.

Interest rate applicable on advance payment to the Contractor shall be 200 Basis Points (BPS) above the MCLR [One Year Tenor rate p.a] published by State Bank of India prevailing as on the date of drawal of advance. The said interest rate shall remain fixed and shall be applicable till the advance amount is fully repaid. The interest will be charged considering proportionate adjustment of advance against progressive payment for the work done as per 1.4 B below. The interest shall be calculated on the daily progressive balances outstanding as on the date of recovery/adjustment.

Further, the Contractor shall submit the certificate of Tax Deduction at Source (TDS) on interest within 3 months from the end of the quarter in which adjustment of advance has been made for claiming refund from Employer. No claim for refund will be entertained after end of the aforesaid period of 3 months. Further, while submitting the TDS Certificate the details of Contract No, Project, Region, Quarter etc to which the TDS certificate pertains, shall also be submitted tallying the amount with the TDS Certificate.

It is the Employer's understanding that as per extant provisions, GST is not payable on Interest on amount of Advance. The Contractor may, however, advised to check the position from their own sources. If payable, the same shall be to the Contractor's account and Employer shall not reimburse any GST on this account.

In case, the Contractor opts not to take interest bearing advance as above, it would be mandatory for him to submit the document listed at Sl. No. A.1 (c) above within twenty eight (28) days of issuance of NOA.

(The above is to be incorporated in case the Contractor has opted for the interest bearing initial advance, as declared by it in its bid in the relevant Attachment to Bid Form).

B Progressive Payment

Eighty percent (80%)^^ shall be paid on completion the each of the items of Erection activity and on successful completion of quality check point involved in

Installation, submission of the details of items, components, raw materials, services etc. procured/availed from MSEs, if any, for the preceding 6 months, in respect of all the contracts in the respective executing Region of RECTPCL as per format enclosed at Section IX, Forms, Volume-I of the bidding documents and certification by Employer's representative and on submission of GST invoice.

^^ This payment shall be 85% instead of 80% in the following cases:

(i) the Contractor opts not to take 1st Installment interest bearing initial advance or has opted to take 1st Installment interest bearing initial advance but the advance payment has become inadmissible for the reason specified in 1.4 (A) above

(ii) the Contractor opts not to take 2nd Installment interest bearing initial advance or has opted to take 2nd Installment interest bearing initial advance but the 2nd Installment advance payment has become inadmissible for the reason specified in 1.4 (A) above, and 1st Installment interest bearing initial advance has been paid to the Contractor.

^^This payment shall be 90% instead of 80% in case, the Contractor opts not to take interest bearing initial advance or has opted to take interest bearing initial advance but the advance payment has become inadmissible for the reason specified in 1.4 (A) above

Further, one of the conditions for release of first progressive payment / subsequent payment shall be submission of 'Safety Plan' alongwith all requisite documents in line with tender document on Safety Precaution and proforma provided in this Section – Sample Forms and Procedure and approval of the same by the Engineer In-Charge.

C. Final Payment

Balance 10% (Ten Percent) of the Installation price component shall be paid as per the following:

C.1 **Five Percent (05%)** of the Installation price component shall be paid on Successful completion of erection, testing and commissioning of individual bay.

C.2 **Five Percent (05%)** of the Installation price component shall be paid on Successful completion of erection, testing and commissioning of Substation and issuance of Taking Over Certificate.

1.6 **Training Charges**

Not Applicable.

1.7 **Payment towards Price adjustment**

Any variation in Contract price due to price adjustment provision of Appendix-2 shall be effected on presentation of **invoice (for supply of Goods and Services from abroad)** and **debit note/credit note (for supply of Goods and Services from within India), as prescribed under the GST law** supported by calculations as per formulae specified

therein along with documentary evidence for different indices applicable for Price Adjustment.

1.7.1 Any increase in Contract price due to price adjustment provision shall be payable as follows:

Supply of Goods Portion:

90% (ninety percent) of the price adjustment amount for the respective shipment shall be paid on receipt of said shipment at site **and issuance of invoice debit note (for Ex-works supplies), as prescribed under the GST law, by the Contractor**. Balance 10% (ten percent) of the price adjustment amount shall be paid alongwith the final payment.

Any interest on GST payable due to increase in Contract price due to price adjustment shall be to the Contractor's account and Employer shall not reimburse any amount on this account.

Supply of Services Portion:

90% (ninety percent) of the price adjustment amount for the respective billing period shall be paid after certification by Employer's representative for quantum of work done in the said billing period **and issuance of Debit Note, as prescribed under the GST law, by the Contractor**. Balance 10% (ten percent) of the price adjustment amount shall be paid alongwith the final payment.

Any interest on GST payable due to increase in Contract price due to price adjustment shall be to the Contractor's account and Employer shall not reimburse any amount on this account.

1.7.2 **For** any reduction in Contract Price due to price adjustment provisions the **Contractor shall issue 'Credit note', as prescribed under the GST law. Further, the reduction in Contract Price shall be effected by recovering 100% of the reduction amount along with applicable GST, if any charged earlier, from Contractor's invoices falling immediately due for payment or any other payments**.

1.8 **Payment towards Taxes and Duties**

Taxes and duties applicable as per Indian Tax laws, **concerning Supply of Goods and Services** in respect of transaction between the Employer and the Contractor, **shall be reimbursed by the Employer as follows:**

(a) GST on Advance payment shall be reimbursed along with the Advance payment.

(b) In case of Ex-works supply of goods, remaining GST (GST charged on invoice less GST on advance) shall be reimbursed along with progressive payment on dispatch.

(c) In case of Installation, the remaining GST(GST charged on invoice less GST on advance) shall be reimbursed along with Progressive payment on completion of Erection activity.

(d) GST on type test shall be reimbursed after successful completion of the Type test and along with the progressive payment on dispatch for the first consignment of Equipment for which the type test has been conducted.

(e) GST on Training charges shall be reimbursed on successful completion of Training.

(f) 100% GST reimbursable on account of increase in Contract price due to price adjustment shall be reimbursed along with the 90% payment of the Price adjustment amount

All GST payment except GST applicable on advance payment shall be against GST invoices/debit notes raised by the Contractor as specified under the GST Act and related Rules, Notifications, etc. as notified by the Government of India in this regard. In the event that the Contractor fails to provide the invoice/debit note in the form and manner prescribed under the GST Act and Rules, the Employer shall not be liable to make any payment against such invoice/debit note.

Reimbursement of GST payment against Advance payment shall be against proforma invoice(s). Further, the Contractor shall, within 7 days from the date of receipt of Advance, furnish an Advance Receipt Voucher to the Employer, as prescribed under the GST Law.

Payment towards taxes & duties shall be released by the Employer directly to the Contractor.

1.9 In addition to the documents stipulated above, valid Income Tax Order, wherever applicable, shall also be submitted for the purpose of TDS under Indian Income Tax Act.

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, complete in all respects and supported by the requisite documents and fulfillment of stipulated conditions, if any. All invoices/claim shall be raised by the contractor in the name of owner acting through RECTPCL .

All payments to be made directly to the Contractor shall be made by the Employer though electronic payment mechanism (e-payment) for which necessary details shall be tied up during execution of the Contract. However, a request for payment to be released through cheque shall be considered on case to case basis and merit of the same.

1.2 Payment Tracking

(Payment Tracking method will be intimated to the contractor in due course of time.)

4.2 PRICE ADJUSTMENT

1. General

1.1 Prices for work and materials covered under the scope of this Specification shall be furnished by the bidder in the manner specified in the Bid Form & Price Schedules. The bidder shall quote base prices for the Ex-Works Price Component of Equipment/Materials for (Transformer, Reactor, CB, CT, CVT and SA), the complete equipment procured as spares (Transformer, Reactor, CB, CT, CVT and SA), Substation Structures and installation (including civil works) price component of the equipment/materials. These price components for certain equipment/ materials, as specified, shall be subject to price adjustment to reflect changes in the cost of labour and material components as per the provisions given below:

1.2 All Ex-Works Price Components for GIS equipment, Installation Hardware, Control and relay panels, PLCC Equipment, Bus Post Insulators, Fire Protection Systems, Illumination System, LT Switchgear, IPS Aluminium Tube, Spares, Maintenance & Testing Equipment, etc. and other items not specifically mentioned below shall remain firm and no Price Adjustment shall be applicable for the price component of these items.

1.3 Other Charges viz. inland transportation, inland insurance, Indian Agent commission, type test charges, computer studies (if any) & training charges etc. shall be firm and no price variation shall be payable for these components.

2. Ex-Works Price Component

The formulae for calculating the price adjustment to be applied to the Ex-works price component of the main equipment will be as follows:

A. <u>Circuit Breaker, Current Transformer, Capacitance Voltage Transformer, Isolator and Surge Arrestor</u>

$$P_1 = P_0 \times \{0.15 + a \times (A_1/A_0) \times F_1 + b \times (B_1/B_0) \times F_2 + c \times (C_1/C_0) \times F_3 + d \times (D_1/D_0) \times F_4 + l \times (L_1/L_0) \times F_L\} - P_0$$

Where,

P_1 = Price adjustment amount expressed in currency of Bid, for each shipment.

P_0 = Ex-works price of the respective equipment, in currency of Bid.

A, B, C, D & L = Published recognized price indices of raw materials used in the equipment and labour.

a, b, c & d = Value of corresponding coefficients of raw materials used and the sum of which should be between 0.55 to 0.65.

l = Coefficient for labour component.

These coefficients are estimated percentage of major raw material/labour component involved in the Ex-works price of equipment such that their summation shall be equal to 0.85.

F_1, F_2, F_3, F_4 & F_L = Exchange rate correction factor for respective materials and labour.

$F = Z_0 / Z_1$

Where Z is the number of units of currency of the country of origin of the index which is equivalent to one unit of the bid currency. For calculating the value of Z, State Bank of India (SBI) Bill Selling Card Rate of Exchange shall be used.

B. **PVC/XLPE Insulated Power and Control Cables**

$$\mathbf{P_1 = P_0 \times \{0.85 + 0.15 \times (A_1/A_0) \times F\} - P_0 + (M_1 - M_0)}$$

Where,

P_1 = Price adjustment amount per Km. of cable.
P_0 = Ex-works price per Km. of cable.
A = Price index for PVC/XLPE as published by IEEMA.

F = Exchange rate correction factor for XLPE/PVC compound such that (F = Z0 / Z1)

Where Z is the number of units of currency of the country of origin of the index which is equivalent to one unit of the bid currencyM1 – M0 = Change in metal component of the Ex-Works Price of particular type & size of cable.

Where,

M = Weight in MT of metal per Km. of Cable x Price index of metal per MT as published by IEEMA.

The Bidder has to specify in his Bid metal component per Km. for each type and size of cable.

C. <u>Sub Station Structures (including Bolts & Nuts)</u>

For Lattice & Pipe Structures (including washers, foundation bolts and Bolts & Nuts).

$P_1 = P_0 \times \{0.15 + 0.58x (A_1/A_0) \times F_1 + 0.16 \times (B_1/B_0) \times F_2 + 0.11 \times (L_1/L_0) \times F_L\} - P_0$

Where,

P_1 = Price adjustment amount expressed in currency of Bid, for each shipment.

P_0 = Ex-works price, in currency of Bid.

A , B &L =Published recognized price indices of Structural Steel, Electrolytic Zinc and Labour respectively.

These coefficients are estimated percentage of major raw material/labour component involved in the Ex-works price such that their summation shall be equal to 0.85.

F_1, F_2 & F_L = Exchange rate correction factor for respective materials and labour.

$F = Z_0 / Z_1$

Where Z is the number of units of currency of the country of origin of the index which is equivalent to one unit of the bid currency. For calculating the value of Z, State Bank of India (SBI) Bill Selling Card Rate of Exchange shall be used.

D. Price adjustment formula for Ex-works Price component of Transformer/Reactor (excluding Insulating Oil)

The formula for calculating the price adjustment to be applied to the Ex-works price component of the main equipment for Reactors/Transformer will be as follows:

$P_1 = P_0 \times \{0.15 + a \times (A_1/A_0) + b \times (B_1/B_0) + c \times (C_1/C_0) + d \times (D_1/D_0) + l \times (L_1/L_0)\} - P_0$

Where,

P_1 = Price adjustment amount, payable to Supplier for each shipment.

P_0 = Ex-works price component of main equipment for Reactor/Transformer (without Insulating oil), shipment-wise.

A, B, C, D & L = Corresponding Published recognized price indices for various materials used in the equipment (except insulating oil) and Labour respectively.

a, b, c & d = Coefficients for copper, electrical lamination steel, Ferrous metals & insulating material respectively for Reactor/transformer. The sum of these coefficients shall be between 0.65 and 0.73

l = Coefficient of labour, value of which shall be between 0.12 and 0.20

Further the coefficient a, b, c, d & l should be so selected that their summation shall be equal to 0.85

E. For Insulating Oil for Transformer/Reactor

$P_2 = P_0 \times \{0.15 + 0.85 \times (E_1/E_0)\} - P_0$

P_2 = Price adjustment amount for insulating oil for Reactor/transformer, payable to Supplier for each shipment.

P_0 = Ex-works price of insulating oil for Reactor/Transformer, shipment-wise.

E = Published recognized price indices for Insulating oil.

F. <u>L.T. Transformer</u>

$P_1 = P_0 \times \{0.15 + a \times (A_1/A_0) + b \times (B_1/B_0) + c \times (C_1/C_0) + d \times (D_1/D_0) + e \times (E_1/E_0) + l \times (L_1/L_0)\} - P_0$

Where,

P_1 = Price adjustment amount expressed in currency of Bid, for each shipment.

P_0 = Ex-works price of L.T. Transformer, in currency of Bid, shipment wise.

A, B, C, D, E & L = Published recognized price indices for the materials identified as below and Labour respectively.

a, b, c, d, e = Value of corresponding co-efficients for Copper, Electrical lamination Steel, Construction Steel, Insulating Material and Oil respectively. The sum of these coefficients shall be between 0.65 and 0.73.

l = The coefficient of labour, which shall be between 0.12 and 0.20.

Further the coefficient a, b, c, d, e & l should be so selected so that their summation shall be equal to 0.85.

2.1 i) Subscript '0' refers to indices as on thirty (30) days prior to date of opening of Bids, for materials & labour. In case of Z_0, subscript '0' refers to value as on 7 days prior to date of opening of bids.

ii) Subscript '1' refers to indices and exchange rate as applicable on:

a) Sixty (60) days prior to the date of shipment for Labour.

b) At the expiry of two third (2/3) period from the date of base index to the shipment of material in case of CB, CT, CVT, ISO and SA.

c) Sixty (60) days prior to the date of shipment for materials in case of Substation Structure.

2.2 The total adjustment for CB, CT, CVT, SA, ISO, PVC/XLPE insulated Power & Control Cables and Sub-Station Structures (including bolts & nuts) shall be subject to a ceiling of ± 20% individually of respective Ex-Works price of CB, CT, CVT, SA, ISO, PVC/XLPE insulated Power & Control Cables and Sub-Station Structures (including bolts & nuts).

The price adjustment for the Ex-Works price component for Transformer/Reactor and Insulating Oil for each shipment will not be subject to any ceiling.

3. **Installation (including Civil Works) Price Component**

The formula for calculation of the monthly price adjustments for Installation (including civil works) price component shall be as under:

A. **Installation price component (including Civil Works but excluding 'Supply & Placement of Reinforcement Steel' and 'Concreting')**

$ER_1 = ER_0 [0.20 + b \times (B_1/B_0) + c \times (EC_1/EC_0) \times F_L] - ER_0$

Where,

ER_1 = Price adjustment amount for the Installation price component (excluding supply & placement of steel and concreting) for each billing

ER_0 = Price for Installation (excluding supply & placement of steel and concreting and including civil works), done in billing period as established by the Contract.

B = Indian field labour index – namely All India average consumer price index for Industrial Workers (monthly) (Base: 2001= 100), as published by Labour Bureau, Shimla, Government of India (www.labourbureau.nic.in).

EC = Expatriate field Labour index for the foreign bidder. In case of Indian bidder, this shall be same as 'B' above.

b = Value of Co-efficient of Indian field labour component of the Erection value as indicated by Bidder in his proposal.

c = Value of Co-efficient of Expatriate field labour component of the Erection value as indicated by Foreign Bidder in his proposal.

These coefficients are estimated percentage of Indian field and Expatriate labour component involved in the Installation such that their summation shall be equal to 0.80. In case of Indian Bidder, 'c' shall be equal to zero.

F_L = Exchange rate correction factor for labour.

$F = Z_0 / Z_1$

Where Z is the number of units of currency of the country of origin of the index which is equivalent to one unit of the bid currency. For calculating the value of Z, State Bank of India (SBI) Bill Selling Card Rate of Exchange shall be used.

B. **Supply and Placement of Reinforcement Steel:**

$ER_1 = ER_0 [0.20 + 0.10 \times (A_1/A_0) + 0.05 \times (L_1/L_0) + 0.65 \times (B_1/B_0)] - ER_0$

Where,

ER_1 = Price adjustment amount payable on price components of Supply and Placement of Steel.

ER_0 = Value of supply & placement of steel in billing period as established by Contract.

A = Wholesale Price Index Number for `High Speed Diesel'(Individual Commodity) (monthly) (Base: 2004-05=100), as published by Office of Economic Advisor, Ministry of Commerce & Industry(www.eaindustry.nic.in).

L = Indian field labour index – namely All India average consumer price index for Industrial Workers (monthly) (Base: 2001= 100), as published by Labour Bureau, Shimla, Government of India (www.labourbureau.nic.in).

B = Wholesale Price Index Number for `Ferrous Metals'(Group Item) (monthly) (Base: 2004-05=100), as published by Office of Economic Advisor, Ministry of Commerce & Industry(www.eaindustry.nic.in).

C. **Concreting**

$ER_1 = ER_0 [0.20 + 0.20 \times (A_1/A_0) + 0.10 \times (L_1/L_0) + 0.30 \times (B_1/B_0) + 0.20 \times (C_1/C_0)] - ER_0$

Where,

ER_1 = Price adjustment amount payable on price components of concreting.

ER_0 = Value of concreting in billing period as established by Contract.

A = Wholesale Price Index Number for `High Speed Diesel'(Individual Commodity) (monthly) (Base: 2004-05=100), as published by Office of Economic Advisor, Ministry of Commerce & Industry(www.eaindustry.nic.in).

L = Indian field labour index – namely All India average consumer price index for Industrial Workers (monthly) (Base: 2001= 100), as published by Labour Bureau, Shimla, Government of India (www.labourbureau.nic.in).

B = Wholesale Price Index Number for `Cement & Lime'(Group Item) (monthly) (Base: 2004-05=100), as published by Office of Economic Advisor, Ministry of Commerce & Industry (www.eaindustry.nic.in).

C = Wholesale Price Index Number for `Structural Clay Products'(Group Item) (monthly) (Base: 2004-05=100), as published by Office of Economic Advisor, Ministry of Commerce & Industry(www.eaindustry.nic.in).

3.1 i) Subscript '0' will correspond to thirty (30) days prior to date of opening of Bids. In case of Z_0, subscript '0' refers to value as on 7 days prior to date of opening of bids.

ii) Subscript '1' will correspond to the month of billing for indices and average of the month for the exchange rate.

3.2 The total price adjustment amount for Installation (including civil works) price component shall not be subject to any ceiling whatsoever.

4. The bidder shall indicate in his bid the actual values of the coefficients a, b, c, d etc to be adopted, keeping in view the range/total values given in para 2 & 3 above.

5. The above price adjustment provision shall be invoked by either party subject to the following further conditions:

a) For the purpose of Price Adjustment on ex-works price components of the equipment, the date of shipment for Goods shall mean scheduled date of shipment or actual date of shipment, whichever is earlier. Scheduled date of shipment will be ex-works date of despatch, governed by the accepted PERT Network/Bar Chart. Similarly, for the purpose of Price Adjustment on Installation price component, the Billing period shall mean the billing period as per Contract time schedule i.e., the agreed Bar Chart or actual period, whichever is earlier. The Billing period for various Installation activities will be as per agreed Installation Bar Chart indicating monthly schedule of Installation activities for completion of works. However, when the Employer's specific approval for advancement of shipment/installation

activities has been obtained in such case the said advanced date shall be treated as the schedule date of shipment/installation activities for the purpose of working out the price adjustment payable.

No price increase shall be allowed beyond the original delivery/ Installation dates unless specifically stated in the Time Extension Letter, if any, issued by the Employer. The Employer will, however, be entitled to any decrease in the Contract Price which may be caused due to lower price adjustment amount in case of delivery of Goods/ Installation beyond the original delivery/Installation dates. Therefore, in case of delivery of Goods/ Installation beyond the original delivery/ Installation dates, the liability of the Employer shall be limited to the lower of the price adjustment amount which may work out either on schedule date or actual date of despatch of Goods/ Installation.

b) For the purpose of price adjustment, the bidder shall indicate in his proposal as to whether the Bid is based on the use of raw materials such as copper, electrical lamination steel, construction steel, insulating material, Aluminium, Structural Steel, zinc etc. and insulating oil at local or international prices. The bidder shall indicate the indices for such raw materials and insulating oil (transformer oil) which are recognized published indices in the Country of origin form where these materials are proposed to be procured or any other Internationally recognized indices in case recognized indices are not available in the Country of Origin.

c) In case of non-publication of applicable indices on a particular date, which happens to be the applicable date for Price Adjustment purposes, the published indices prevailing immediately prior to the particular date shall be applicable.

d) If the Price Adjustment amount works out to be positive, the same is payable to the Contractor by the Employer and if it works out to be negative, the same is to be recovered by the Employer from the Contractor.

e) The Contractor/Supplier shall promptly submit price adjustment invoices for the supplies made/work done, positively within 3 months of the dispatch or within ten(10) days of publication of all relevant indices, whichever is earlier, whether it is positive or negative.

Further, in case of CIF supplies under the Off-shore contract, to minimize RECTPCL's liability, if any, to pay interest on the Customs Duty on the account of price adjustment, the Contractor/Supplier shall submit a provisional price adjustment invoice on the basis of latest indices available as on the date of Bill of Lading and forward the same to the RECTPCL (Finance department) preferably along with the Shipping Documents but no later than 10 days of dispatch. This provisional invoice shall only be for the purpose of assessing the interest liability on the Customs Duty applicable on price adjustment amount and shall not be for the purpose of payment of price

adjustment to the Contractor/ Supplier which shall continue to be made based on the price adjustment invoices as per the indices in line with Contract provisions. In case the Contractor/Supplier fails to submit the provisional price adjustment invoice and /or the final price adjustment invoice within stipulated time as specified above, the additional liability to Employer/ Purchaser on account of interest, if any, on Customs Duty for the period of delay attributable to the Contractor/Supplier, shall be recovered by the Employer/ Purchaser from the Contractor/ Supplier.

No price increase shall be allowed beyond the original delivery/ Installation dates unless specifically stated in the Time Extension Letter, if any, issued by the Employer. The Employer will, however, be entitled to any decrease in the Contract Price which may be caused due to lower price adjustment amount in case of delivery of Goods/ Installation beyond the original delivery/Installation dates. Therefore, in case of delivery of Goods/ Installation beyond the original delivery/ Installation dates, the liability of the Employer shall be limited to the lower of the price adjustment amount which may work out either on schedule date or actual date of despatch of Goods/ Installation.

b) For the purpose of price adjustment, the bidder shall indicate in his proposal as to whether the Bid is based on the use of raw materials such as copper, electrical lamination steel, construction steel, insulating material, Aluminium, Structural Steel, zinc etc. and insulating oil at local or international prices. The bidder shall indicate the indices for such raw materials and insulating oil (transformer oil) which are recognized published indices in the Country of origin form where these materials are proposed to be procured or any other Internationally recognized indices in case recognized indices are not available in the Country of Origin.

c) In case of non-publication of applicable indices on a particular date, which happens to be the applicable date for Price Adjustment purposes, the published indices prevailing immediately prior to the particular date shall be applicable.

d) If the Price Adjustment amount works out to be positive, the same is payable to the Contractor by the Employer and if it works out to be negative, the same is to be recovered by the Employer from the Contractor.

e) The Contractor/Supplier shall promptly submit price adjustment invoices for the supplies made/work done, positively within 3 months of the dispatch or within ten(10) days of publication of all relevant indices, whichever is earlier, whether it is positive or negative.

4.3 INSURANCE REQUIREMENTS

A) Insurances to be taken out by the Contractor

In accordance with the provisions of GCC Clause 40, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified. The identity of the insurers and the form of the policies shall be subject to the approval of the Employer, such approval not to be unreasonably withheld. The inability of the insurers to provide insurance cover in the sums and with the deductibles and other conditions as set forth below, shall not absolve the Contractor of his risks and liabilities under the provisions of GCC Clause 40. However, in such a case the Contractor shall be required to furnish to the Employer documentary evidence from the insurer in support of the insurer's inability as aforesaid.

(a) **Marine Cargo Policy/Transit Insurance Policy**:

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

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

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

Similarly, Transit Insurance Policy shall be taken wherein only inland transit is involved for the movement of Plant and Equipment including mandatory Spares supplied from within India. The policy shall cover movement of Plant and Equipment including mandatory Spares from the manufacturer's works to the project's warehouse at final destination site. Inland Transit Clause (ITC) 'A' along with war & Strike Riots & Civil Commotion (SRCC) extension cover shall be taken.

Amount	Deduc-tible Limits	Parties insured	From	To
120% of CIP Entry Border Point Price /CIF Indian Port of Entry Price of all the Plant and Equipment including mandatory Spares to be supplied from abroad plus customs duties (**including BCD, GST, Cess etc**.) on merit rate and 120% of Ex-work Price of all the Plant and Equipment including mandatory Spares to be supplied from within India plus **GST,** if additionally payable.	Nil	Contractor & Employer	Mfrs ware-house	Project's ware-house store at final destination

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

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

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

(I) The policy should cover all physical loss or damage to the facility at site during storage, erection and commissioning covering all the perils as provided in the policy as a basic cover and the add on covers as mentioned at Sl. No. (III) below.

Amount	Deductible limits	Parties insured	From	To
105% of CIP Entry Border Point Price /CIF Indian Port of Entry	Nil	Contractor & Employer	Receipt at site of first lot of the Plant and	Up to Operational Acceptance

Price of all the Plant and Equipment including mandatory Spares to be supplied from abroad plus customs duties **(including BCD, GST, Cess etc**.) on merit rate and 105% of Ex-work Price of all the Plant and Equipment including mandatory Spares to be supplied from within India plus **GST**., if additionally payable. and 100% of erection price component			Equipment including mandatory Spares	

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

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

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

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

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

The third party liability add-on cover shall cover bodily injury or death suffered by third parties (including the Employer's personnel) and loss of

or damage to property (including the Employer's property and any parts of the Facilities which have been accepted by the Employer) occurring in connection with supply and installation of the Facilities.

Amount	Deductible limits	Parties insured	From	To
• For projects upto Rs. 100 crores, the third party liability limit shall be 10% of the project value for single occurrence/ multiple occurrences in aggregate during the entire policy period. • For projects from Rs. 100 crores to Rs. 500 crores, the third party liability limit shall be Rs. 10 crores for single occurrence/multiple occurrences in aggregate during entire policy period. For projects of more than Rs.500 crores, the third party liability limit shall be Rs. 25 crores for single occurrence/ multiple occurrences in aggregate during entire policy period.	Nil	Contractor/ Sub-contractor	Receipt at site	Upto Defect Liability Period.

(V) As there is no OSM material in this contract. So, Contractor shall take consolidated insurance on all supply items mentioned in the Supply Contract.

(c) **Automobile Liability Insurance**

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

(d) **Workmen Compensation Policy**:

(I) Workmen Compensation Policy shall be taken by the Contractor in accordance with the statutory requirement applicable in India. The Contractor shall ensure that all the workmen employed by the Contractor

or its Subcontractors for the project are adequately covered under the policy.

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

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

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

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

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

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

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

B) Insurances to be taken out by the Employer

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

Amount	Deductible limits	Parties Insured	From	To
_____ NIL _____				

-- End –

Appendix-4

4.4 TIME SCHEDULE

1. The Project Completion Schedule shall be as follows:

Description	Duration in Months from the date of Notification of Award
Taking Over by the Employer upon successful Completion of:	
A. 160 MVA, 220/33kV Lassipora (GIS) Grid Substation	24 months

1.1 The activity(ies) under the Contractor's programme for Project Completion shall be in the form of a master network (MNW) and shall identify the various activities like design, engineering, manufacturing, supply, installation, factory testing, transportation to site, site testing and commissioning, trial operation and Taking Over etc. of the Facilities or specific part thereof (where specific parts are specified in GCC). The network shall conform to the above Project Completion Schedule.

This master network will be discussed and agreed before Award in line with above, engineering drawing and data submission schedule shall also be discussed and finalised before Award. Liquidated damages for delay in successful Completion of the Facilities or specific part thereof (where specific parts are specified in GCC) and Operational Acceptance at rates specified in Tender document shall be applicable beyond the date specified above.

1.2 The Employer reserves the right to request minor changes in the work schedule at the time of Award of Contract to the successful Bidder.

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

Appendix-5

4.5 LIST OF APPROVED SUBCONTRACTORS

Prior to award of Contract, the following details shall be completed indicating those sub-contractors proposed by the Bidder by Attachment to its bid that are approved by the Employer for engagement by the Contractor during the performance of the contract.

The following Subcontractors are approved by PGCIL (CTU) or JKPDD (STU of J&K) 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 tender document, the Contractor is free to submit proposals for Subcontractors for additional items from time to time. No Subcontracts shall be placed with any such Subcontractors for additional items until the Subcontractors have been approved in writing by the OWNER/Employer/PGCIL and their names have been added to this list of Approved Subcontractors.

Item of Facilities	Approved Subcontractors	Nationality

Further, erection portion of the contract shall not be subcontracted without the prior approval of the Employer. However, such approval shall not be necessary for engaging labour.

Appendix-6

4.6 LIST OF DOCUMENTS FOR APPROVAL OR REVIEW

Pursuant to tender document, the Contractor shall prepare, or cause its Subcontractor to prepare, and present to the Project Manager (EMPLOYER) in accordance with the requirements of contract (Program of Performance), the following documents for:

A. Approval

1.

2.

3.

B. Review

1.

2.

3.

Note:

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

4.7 GUARANTEES, LIQUIDATED DAMAGES FOR NON – PERFORMANCE

1. The equipment offered shall meet the rating and performance requirements stipulated in Technical Specification for various equipment or indicated in Data requirement.

2. The ratings and performance figures of the below mentioned equipments are guaranteed by you.

Sl.	Equipment	Parameter to be taken for applying differential price factor (F)
1.	53.33 MVA, 220/33 kV, Single Phase Power Transformer	Differential Copper loss (KW)
		Differential Iron loss (KW)
		Auxiliary Losses (KW)

3. If the aforementioned guarantees are not established at factory tests, then the Employer at his discretion may reject or accept the equipment after assessing the liquidated damages as per table above against the Contract and such amounts plus GST payable thereon shall be deducted from the Contract Price or otherwise recovered from the Contractor. However, the equipment under no circumstances shall be accepted if the measured losses are meeting the clauses mentioned under clause 4 (f) of this appendix.

4. GUARANTEE, EVALUATION OF LOSSES & PENALTIES

The bidder shall indicate the Guaranteed values of No load losses, load losses and auxiliary losses in his bid.

a. Capitalization Formula for Transformer Losses

The rate of Capitalization of transformer losses depends upon the rate of interest, rate of electrical energy per kWh, life of transformer and average annual loss factor. In computing the rate of capitalization of iron losses, copper losses and auxiliary losses, following realization assumptions have been made:

i) Rate of interest (r = 12.5%)
ii) Rate of electrical energy (EC = Rs. 7/kW)
iii) Life of the transformer (n = 35 Years)
iv) Average annual loss factor (LS = 0.432)
v) Annual load factor (LF = 60)

Capitalized Cost of Transformer = Initial cost + Capitalized cost of annual iron losses + Capitalized cost of annual copper losses + Capitalized cost of annual auxiliary losses.

Capitalized cost of iron losses per KW = $8400 \times EC \times \frac{(1+r)^n - 1}{r(1+r)^n}$

Capitalized cost of copper Losses per kW = $8400 \times EC \times \frac{(1+r)^n - 1}{r(1+r)^n} \times LS$

Capitalized cost of auxiliary Losses per kW = $0.4 \times 8400 \times EC \times \frac{(1+r)^n - 1}{r(1+r)^n}$

b. The measured losses of each transformer shall not exceed the value in the tender, by more than the tolerance admissible as per **IS: 2026**. The losses need to be very low.

c. The No load loss in Kilo watts at rated voltage and rated frequency shall be guaranteed. The excess of difference between test values of total losses and No load losses in 'Kilo-watt' over corresponding guaranteed losses shall be recovered. In case of fraction of KW, the penalties shall be applied for full KW.

d. **Liquidated Damage for Excessive Losses:** On testing, if it is found that actual losses are more than the values quoted including maximum tolerance, the undisputed liquidate damages shall be recovered from the bidder at the rates double of that calculated from above.

e. **Guarantee, Evaluation of Auxiliary Power Consumption and Penalties**

i. 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.

ii. 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 above shall be taken.

f. REJECTION

The Employer may reject any transformer if during tests or service any of the following conditions arise:

i) No load loss exceeds the guaranteed value by 15% or more.
ii) Load loss exceeds the guaranteed value by 15% or more.
iii) Total losses exceed the guaranteed value by 10% or more.

iv) Impedance value exceeds the guaranteed value by + 10% or more.
v) Transformer fails on impulse test.
vi) Transformer fails on power frequency voltage withstand test.
vii) Transformer provided to have been manufactured not in accordance with the specification.

Appendix-8

4.8 AGREEMENT

UNDER INTEGRITY PACT

No.
Dated

To,
REC Transmission Projects Company Limited,
New Delhi

Sub : Procurement of Bidding Documents

Ref. Tender no.

RECTPCL and the Bidder agree that the Notice Inviting Tender (NIT) is an offer made on the condition that the bidder will sign the Integrity Pact and the Bid would be kept open in its original form without variation or modification for a period of (state the number of days from the last date for the receipt of tenders stated in the NIT) …….. days and the making of the bid shall be regarded as an unconditional and absolute acceptance of this condition of the NIT.

We confirm acceptance and compliance with the Integrity Pact in letter and spirit. We further agree that the contract consisting of the above conditions of NIT as the offer and the submission of Bid as the Acceptance shall be separate and distinct from the contract which will come into existence when bid is finally accepted by RECTPCL.

The consideration for this separate initial contract preceding the main contract is that RECTPCL is not agreeable to sell the NIT to the Bidder and to consider the bid to be made except on the condition that the bid shall be kept open for …… days after the last date fixed for the receipt of the bids and the Bidder desires to make a bid on this condition and after entering into this separate initial contract with RECTPCL.

RECTPCL promises to consider the bid on this condition and the Bidder agrees to keep the bid open for the required period. These reciprocal promises form the consideration for this separate initial contract between the parties.

If Bidder fails to honour the above terms and conditions, RECTPCL shall have unqualified, absolute and unfettered right to encash / forfeit the bid security submitted in this behalf.

Yours faithfully,

(BIDDER)

Yours faithfully

(PURCHASER)

INTEGRITY PACT

PRE-CONTRACT INTEGRITY PACT

General

This pre-bid pre-contract Agreement (hereinafter called the Integrity Pact) is made on day of the month of __ 20, between, on one hand, **REC Transmission Projects Company Limited** acting through Shri (Designation of the officer,), Department (hereinafter called the "BUYER", which expression shall mean and include, unless the context otherwise requires, his successors in office and assigns) of the First Part and M/s._____ represented by Shri _____, _____, (hereinafter called the "BIDDER/Seller" which expression shall mean and include unless the context otherwise requires, his successors and permitted assigns) of the Second Part.

WHEREAS the BUYER proposes to procure_____ (Name what is being procured) and the BIDDER/Seller is willing to offer/has offered the (State what is being offered).

WHEREAS the BIDDER/SELLER is a private company/ public company/Government undertaking / partnership / registered export agency, constituted in accordance with the relevant law in the matter and the BUYER is a Ministry/Department of the Government of Indian/PSU performing its functions on behalf of the President of India.

NOW, THEREFORE,

To avoid all forms of corruption by following a system that is fair, transparent and free from any influence/unprejudiced dealings prior to, during and subsequent to the currency of the contract to be entered into with a view to:-

Enabling the BUYER to obtain the desired said stores/equipment item at a competitive price in conformity with the defined specifications by avoiding the high cost and the distortionary impact of corruption on public procurement, and

Enabling BIDDER/SELLER to abstain from bribing or indulging in any corrupt practice in order to secure the contract by providing assurance to them that their competitors will also abstain from bribing and other corrupt practices and the BUYER will commit to prevent corruption, in any form, by their officials by following transparent procedures.

The parties hereto hereby agree to enter into this Integrity Pact and agree as follows:

Commitments of the Buyer

1.1 The Buyer undertakes that no official of the BUYER, connected directly or indirectly with the contract, will demand, take a promise for or accept, directly or through intermediaries, any bribe, consideration, gift, reward, favour or any material or immaterial benefit or any other advantage from the BIDDER, either for themselves or for any person, organization or third party related to the contract in exchange for an advantage in the bidding process,bid evaluation, contracting or implementation process related to the Contract.

1.2 The Buyer will, during the pre-contract stage, treat all Bidders alike, and will provide to all Bidders the same information and will not provide any such information to any particular BIDDER which could afford an advantage to that particular BIDDER in comparison to other BIDDERs.

1.3 All the officials of the Buyer will report to SBU Head or concerned Functional Director of RECTPCL for any attempted or completed breaches of the above commitments as well as any substantial suspicion of such a breach.

2. In case of any such preceding misconduct on the part of such official(s) is reported by the BIDDER/SELLER to the BUYER with full and verifiable facts and the same is *prima facie* found to be correct by the Buyer, necessary disciplinary proceedings, or any other action as deemed fit, including criminal proceedings may be initiated by the BUYER and such a person shall be debarred from further dealings related to the contract process. In such a case while an enquiry is being conducted by the Buyer the proceedings under the contract would not be stalled.

2.1 The BUYER will exclude from the process all known prejudiced persons.

2.2 If the BUYER obtains information on the conduct of any of its employees which is a criminal offense under the relevant Anti-Corruption Laws of India, or if there be a substantive suspicion in this regard, the BUYER will inform its Vigilance Office and in addition can initiate disciplinary actions.

Commitments of Bidders

3. The BIDDER/SELLER commits himself to take all measures necessary to prevent corrupt practices, unfair means and illegal activities during any stage of its bid or during any pre contract or post-contract stage in order to secure the contract or in furtherance to secure it and in particular commits himself to the following:-

3.1 The BIDDER/SELLER will not offer, directly or through intermediaries, any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the Buyer, connected directly or indirectly with the bidding process, or to any person, organization or third party related to the contract in exchange for any advantage in the bidding, evaluation, contracting and implementation of the Contract.

3.2 The BIDDER/SELLER further undertakes that it has not given, offered or promised to give, directly or indirectly any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the Buyer or otherwise in procuring the Contract or for bearing to do or having done any act in relation to the obtaining or execution of the Contract or any other Contract with the BUYER for showing or for bearing to show favour or dis-favour to any person in relation to the Contract or any other Contract with the BUYER.

3.3 BIDDERs shall disclose the name and address of agents and representatives and Indian BIDDERs shall disclose their foreign principals or associates.

3.4 BIDDERs shall disclose the payments to be made by them to agents/brokers or any other intermediary, in connection with this bid/contract.

3.5 The BIDDER further confirms and declares to the BUYER that the BIDDER is the original manufacturer/integrator and has not engaged any individual or firm or company whether Indian or foreign to intercede, facilitate or in any way to recommend to the BUYER or any of its functionaries, whether officially or unofficially to the award of the contract to the BIDDER, nor has any amount been paid, promised or intended to be paid to any such individual, firm or company in respect of any such intercession, facilitation or recommendation.

3.6 The Bidder, either while presenting the bid or during pre-contract negotiations or before signing the contract, shall disclose any payments he has made, is committed to or intends to make to officials of the Buyer or their family members, agents, brokers or any other intermediaries in connection with the contract and the details of services agreed upon for such payments.

3.7 The BIDDER/SELLER will not collude with other parties interested in the contract to impair the transparency, fairness and progress of the bidding process, bid evaluation, contracting and implementation of the contract.

3.8 The BIDDER/SELLER will not accept any advantage in exchange for any corrupt practice, unfair means and illegal activities.

3.9 The BIDDER/SELLER shall not use improperly, for purposes of competition or personal gain, or pass on to others, any information provided by the BUYER as part of the business relationship, regarding plans, technical proposals and business details, including information contained in any electronic data carrier. The BIDDER/SELLER also undertakes to exercise due and adequate care lestany such information is divulged.

3.10 The BIDDER/SELLER commits to refrain from giving any complaint directly or through any other manner without supporting it with full and verifiable facts.

3.11 The BIDDER/SELLER shall not instigate or cause to instigate any third person to commit any of the actions mentioned above.

3.12 The BIDDER/SELLER or any employee of the BIDDER/SELLER or any person acting on behalf of the BIDDER/SELLER, either directly or indirectly, is a relative of any of the officers of the BUYER, or alternatively, if any relative of an officer ofthe BUYER has financial interest/stake in the BIDDER/SELLER's firm, the same shall be disclosed by the BIDDER/SELLER at the time of filing of tender.

The term 'relative' for this purpose would be as defined in Section 6 of the Companies Act 1956.

3.13 The BIDDER/SELLER shall not lend to or borrow any money from or enter into any monetary dealings or transactions, directly or indirectly, with any employee ofthe BUYER.

4. Previous Transgression

4.1 The BIDDER/SELLER declares that no previous transgression occurred in the last three years immediately before signing of this Integrity Pact, with any othercompany in any country in respect of any corrupt practices envisaged hereunder or with any Public Sector Enterprise in India or any Government Department in India that could justify BIDDER/SELLERs exclusion from the tender process.

4.2 The BIDDER/SELLER agrees that if it makes incorrect statement on this subject, BIDDER/SELLER can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

Earnest Money

5.1 While submitting commercial bid, the BIDDER/SELLER shall deposit an amount (to be specified in the RFP (Request for Proposal) as Earnest Money, with the BUYER through any of the following instruments (as specified In RFP):-

(i) Bank Draft or a Pay Order

(ii) A confirmed guarantee by an Indian Nationalized Bank, promising payment of the guaranteed sum to the BUYER, on demand within three working days without any demur whatsoever and without seeking any reasons whatsoever. The demand for payment by the BUYER shall be treated as conclusive proof for payment.

(iii) Any other mode or through any other instrument (to be specified in RFP).

5.2 The Security Deposit & Retention Money shall be valid & retained by the buyer for such period as specified in the RFP/GTC.

5.3 In the case of successful BIDDER/SELLER a clause would also be incorporated in the Article pertaining to Performance Bond in the Purchase Contract that the provisions of Sanctions for Violation shall be applicable for forfeiture of Performance Bond in case of a decision by the BUYER to forfeit the same without assigning any reason for imposing sanction for violation of this pact.

5.4 No interest shall be payable by the BUYER to the BIDDER/SELLER on Earnest Money/Security Deposit for the period of its currency.

6. Sanctions for Violation

6.1 Any breach of the aforesaid provisions by the BIDDER/SELLER or any one employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER/SELLER) shall entitle the BUYER to take all or anyone of the following actions, wherever required:-

(i) To immediately call off the pre-contract negotiations without assigning any reason or giving any compensation to the BIDDER / SELLER. However, the proceedings with the other BIDDER(s) / SELLER(s) would continue.

(ii) The Earnest Money Deposit (in pre-contract stage) and/or Security Deposit Performance Bond (after the contract is signed) shall stand forfeited either fully or partially, as decided by the BUYER and the BUYER shall not be required to assign any reason therefore.

(iii) To immediately cancel the contract, if already signed, without giving any compensation to the BIDDER/SELLER.

(iv) To recover all sums already paid by the BUYER and in case of an Indian BIDDER/SELLER with interest thereon at 2% higher than the prevailing Prime Lending Rate of State Bank of India, while in case of a BIDDER/SELLER from a country other than India with interest thereon at 2% higher than the L1BOR. If any outstanding payment is due to the BIDDER/SELLER from the BUYER in connection with any other contract for any other stores, such outstanding payment could also be utilized to recover the aforesaid sum and interest.

(v) To encash the advance bank guarantee and performance bond/warranty bond, if furnished by the BIDDER/SELLER, in order to recover the payments, already made by the BUYER, along with interest.

(vi) To cancel all or any other Contracts with the BIDDER/SELLER. The BIDDER/SELLER shall be liable to pay compensation for any loss or damage to the BUYER resulting from such cancellation/rescission and the BUYER shall be entitled to deduct the amount so payable from the money(s) due the BIDDER/SELLER

(vii) To debar the BIDDER/SELLER from participating in future bidding processes of the Government of India or the BUYER for a minimum period of five years, which may be further extended at the discretion of the BUYER.

(viii) To recover all sums paid in violation of this Pact by BIDDER/SELLER(s) to any middleman or agent or broker with a view to securing the contract.

(ix) In cases where irrevocable Letters of Credit have been received in respect of any contract signed by the BUYER with the BIDDER/SELLER, the same shall not be opened.

(x) Forfeiture of Performance Bond in case a decision by the BUYER to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

6.2 The BUYER will be entitled to take all or any of the actions mentioned at para 6.1 (i) to (x) of this Pact also on the Commission by the BIDDER/SELLER or anyone employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER/SELLER), of an offence as defined in Chapter IX of the Indian Penal code, 1860 or Prevention of Corruption Act, 1988 or any other statute enacted for prevention of corruption.

6.3 The decision of the BUYER to the effect that a breach of the provisions of this Integrity Pact has been committed by the BIDDER/SELLER shall be final and conclusive on the BIDDER/SELLER. However, the BIDDER/SELLER can approach the Independent external monitor(s) appointed for the purposes of this Pact.

7. **Fall Clause**

a) The Bidder undertakes that during the previous one year, the Bidder has not supplied *I* is not supplying and/or has not agreed to supply similar product systems or subsystems at a price lower than that offered in the present bid in respect of same location as mentioned in the present bid to any other Ministry/Department of the Government of India or PSU.

b) Further the Bidder unconditionally agrees and confirms that in case it is found at anystage that during the financial year in which bid was submitted by the bidder, the bidder had supplied/agreed to supply similar product systems or subsystems inrespect of same location to any other Ministry/Department of the Government of India or a PSU at a price lower than that mentioned in the present bid **("Lower Price"**),then the Buyer by providing a written notice to the Bidder shall be at liberty to apply Lower Price to the contract and accordingly reduce the contract value. The Bidder further undertakes to refund to the Buyer the difference between payment received under the contract and the Lower Price **("Price Difference**") within 15 days of receipt of the said written notice.

c) In case the Price Difference is not received by the Buyer from the Bidder within the period stipulated under clause 7 (b), then the Buyer shall be free to recover the Price difference from any amount due and payable to the Bidder under any contract or transaction undertaken with the Buyer.

8. **Independent Monitors**

8.1 The BUYER has appointed Independent Monitors (hereinafter referred to as Monitors) for this Pact.

Shri Jatin Kumar Nayak
Contact Details:
C/o Office of the Chief Financial Officer,
REC Transmission Projects Company Limited,
ECE House, 3rd Floor, Annexe – II,
28 A, K G MARG, NEW DELHI – 110 001
Tel: 011 – 47964706, Fax : 011-47964704
Email- nayakjatin@rectpcl.in

8.2 The task of the Monitors shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this Pact.

8.3 The Monitors shall not be subject to instructions by the representatives of the parties and perform their functions neutrally and independently.

8.4 Both the parties accept that the Monitors have the right to access all the documents relating to the project procurement, including minutes of meetings.

8.5 As soon as the Monitors notice, or have reason to believe, a violation of this Pact, he will so inform the C&MD of the BUYER Corporation.

8.6 The BIDDER(s) accepts that the Monitors have the right to access without restriction to all Project documentation of the BUYER including that provided by the BIDDER/SELLER. The BIDDER/SELLER will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor shall be under contractual obligation to treat the information and documents of the BIDDER/Subcontractor(s) with the confidentiality.

8.7 The BUYER will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have animpact on the contractual relations between the parties. The parties will offer to the Monitor the option to participate in such meetings.

8.8 The Monitors will submit a written report to the C&MD of the BUYER/Secretary in the Department/within 8 to 10 weeks from the date of reference or intimation to him by the BUYER / BIDDER and, should the occasion arise, submit proposals for correcting problematic situations.

9. **Facilitation of Investigation**

In case of any allegation of violation of any provisions of this Pact or payment of commission, the BUYER or its authorised agencies & other Govt. authorities shall be entitled to examine all the documents including the Books of Accounts of the BIDDER/SELLER and the BIDDER/SELLER shall provide necessary information and documents in English and shall extend all possible help for the purpose of such examination.

10. **Law and Place of Jurisdiction**

This Pact is subject to Indian Law. The place of performance and jurisdiction is the seat of the BUYER.

11. **Other Legal Actions**

The actions stipulated in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings.

12. **Validity**

12.1 The validity of this Integrity Pact shall be from date of its signing and extend up to 5 years or the complete execution of the contract to the satisfaction of both the BUYER and the

BIDDER/SELLER, including warranty period, whichever is later. In case BIDDER is unsuccessful, this Integrity Pact shall expire after six months from the date of the Signing of the contract.

12.2 Should one or several provisions of this Pact turn out to be invalid, the remainder of this Pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

13. The Parties hereby sign this Integrity Pact at _____ on _____

BUYER	BIDDER
Name of the Officer Designation RECTPCL	Name of the Officer Designation Name of the Organisation/Dep/Ministry/PSU
Witness	Witness
1._____	1. _____
2. _____	2. _____

Instruction for printing & submitting Safety Pact

1. The requisite format of Safety Pact is getting generated automatically and displayed here below.

2. Take print out of first page on a non-judicial stamp paper of Rs. 100/- /Company's Letterhead, as applicable, and other pages on plain A4 size paper. Such two sets shall be prepared by the bidder.

3. All the pages of both the copies of the Safety Pact shall be signed by the authorised representative of the bidder and duly stamped.

4. Both the original copies shall be submitted by the bidder in the form of Hard Copy as part of the first envelope before due date & time of submission of the bid.

Appendix-9

4.9 SAFETY PACT

Between

REC Transmission Projects Company Limited,
(A 100% subsidiary of REC Ltd, Government of India Enterprise), a company incorporated in India having their Registered Office at Core-4, SCOPE Complex, 7, Lodhi Road, New Delhi-110003,, India

hereinafter referred to as "RECTPCL"

and

insert name of bidder

having its Registered Office at

and

insert name of partner(s) in case of JV …… …… …… …….. having its Registered Office at

Hereinafter referred to as "The Bidder/Contractor"

Preamble

RECTPCL intends to award, under laid-down organisational procedures, contract(s) for Cable Package of **"Construction of 160 MVA, 220/33 kV Lassipora (GIS) Grid Substation under PMDP Sceme-15"**and Specification Number: **xxxxxxxxxxxxxxx**

RECTPCL values full compliance with all relevant laws and regulations and the principles of Safety, Health & Environment in its relations with its Bidders/ Contractors.

In order to achieve these goals, RECTPCL and the above named Bidder / Contractor enter into this agreement called "Safety Pact" which will form part of the Bid.

It is hereby agreed by and between the parties as
under:

Section I - Commitments of RECTPCL:

RECTPCL commits itself to take all measures necessary to prevent accidents during Construction and Operation of the Transmission Assets and to observe the following:

1 RECTPCL recognizes and accepts its statutory responsibilities for ensuring construction, operation and maintenance of equipments and for the provision of safe methods of work and safe working conditions.

2 RECTPCL recognizes and accepts its statutory responsibilities for ensuring safety of not only its employees but also that of the Contracting Agencies as Principal Employer.

3 RECTPCL shall review the accidents in a structured manner and take necessary actions to ensure that the safety criteria are strengthened for safe construction as well as Operation & Maintenance of the Transmission Assets.

4 RECTPCL shall conduct necessary awareness and training programmes to its Employees to augment the various safety requirements to be followed during Construction and Operation & Maintenance of the Transmission Assets from time to time.

5 RECTPCL shall, from time to time, issue necessary guidelines, instructions and deterrents to its employees as well as to the Contracting Agencies, to update them to take necessary preventive measures to avoid repetition of similar accident attributes.

6 RECTPCL shall review and provide necessary guidance to the Contracting Agencies, as and when, any abnormality / special situations are brought to its notice by the Contracting Agencies during execution of the Transmission Projects being executed by them.

7 RECTPCL shall conduct periodical surveillance site inspections / audits to identify the unsafe conditions and unsafe actions, and bring them to the knowledge of the Contracting Agencies for taking timely corrective actions.

8 RECTPCL shall investigate all accidents, fatal as well as non-fatal, to identify the lapses, the reason for the accident / incident and suggest measures for prevention of recurrence of such accidents, and fix responsibility for the lapses leading to the accident.

9 RECTPCL shall augment the training to the workers and supervising personnel of the Contracting Agencies, as per schedules, upon nomination by the Contracting Agencies in reasonable time frame.

10 RECTPCL shall exercise the right to claim and recover compensation from the Contracting Agencies in case of any violation of the safety requirements / provisions during execution of the Transmission Projects, as built in the applicable Laws and contractual specifications / guidelines in vogue / issued by RECTPCL from time to time.

11 **Section II - Commitments of the Bidder / Contractor:**

The Bidder / Contractor commits himself to take all measures necessary to prevent / minimise accidents at their construction / erection sites and to observe the following:

1 The Bidder / Contractor recognizes and accepts the statutory and comprehensive responsibility for ensuring safe construction and Testing & Commissioning in the Transmission Projects being executed by them by providing safe methods of work, working conditions and Tools & Plants for human safety.

2 The Bidder / Contractor recognizes and accepts the responsibilities for ensuring safety of not only their employees but also that of the Sub-contractors, Principal Employer and the general public during execution of the Transmission Projects / works.

3 The Bidder / Contractor shall review the accidents in a structured manner and take necessary actions to ensure that the safety criteria are strengthened for safe construction of the Transmission Assets.

4 The Bidder / Contractor shall endeavour continuous development of safe methods of work to ensure that the effect of risks and perils are minimised to the extent possible and implement the same at their work sites.

5 The Bidder / Contractor shall conduct periodical Training to their Employees as well as to that of their Sub-contractors for safety awareness during construction works being executed by them.

6 The Bidder / Contractor shall provide all requisite Tools & Plants required for the work and ensure their healthiness by periodical inspections / testing as required. Unhealthy and sub-standard Tools & Plants will be immediately removed from site as and when they are identified.

7 The Bidder / Contractor shall, at their cost, provide all necessary Personal Protective Equipments such as Double Lanyard Safety Belts, Appropriate Fall Arrest Systems, Safety Helmets, Foot Wear, Hand Gloves, etc., as required for various activities pertaining to execution of the Projects / works, confirming to relevant Indian Standards.

8	The Bidder / Contractor shall ensure that dedicated qualified Safety Officers are posted in the construction projects being executed by them and ensure that the Safety Officer visits each and every gang periodically and conducts audits / inspections to identify the unsafe conditions and unsafe actions, to be rectified by the site supervising personnel promptly.
9	The Bidder / Contractor shall conduct appropriate medical checks-up for the workers before deploying them at their construction sites to ensure that only those who are medically fit are deployed in the Projects / works to be executed by them. The copy of the Medical Reports shall be provided by the Bidder / Contractor to RECTPCL, whenever requested by RECTPCL.
10	The Bidder / Contractor shall screen the workers before deploying them at their construction sites to ensure that only those with the skills, experience and competence to work at height and also medically fit for work at height are deployed for work at height in the Projects executed by them.
11	The Bidder / Contractor shall ensure daily before starting the work that their site Supervising Personnel / Safety Officer briefs the workers about the work for the day and the safety measures / precautions required to be taken by them.
12	The Bidder / Contractor shall investigate all the accidents at their working sites to ascertain the lapses leading to the incident and the precautionary / corrective measures required to be taken to avoid recurrence of such accidents. These accidents will be reviewed at the Board Management level of the Agencies and the findings / recommendations will be put up to RECTPCL Apex Safety Board within the stipulated period.
13	The Bidder / Contractor shall ensure that all accidents, whether fatal or non-fatal in nature, will be informed to RECTPCL, in writing, immediately on the occurrence of the same and in any case, within not more than 24 hours of occurrence of the same.
14	The Bidder / Contractor shall ensure that in case of any accident, all necessary medical help / support shall be provided to the victims / injured till they are completely fit to return to work.
15	The Bidder / Contractor shall ensure that in case of fatal accidents, all statutory Authorities, including Police, concerned Labour Dept. Officials, concerned Workmen Compensation Commissioner, etc., will be intimated in writing as required by the statutory Law, and followed up for compliance of all statutory obligations. The Bidder / Contractor shall own full responsibility of timely accident reporting to various authorities, including RECTPCL.

16 The Bidder / Contractor shall ensure that in case of fatality or serious injury leading to permanent disablement of the victims, the compensation amount will be deposited with the concerned authorities, as required by the Laws, and followed up for early disbursement to the beneficiaries of the victims.

17 The Bidder / Contractor assures that they shall co-operate to the fullest extent for carrying out any investigation of the accidents at their work sites by RECTPCL to identify the lapses, the reason for the accident / incident and suggest measures for prevention of recurrence of such accidents. All factual details of the occurrence of the accident will be provided to RECTPCL, as and when required.

18 The Bidder / Contractor assures that they take full responsibility of meeting the statutory obligations in case of accidents, and in case of any reference by any Statutory Body at a later date also, they shall provide all information to RECTPCL and meet all the statutory obligations, including payment of additional compensation, if any.

19 The Bidder / Contractor assures that in case of any inspection of their work site or Notice by any Statutory Authority, they shall comply promptly and inform RECTPCL Site Officials of the same, and also provide all necessary information and assistance for smooth compliance of the observations / instructions of such Authorities.

20 The Bidder / Contractor accepts the provisions regarding safety, including payment of compensation to RECTPCL, in case of any violation of the safety requirements / provisions during execution of the Transmission Projects, as built in the Contractual Conditions, Safety Plan and the Safety Pact, and confirm to abide by the same.

Section III - Equal treatment to all Bidders / Contractors:

1 RECTPCL will enter into agreements with identical conditions as this one with all Bidders.

2 RECTPCL will disqualify, from the tender process, any bidder/ take punitive actions on the bidder, who does not sign this Pact or violate its provisions.

Section IV - Pact Duration:

This Pact begins when both parties have legally signed it. It expires for the successful Bidder / Contractor after closure of the contract and, for all other Bidders, after the contract has been awarded.

Section V - Other Provisions:

1	This agreement is subject to Indian Law. Place of performance and jurisdiction is the establishment of RECTPCL. The Arbitration clause provided in the main tender document / contract shall not be applicable for any issue / dispute arising under the Safety Pact.
2	Changes and supplements need to be made in writing, which shall come into force only upon mutual agreement / acceptance.
3	If the Contractor is a partnership firm or consortium of Joint Venture, this agreement must be signed by all partners, consortium members and Joint Venue partners, as applicable as per the Tender Specifications.
4	Nothing in this agreement shall affect the rights of the parties available under General Conditions of Contract (GCC) and Special Conditions of Contract (SCC).
5	Should one or several provisions of this agreement turn out to be invalid, the reminder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

(Signature)_____
(For & on behalf of RECTPCL)
(Office Seal)

Name:_____
Designation:_____

(Signature)_____
(For & on behalf of Bidder / Partner(s) of Joint Venture/ Consortium partner (s))
(Office Seal)

Name:_____
Designation:_____

Witness 1:_____

(Name & Address)_____

Witness 2:_____

(Name & Address)_____

Witness 1:_____

(Name & Address)_____

Witness 2:_____

(Name & Address)_____

5. PERFORMANCE SECURITY FORM

(*TO BE SUBMITTED BY THE CONTRACTOR OPTING FOR SUBMISSION OF PERFORMANCE SECURITY IN ACCORDANCE WITH CLAUSE GCC 9)*

(For the purpose of verification/confirmation of this Bank Guarantee by the Employer, the Bank shall indicate 2 official email ids of the authorized signatories from Issuing Branch and also of the designated higher office (Corporate Office, Zonal Office etc)in the covering letter of the Bank forwarding the Bank Guarantee.)

Bank Guarantee No. …… Date.....

NOA/Contract No.....

……..*[Name of Contract]*……..

To: *[Name and address of the **Owner**]*

Dear Ladies and/or Gentlemen,

We refer to the Contract ("the Contract")

vide notification of award issued on *..... (insert date of the notification of award)*....by M/s. REC Transmission Project Company Ltd., 3rd Floor ECE House, Annex-II, 28A KG MARG ,New Delhi-110001 ("the Employer"/"RECTPCL") on behalf of ..... Name of OWNER…..... (hereinafter referred to as 'Owner') to M/s ..... *(Name of Contractor)* .....,

(or)

signed on .....*(insert date of the Contract)*..... between M/s. REC Transmission Project Company Ltd., having its Registered Office at Core-4 SCOPE Complex, 7, Lodhi Road, New Delhi-110003 ("the Employer"/"RECTPCL") on behalf of ..... Name of OWNER…..... (hereinafter referred to as 'Owner'), and M/s ..... *(Name of Contractor)* .....,having its Principal place of business at ……..*(Address of Contractor)* ..... and Registered Office at ……..*(Registered address of Contractor)* ..... ("the Contractor") and the Contract ("the Contract") signed on .....*(insert date of the Contract)*..... between you and M/s ..... *(Name of Associate)* ....., having its Principal place of business at ……..*(Address of Associate)* ..... and Registered Office at ……..*(Registered address of Associate)* ....., the Associate of the Contractor for executing the Facilities concerning ……..... *(Indicate brief scope of work)* ..... for the complete execution of the …… *(insert name of Package*

alongwith name of the Project)…….. [Applicable for Bank Guarantees to be issued by Contractor against those Contracts awarded to their Associate]

By this letter we, the undersigned, ……..*(insert name & address of the issuing bank)* ……., a Bank (which expression shall include its successors, administrators, executors and assigns) organized under the laws of ……. and having its Registered/Head Office at ……..*(insert address of registered office of the bank)*……. do hereby irrevocably guarantee payment to you up to …… i.e., ten percent (10%) of the Contract Price until 60 months i.e., upto and inclusive of …… *(dd/mm/yy)*.

We undertake to make payment under this Letter of Guarantee upon receipt by us of your first written demand signed by the Employer's duly authorized officer or the authorized officer of Owner declaring the Contractor to be in default under the Contract and without cavil or argument any sum or sums within the above named limits, without your need to prove or show grounds or reasons for your demand and without the right of the Contractor to dispute or question such demand.

Our liability under this Letter of Guarantee shall be to pay to 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 remain in full force and shall be valid from the date of issue until 60 months i.e. upto and inclusive of …… *(dd/mm/yy)* and shall be extended from time to time for such period, as may be desired by M/s. …… on whose behalf this Letter of Guarantee has been given.

Except for the documents herein specified, no other documents or other action shall be required, notwithstanding any applicable law or regulation.

Our liability under this Letter of Guarantee shall become null and void immediately upon its expiry, whether it is returned or not, and no claim may be made hereunder after such expiry or after the aggregate of the sums paid by us to you shall equal the sums guaranteed hereunder, whichever is the earlier.

All notices to be given under shall be given by registered (airmail) posts to the addressee at the address herein set out or as otherwise advised by and between the parties hereto.

We hereby agree that any part of the Contract may be amended, renewed, extended, modified, compromised, released or discharged by mutual agreement between you and the Contractor, and this security may be exchanged or surrendered without in any way impairing or affecting our liabilities hereunder without notices to us and without the necessity for any additional endorsement, consent or guarantee by us, provided, however, that the sum guaranteed shall not be increased or decreased.

No action, event or condition which by any applicable law should operate to discharge us from liability hereunder shall have any effect and we hereby waive any right we may have to apply such law so that in all respects our liability hereunder shall be irrevocable and, except as stated herein, unconditional in all respects.

Notwithstanding anything contained herein:

1. Our liability under this Bank Guarantee shall not exceed _____ (*value in figures*)_____ [_____ (*value in words*)_____].

2. This Bank Guarantee shall be valid upto _____*(validity date)*_____.

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

For and on behalf of the Bank

[*Signature of the authorised signatory(ies)*]

Signature_____

Name_____

Designation_____

POA Number_____

Contact Number(s): Tel._____Mobile_____

Fax Number_____

email _____

Common Seal of the Bank_____

Witness:

Signature_____

Name_____

Address_____

Contact Number(s): Tel._____Mobile_____

email _____

Note :

1. For the purpose of executing the Bank Guarantee, the non-judicial stamp papers of appropriate value shall be purchased in the name of Bank who issues the 'Bank Guarantee'.

2. The Bank Guarantee shall be signed on all the pages by the Bank Authorities indicating their POA nos. and should invariably be witnessed.

3. The Bank Guarantee should be in accordance with the proforma as provided. However, in case the issuing bank insists for additional paragraph regarding applicability of ICC publication No: 758, the following may be added at the end of the proforma of the Bank Guarantee [*i.e., end paragraph of the Bank Guarantee preceding the signature(s) of the issuing authority(ies) of the Bank Guarantee*]:
"This Guarantee is subject to Uniform Rules for Demand Guarantee, ICC publication No. 758 except that article 15(a) is hereby excluded."

6. FORM OF TAKING OVER CERTIFICATE

Date.....

Name of Contract.....

Contract No.....

To :

(Name and address of the Contractor)

Dear Ladies and/or Gentlemen,

Pursuant to GCC 30 (Taking Over) of the General Conditions of the Contract entered into between yourselves and the Employer dated …… relating to the ..... *(insert brief description of the Facilities)*..... we hereby notify you that the following part(s) of the Facilities was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Employer hereby takes over the said part(s) of the Facilities, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below :

1. Description of the Facilities or part thereof .....
   .....

2. Date of Completion :.....

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defects Liability Period.

Very truly yours,

Title
(Project Manager)

7. FORM OF INDEMNITY BOND TO BE EXECUTED BY THE CONTRACTOR FOR THE EQUIPMENT HANDED OVER IN ONE LOT BY .....*(abbreviated name of the Employer)*..... FOR PERFORMANCE OF ITS CONTRACT

INDEMNITY BOND

THIS INDEMNITY BOND is made this..... day of ..... 20..... by ..... a Company registered under the Companies Act, 1956/Partnership firm/ proprietary concern having its Registered Office at.....(hereinafter called as 'Contractor' or "Obligor" which expression shall include its successors and permitted assigns) in favour of ..... *(insert name of the Employer)*....., a Company incorporated under the Companies Act, 1956 having its Registered Office at .....*(insert registered address of the Employer)* and its project at ..... (hereinafter called ".....*(abbreviated name of the Employer)*....." which expression shall include its successors and assigns):

WHEREAS .....*(abbreviated name of the Employer)*..... has awarded to the Contractor a Contract for..... .....vide its Notification of Award/Contract No..... dated..... and its Amendment No. ..... (applicable when amendments have been issued) (hereinafter called the "Contract") in terms of which .....*(abbreviated name of the Employer)*..... is required to hand over various Equipment to the Contractor for execution of the Contract.

And WHEREAS by virtue of Clause No.....of the said Contract, the Contractor is required to execute an Indemnity Bond in favour of .....*(abbreviated name of the Employer)*..... for the Equipment handed over to it by .....*(abbreviated name of the Employer)*..... for the purpose of performance of the Contract/Erection portion of the contract (hereinafter called the "Equipment").

AND THEREFORE, This Indemnity Bond witnesseth as follows:

1. That in consideration of various Equipment as mentioned in the Contract, valued at (amount in words.....) handed over to the Contractor for the purpose of performance of the Contract, the Contractor hereby undertakes to indemnify and shall keep .....*(abbreviated name of the Employer)*..... indemnified, for the full value of the Equipment. The Contractor hereby acknowledges receipt of the Equipment as per despatch title documents handed over to the Contractor duly endorsed in their favour and detailed in the Schedule appended hereto. It is expressly understood by the Contractor that handing over of the despatch title documents in respect of the said Equipments duly endorsed by .....*(abbreviated name of the Employer)*..... in favour of the Contractor shall be construed as handing over of the Equipment purported to be covered by such title documents and the Contractor shall hold such Equipment in trust as a Trustee for and on behalf of .....*(abbreviated name of the Employer)*.....

2. That the Contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the Equipment at .....*(abbreviated name of*

the Employer)..... project Site against all risks whatsoever till the Equipment are duly used/erected in accordance with the terms of the Contract and the Plant/Package duly erected and commissioned in accordance with the terms of the Contract, is taken over by .....*(abbreviated name of the Employer)*..... The Contractor undertakes to keep .....*(abbreviated name of the Employer)*..... harmless against any loss or damage that may be caused to the Equipment.

3. The Contractor undertakes that the Equipment shall be used exclusively for the performance/execution of the Contract strictly in accordance with its terms and conditions and no part of the equipment shall be utilised for any other work of purpose whatsoever. It is clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal/penal consequences.

4. That .....*(abbreviated name of the Employer)*..... is and shall remain the exclusive Employer of the Equipment free from all encumbrances, charges or liens of any kind, whatsoever. The equipment shall at all times be open to inspection and checking by the Employee or Employer's Representative in this regard. Further, ...*(abbreviated name of the Employer)*..... shall always be free at all times to take possession of the Equipment in whatever form the equipment may be, if in its opinion, the Equipment are likely to be endangered, misutilised or converted to uses other than those specified in the Contract, by any acts of omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions of demand of .....*(abbreviated name of the Employer)*..... to return the equipment without any demur or reservation.

5. That this indemnity Bond is irrevocable. If at any time any loss or damage occurs to the Equipment or the same or any part thereof is misutilised in any manner whatsoever, then the Contractor hereby agrees that the decision of the Employer's Representative as to assessment of loss or damage to the Equipment shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Equipment at his own cost and/or shall pay the amount of loss to .....*(abbreviated name of the Employer)*..... without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to .....*(abbreviated name of the Employer)*..... against the Contractor under the Contract and under this Indemnity Bond.

6. NOW THE CONDITION of this Bond is that if the Contractor shall duly and punctually comply with the terms and conditions of this Bond to the satisfaction of .....*(abbreviated name of the Employer)*....., THEN, the above Bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorised representative under the common seal of the Company, the day, month and year first above mentioned.

SCHEDULE

Particulars of the Equipment handed over	Quantity	Particulars of Despatch title Documents		Value of the Equipment	Signature of the Attorney in token of receipt
		RR/GR No. date of lading	Carrier		

For and on behalf of
M/s.....

WITNESS

1. Signature..... Signature.....

   Name..... Name.....

   Address..... Address.....

2. Signature..... Authorised representative

   Name..... (Common Seal)

   Address..... (In case of Company)

Indemnity Bonds are to be executed by the authorised person and (i) in case of contracting Company under common seal of the Company or (ii) having the power of attorney issued under common seal of the company with authority to execute Indemnity Bonds, (iii) In case of (ii), the original Power of Attorney if it is specifically for this Contract or a Photostat copy of the Power of Attorney if it is General Power of Attorney and such documents should be attached to Indemnity Bond.

8. FORM OF INDEMNITY BOND TO BE EXECUTED BY THE CONTRACTOR FOR THE EQUIPMENT HANDED OVER IN INSTALLMENTS BY .....*(abbreviated name of the Employer)*..... FOR PERFORMANCE OF ITS CONTRACT

INDEMNITY BOND

THIS INDEMNITY BOND is made this …….. day of …….. 20..... by …….. a Company registered under the Companies Act, 1956/Partnership firm/proprietary concern having its Registered Office at ……..(hereinafter called as 'Contractor' or 'Obligor' which expression shall include its successors and permitted assigns) in favour of .....*(insert name of the Employer)*....., a company incorporated under the Companies Act, 1956 having its Registered Office at .....*(insert registered address of the Employer)*..... and its project at …….. (hereinafter called ".....*(abbreviated name of the Employer)*....." which expression shall include its successors and assigns):

WHEREAS .....*(abbreviated name of the Employer)*..... has awarded to the Contractor a Contract for .....vide its Notification of Award/Contract No. …….. dated ……..and Amendment No. ..... (applicable when amendments have been issued) (hereinafter called the "Contract") in terms of which .....*(abbreviated name of the Employer)*..... is required to handover various Equipment to the Contractor for execution of the Contract.

AND WHEREAS by virtue of Clause No.....of the said Contract, the Contractor is required to execute an Indemnity Bond in favour of .....*(abbreviated name of the Employer)*..... for the Equipment handed over to it by .....*(abbreviated name of the Employer)*..... for the purpose of performance of the contract/Erection portion of the Contract (hereinafter called the "Equipment".)

NOW THEREFORE, This Indemnity Bond witnesseth as follows:

1. That in consideration of various Equipments as mentioned in the Contract, valued at (amount in words _____) to be handed over to the Contractor in installments from time to time for the purpose of performance of the contract, the Contractor hereby undertakes to indemnify and shall keep .....*(abbreviated name of the Employer)*..... indemnified, for the full value of Equipment. The Contractor hereby acknowledges receipt of the initial installment of the equipment per details in the schedule appended hereto. Further, the Contractor agrees to acknowledge receipt of the subsequent installments of the Equipment as required by .....*(abbreviated name of the Employer)*..... in the form of Schedules consecutively numbered which shall be attached to this Indemnity bond so as to form integral parts of this Bond. It is expressly understood by the Contractor that handing over the despatch title documents in respect of the said Equipments duly endorsed by .....*(abbreviated name of the Employer)*..... in favour of the Contractor shall be construed as handing over the Equipment purported to be covered by such title documents

and the Contractor shall hold such Equipments in trust as a Trustee for and on behalf of .....*(abbreviated name of the Employer)*.....

2. That the Contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the Equipment at .....*(abbreviated name of the Employer)*..... project Site against all risks whatsoever till the Equipment are duly used/erected in accordance with the terms of the Contract and the Plant/Package duly erected and commissioned in accordance with the terms of the Contract, is taken over by .....*(abbreviated name of the Employer)*..... The Contractor undertakes to keep .....*(abbreviated name of the Employer)*..... harmless against any loss or damage that may be caused to the Equipment.

3. The Contractor undertakes that the Equipment shall be used exclusively for the performance/execution of the Contract strictly in accordance with its terms and conditions and no part of the equipment shall be utilised for any other work or purpose whatsoever. It is clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal/penal consequences.

4. That .....*(abbreviated name of the Employer)*..... is and shall remain the exclusive Employer of the Equipment free from all encumbrances, charges or liens of any kind, whatsoever. The equipment shall at all times be open to inspection and checking by the Employer or Employer's Representative in this regard. Further, ...*(abbreviated name of the Employer)*..... shall always be free at all times to take possession of the Equipment in whatever form the Equipment may be, if in its opinion, the Equipment are likely to be endangered, misutilised or converted to uses other than those specified in the Contract, by any acts of omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions of demand of .....*(abbreviated name of the Employer)*..... to return the equipment without any demur or reservation.

5. That this indemnity Bond is irrevocable. If at any time any loss or damage occurs to the Equipment or the same or any part thereof is misutilised in any manner whatsoever, then the Contractor hereby agrees that the decision of the Employer's Representative as to assessment of loss or damage to the Equipment shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Equipment at its own cost and/or shall pay the amount of loss to .....*(abbreviated name of the Employer)*..... without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to .....*(abbreviated name of the Employer)*..... against the Contractor under the Contract and under this Indemnity Bond.

6. NOW THE CONDITION of this Bond is that if the Contractor shall duly and punctually comply with the terms and conditions of this Bond to the satisfaction

of .....*(abbreviated name of the Employer)*....., THEN, the above Bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorised representative under the common seal of the Company, the day, month and year first above mentioned.

SCHEDULE No. 1

Particulars of the Equipment handed over	Quantity	Particulars of Despatch title Documents		Value of the Equipment	Signature of the Attorney in token of receipt
		RR/GR No. date of lading	Carrier		

For and on behalf of
M/s.....

WITNESS

1. Signature..... Signature.....

   Name..... Name.....

   Address..... Address.....

2. Signature..... Authorised representative

   Name..... (Common Seal)

   Address..... (In case of Company)

Indemnity Bonds are to be executed by the authorised person and (i) in case of contracting Company under common seal of the Company or (ii) having the power of attorney issued under common seal of the company with authority to execute Indemnity Bonds, (iii) In case of (ii), the original Power of Attorney if it is specifically for this Contract or a photostat copy of the Power of Attorney if it is General Power of Attorney and such documents should be attached to Indemnity Bond.

9. FORM OF AUTHORISATION LETTER

Ref. No:

Date :

To

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

REF.: Contract No. ……..... dated ..... for ……..…..... awarded by ....*(insert name of the Employer)*.....

Dear Sir,

Kindly refer to Contract No. ……..... dated ….…..... for .....
You are hereby authorised on behalf of ..... *(Name of Employer)*..... a company incorporated under the laws of Companies Act 1956 and having its Registered Office at ……*(registered address of the Employer)* ……. and its Project at ..... to take physical delivery of materials/equipments covered under Despatch Document/Consignment Note No. ……..*..... 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.

Schedule of Material/Equipment covered under Despatch Title Document (RR No./LR No. .....)

Sl. No.	Contract Name	NOA No./ CA No.	Description of Materials/ Equipments	Spec. No.	Qty.	Value	Remarks

(Signature of the Project Authority)

(Designation) .....

(Date) .....

10. FORM OF TRUST RECEIPT FOR PLANT, EQUIPMENT AND MATERIALS RECEIVED

We M/s. ……..*(insert name of the Contractor)* ..... having our Principal place of business at ..... having been awarded a Contract No. ..... dated ..... for ……. *(insert Package name alongwith name of the Project)*..... by ……*(insert name of the Employer)* .....

We do hereby acknowledge the receipt of the Plant, Equipment and Materials as are fully described and mentioned under Documents of Title/RR/LR etc. and in the schedule annexed hereto, which shall form an integral part of this receipt as "Trustee" of ..... *(insert name of the Employer)*……. The aforesaid materials etc. so received by us shall be exclusively used in the successful performance of the aforesaid Contract and for no other purpose whatsoever. We undertake not to create any charge, lien or encumbrance over the aforesaid materials etc, in favour of any other person/institution(s)/Banks.

For M/s .....
(Contractor's Name)

Dated : .....

(AUTHORISED SIGNATORY)

Place : .....

SEAL OF COMPANY

11. FORM OF EXTENSION OF BANK GUARANTEE

Ref. No..... Dated:.....

To: *[Name and address of the Employer]*

Dear Sirs,

Sub.: Extension of Bank Guarantee No. …… …… dated …… for ……., issued to you on behalf of M/s. ……*(insert name of the Contractor)* ……. in respect of Contract No. ……. dated …….. for …….. *(insert name of the Package alongwith the Project name)* ……. (hereinafter called original Bank Guarantee).

At the request of M/s…… *(insert name of the Contractor)* ……., We ……*(insert name & address of the issuing bank)* ……., a Bank organized under the laws of ..... and having its Registered/Head Office at ……*(insert address of registered office of the bank)*…… do hereby extend our liability under the above-mentioned Guarantee No. ……..... Dated ……..... for a further period of ..... Years/Months from ..... to expire on ..... Except as provided above, all other terms and conditions of the original Bank Guarantee No. ……..... dated ..... shall remain unaltered and binding.

Please treat this as an integral part of the original Guarantee to which it would be attached.

For and on behalf of the Bank

[*Signature of the authorised signatory(ies)*]

Signature_____

Name_____

Designation_____

POA Number_____

Contact Number(s): Tel._____Mobile_____

Fax Number_____

email _____

Common Seal of the Bank_____

Witness:

Signature_____

Name_____

Address_____

Contact Number(s): Tel._____Mobile_____

email _____

Note:

1. For the purpose of executing the Bank Guarantee, the non-judicial stamp papers of appropriate value shall be purchased in the name of Bank who issues the 'Bank Guarantee'.

2. The Bank Guarantee shall be signed on all the pages by the Bank Authorities indicating their POA nos. and should invariably be witnessed.

12. FORM OF POWER OF ATTORNEY FOR JOINT VENTURE

KNOW ALL MEN BY THESE PRESENTS THAT WE , the Partners whose details are given hereunder ..... have formed a Joint Venture under the laws of ..... and having our Registered Office(s)/Head Office(s) at ..... (hereinafter called the 'Joint Venture' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assigns) acting through M/s ..... being the Partner in-charge do hereby constitute, nominate and appoint M/s..... a Company incorporated under the laws of .....and having its Registered/Head Office at ..... as our duly constituted lawful Attorney (hereinafter called "Attorney" or "Authorised Representative" or "Partner In-charge") to exercise all or any of the powers for and on behalf of the Joint Venture in regard to Specification No..... Package ..... the bids for which have been invited by …… (insert name of the Employer alongwith address) …… (hereinafter called the 'Employer') to undertake the following acts :

i) To submit proposal and participate in the aforesaid Bid Specification of the Employer on behalf of the "Joint Venture".

ii) To negotiate with the Employer the terms and conditions for award of the Contract pursuant to the aforesaid Bid and to sign the Contract with the Employer for and on behalf of the "Joint Venture".

iii) To do any other act or submit any document related to the above.

iv) To receive, accept and execute the Contract for and on behalf of the "Joint Venture".

It is clearly understood that the Partner In-charge (Lead Partner) shall ensure performance of the Contract(s) and if one or more Partner fail to perform their respective portions of the Contract(s), the same shall be deemed to be a default by all the Partners.

It is expressly understood that this Power of Attorney shall remain valid binding and irrevocable till completion of the Defect Liability Period in terms of the Contract.

The Joint Venture hereby agrees and undertakes to ratify and confirm all the whatsoever the said Attorney/Authorised Representatives/Partner in-charge quotes in the bid, negotiates and signs the Contract with the Employer and/or proposes to act on behalf of the Joint Venture by virtue of this Power of Attorney and the same shall bind the Joint Venture as if done by itself.

IN WITNESS THEREOF the Partners Constituting the Joint Venture as aforesaid have executed these presents on this ..... day of ……..... under the Common Seal(s) of their Companies.

for and on behalf of the
Partners of Joint Venture

.....

.....

.....

The Common Seal of the above Partners of the Joint Venture:

The Common Seal has been affixed there unto in the presence of:

WITNESS

1. Signature.....

   Name .....

   Designation .....

   Occupation .....

2. Signature.....

   Name .....

   Designation .....

   Occupation .....

Note:

1. For the purpose of executing the Agreement, the non-judicial stamp papers of appropriate value shall be purchased in the name of Joint Venture.
2. The Agreement shall be signed on all the pages by the authorised representatives of each of the partners and should invariably be witnessed.

13. FORM OF UNDERTAKING BY THE JOINT VENTURE PARTNERS

THIS JOINT DEED OF UNDERTAKING executed on this……. day of……... Two Thousand and……..... by …….. a company incorporated under the laws of …….. and having its Registered Office at .....(hereinafter called the "Party No.1" which expression shall include its successors, executors and permitted assigns) and M/s……a company incorporated under the laws of …….. and having its Registered Office at …….. (hereinafter called the "Party No.2" which expression shall include its successors, executors and permitted assigns) and M/s.. .. .. a Company incorporated under the laws of …….. and having its Registered Office at …….. (hereinafter called the "Party No.3" which expression shall include its successors, executors and permitted assigns) for the purpose of making a bid and entering into a contract [hereinafter called the "Contract" {in case of award)] against the Specification No…….. for …… *(insert name of the package alongwith project name)* …….. of …….. *(insert names of the Employer)* ……., a Company incorporated under the Companies Act of 1956 having its registered office at ……..*(insert registered address of the Employer)*…….. (hereinafter called the "Employer").

WHEREAS the Party No.1, Party No.2 and Party No.3 have entered into an Agreement dated.....

AND WHEREAS the Employer invited bids as per the above mentioned Specification for the design, manufacture, supply, erection, testing and commissioning of Equipment/ Materials stipulated in the Bidding Documents under …… *(insert name of the package alongwith project name)* ……

AND WHEREAS Clause 9.3, Section-ITB and Section-III, VOl-I., Qualification Requirement forming part of the Bidding Documents, inter-alia stipulates that an Undertaking of two or more qualified manufacturers as partners, meeting the requirements of Qualification Criteria, as applicable may bid, provided, the Joint Venture fulfills all other requirements under Clause 9.3 (c) of ITB and Section-III, VOl-I., Qualification Requirement and in such a case, the Bid Forms shall be signed by all the partners so as to legally bind all the Partners of the Joint Venture, who will be jointly and severally liable to perform the Contract and all obligations hereunder.

The above clause further states that this Undertaking shall be attached to the bid and the Contract performance guarantee will be as per the format enclosed with the Bidding Documents without any restrictions or liability for either party.

AND WHEREAS the bid is being submitted to the Employer vide proposal No……..dated ……... by Party No.1 based on this Undertaking between all the parties; under these presents and the bid in accordance with the requirements of Clause 9.3, Section-ITB and Section-III, VOl-I., Qualification Requirement , has been signed by all the parties.

NOW THIS UNDERTAKING WITNESSETH AS UNDER:

In consideration of the above premises and agreements all the parties of this Deed of Undertaking do hereby declare and undertake:

1. In requirement of the award of the Contract by the Employer to the Joint Venture Partners, we, the Parties do hereby undertake that M/s…… the Party No.1, shall act as Lead Partner and further declare and confirm that we the parties to the Joint Venture shall jointly and severally be bound unto the Employer for the successful performance of the Contract and shall be fully responsible for the design, manufacture, supply and successful performance of the equipment in accordance with the Contract:

2. In case of any breach or default of the said Contract by any of the parties to the Joint Venture, the party(s) do hereby undertake to be fully responsible for the successful performance of the Contract and to carry out all the obligations and responsibilities under the Contract in accordance with the requirements of the Contract.

3. Further, if the Employer suffers any loss or damage on account of any breach in the Contract or any shortfall in the performance of the equipment in meeting the performances guaranteed as per the specification in terms of the Contract, the Party(s) of these presents undertake to promptly make good such loss or damages caused to the Employer, on its demand without any demur. It shall not be necessary or obligatory for the Employer to proceed against Lead Partner to these presents before proceeding against or dealing with the other Party(s), the Employer can proceed against any of the parties who shall be jointly and severally liable for the performance and all other liabilities/obligations under the Contract to the Employer.

4. The financial liability of the Parties of this Deed of Undertaking to the Employer, with respect to any of the claims rising out of the performance or non-performance of the obligations set forth in this Deed of Undertaking, read in conjunction with the relevant conditions of the Contract shall, however not be limited in any way so as to restrict or limit the liabilities or obligations of any of the Parties of this Deed of Undertaking.

5. It is expressly understood and agreed between the Parties to this Undertaking that the responsibilities and obligations of each of the Parties shall be as delineated in Appendix – I *(to be suitably appended by the Parties alongwith this Undertaking in its bid)* to this Deed of Undertaking. It is further undertaken by the parties that the above sharing of responsibilities and obligations shall not in any way be a limitation of joint and several responsibilities of the Parties under the Contract.

6. It is also understood that this Undertaking is provided for the purposes of undertaking joint and several liabilities of the partners to the Joint Venture for

submission of the bid and performance of the Contract and that this Undertaking shall not be deemed to give rise to any additional liabilities or obligations, in any manner or any law, on any of the Parties to this Undertaking or on the Joint Venture, other than the express provisions of the Contract.

7. This Undertaking shall be construed and interpreted in accordance with the provisions of the Contract.

8. In case of an award of a Contract, we the parties to this Deed of Undertaking do hereby agree that we shall be jointly and severally responsible for furnishing a Contract performance security from a bank in favour of the Employer in the currency/currencies of the Contract.

9. It is further agreed that this Deed of Undertaking shall be irrevocable and shall form an integral part of the bid and shall continue to be enforceable till the Employer discharges the same or upon the completion of the Contract in accordance with its provisions, whichever is earlier. It shall be effective from the date first mentioned above for all purposes and intents.

IN WITNESS WHEREOF, the Parties to this Deed of Undertaking have through their authorised representatives executed these presents and affixed Common Seals of their companies, on the day, month and year first mentioned above.

Common Seal of ……..
has been affixed in my/ our
presence pursuant to Board of
Director's Resolution dated ……..

Name ……..

Designation ……..

Signature ……..

For Lead Partner (Party No.-1)
For and on behalf of M/s
……..

(Signature of the authorized representative)

WITNESS :

I. ……

II. ……

Common Seal of ……..
has been affixed in my/ our
presence pursuant to Board of
Director's Resolution dated ……..

For Party No.-2
For and on behalf of M/s……..

Name ……..

Designation ……..

Signature ……..

(Signature of the authorized representative)

WITNESS :

I. ……

II. ……

Common Seal of …….. has been affixed in my/ our presence pursuant to Board of Director's Resolution dated ……..

Name ……..

Designation ……..

Signature ……..

For Party No.-3
For and on behalf of M/s. ……..

(Signature of the authorized representative)

WITNESS :

I. ……

II. ……

Note:

1. For the purpose of executing the Joint Deed of Undertaking, the non-judicial stamp papers of appropriate value shall be purchased in the name of Joint Venture.

2. The Undertaking shall be signed on all the pages by the authorised representatives of each of the partners and should invariably be witnessed.

14. FORMAT FOR EVIDENCE OF ACCESS TO OR AVAILABILITY OF CREDIT/FACILITIES

BANK CERTIFICATE

This is to certify that M/s. _____ *(insert Name & Address of the Contractor)* _____ who have submitted their bid to ……..*(insert name of the Employer)*……. against their tender specification Vide ref. No. ……. for ……. *(insert name of the package alongwith the project name)* …….. is our customer for the past …… years.

Their financial transaction with our Bank have been satisfactory. They enjoy the following fund based and non fund based limits including for guarantees, L/C and other credit facilities with us against which the extent of utilization as on date is also indicated below:

Sl. No.	**Type of Facility**	**Sanctioned Limit as on Date**	**Utilisation as on Date**

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

Signature _____

Name of Bank _____

Name of Authorised Signatory _____

Designation _____

Phone No. _____

Address _____

SEAL OF THE BANK

15. FORM OF OPERATIONAL ACCEPTANCE

Date.....

Name of Contract.....

Contract No.....

To :

(Name and address of the Contractor)

Dear Ladies and/or Gentlemen,

Pursuant to GCC 29, 30 of the General Conditions of the Contract entered into between yourselves and the Employer dated …….. relating to the ..... *(insert brief description of the Facilities)*..... we hereby notify you that the we System tests and Acceptance tests of the following part(s) of the Facilities were satisfactorily completed on the date specified below :

1. Description of the Facilities or part thereof .....
   ……

2. Date of Operational Acceptance:.....

This letter does not relieve you of your obligation during the Defects Liability Period and Latent Defect warranty.

Very truly yours,

Title
(Project Manager)

FORM No. 16

FORM OF SAFETY PLAN TO BE SUBMITTED BY THE CONTRACTOR WITHIN SIXTY DAYS OF AWARD OF CONTRACT

[TO BE EXECUTED ON A NON JUDICIAL STAMP PAPER WORTH RS. TWENTY ONLY]

SAFETY PLAN

THIS SAFETY PLAN is made this …….…….…….... day of ……..…... 20..... by …….…… a Company registered under the Companies Act, 1956 or 2013, as the case may be/Partnership firm/proprietary concern having its Registered Office at ……..…….....[*to be modified suitably for JV Contractor*] (hereinafter called as 'Contractor' which expression shall include its successors and permitted assigns) for approval of .....*(insert name of the Employer)*....., a company incorporated under the Companies Act, 1956 having its Registered Office at .....*(insert registered address of the Employer)*..... for its Contract for ……..…….…….... .....*(insert package name, project name alongwith Specification number of the Contract)*.....

WHEREAS .....*(abbreviated name of the Employer)*..... has awarded to the Contractor the aforesaid Contract vide its Notification of Award/Contract No. ……..…….... dated ……..……..and Amendment No. ..... (applicable when amendments have been issued) (hereinafter called the "Contract") in terms of which the Contractor is required to submit 'Safety Plan' alongwith certain documents to the Engineer In-Charge/Project Manager of the Employer within Sixty (60) days of Notification of Award for its approval.

NOW THEREFORE, the Contractor undertakes to execute the Contract as per the safety plan as follows:

1. THAT the Contractor shall execute the works as per provisions of Bidding Documents including those in regard to Safety Precautions / provisions as per statutory requirements.

2. THAT the Contractor shall execute the works in a well planned manner from the commencement of Contract as per agreed mile stones of work completion schedule so that planning and execution of construction works goes smoothly and consistently through out the contract duration without handling pressure in last quarter of the financial year/last months of the Contract and the shall be finalized in association with RECTPCL Engineer In-charge/Project Manager from time to time as required.

3. THAT the Contractor has prepared the safe work procedure for each activity i.e. foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc. to be executed at site, which is enclosed at **Annexure – 1A (SP)** for acceptance and approval of Engineer

In-charge/Project Manager. The Contractor shall ensure that on approval of the same from Engineer In-charge/Project Manager , the approved copies will be circulated to Employer's personnel at site [Supervisor(s)/Executive(s)] and Contractor's personnel at site [Gang leader, supervisor(s) etc.] in their local language / language understood by gang.

THAT the Contractor has prepared minimum manpower deployment plan, activity wise as stated above, which is enclosed at **Annexure – 1B (SP)** for approval of Engineer In-charge/Project Manager.

4. THAT the Contractor shall ensure while executing works that they will deploy minimum 25% of their own experienced work force who are on the permanent roll of the company and balance 75% can be a suitable mixed with the hired gangs / local workers / casual workers if required. The above balance 75% work force should be provided with at least 10 days training by the construction agencies at sites and shall be issued with a certificate. No worker shall be engaged without a valid certificate. Hired gang workers shall also follow safe working procedures and safety norms as is being followed by company's workmen. It should also be ensured by the contractor that certified fitters who are climbing towers / doing stringing operations can be easily identifiable with a system like issue of Badge / Identification cards (ID cards) etc. Colour identification batches should be worn by the workers. Contractor has to ensure that inexperience workers / unskilled workers should not be deployed for skilled job.

5. THAT the Contractor's Gang leader / Supervisor / Senior most member available at every construction site shall brief to each worker daily before start of work about safety requirement and warn about imminent dangers and precautions to be taken against the imminent dangers (Daily Safety Drill). This is to be ensured without fail by Contractor and maintain record of each gang about daily safety instructions issued to workers and put up to RECTPCL site In-charge for his review and record.

6. THAT the Contractor shall ensure that working Gangs at site should not be left at the discretion of their Gang Leaders who are generally hired and having little knowledge about safety. Gang leader should be experienced and well versed with the safe working procedures applicable for transmission line/ Sub Station works. In case gang is having Gang leader not on permanent roll of the company then additional Supervisor from company's own roll having thorough knowledge about the works would be deployed so as to percolate safety instructions upto the grass root level in healthy spirits. Contractor has to ensure close supervision while executing critical locations of transmission lines / sub stations and ensures that all safety instructions are in place and are being followed.

7. THAT the Contractor shall maintain in healthy and working condition all kind of Equipments / Machineries / Lifting tools / Lifting tackles / Lifting gears / All kind of Ropes including wire ropes / Polypropylene ropes etc. used for Lifting purpose during execution of the project and get them periodically examined and load

tested for safe working load in accordance with relevant provisions and requirement of Building & other construction workers Regulation of Employment and Conditions of Services Act and Central Rule 1998, Factories Act 1948, Indian Electricity Act 2003 before start of the project. A register of such examinations and tests shall be properly maintained by the contractor and will be promptly produced as and when desired by the Engineer In-charge/Project Manager or by the person authorised by him. The Contractor has to ensure to give special attention on the formation / condition of eye splices of wire rope slings as per requirement of IS 2762 Specification for wire rope slings and sling legs.

THAT the Contractor has prepared a list of all Lifting machines, lifting Tools / Lifting Tackles / Lifting Gears etc. / All types of ropes and Slings which are subject to safe working load is enclosed at **Annexure – 2 (SP)** for review and approval of Engineer In-charge/Project Manager.

8. THAT the Contractor has to procure sufficient quantity of Personal Protective Equipment (PPE)conforming to Indian / International standards and provide these equipment to every workman at site as per need and to the satisfaction of Engineer-in-charge/Project Manager of RECTPCL. The Contractor's Site Supervisor/ Project Manager has to ensure that all workmen must use Personal Protective Equipment at site. The Contractor shall also ensure that Industrial Safety helmets are being used by all workmen at site irrespective of their working (at height or on ground). The Contractor shall further ensure use of safety shoes by all ground level workers and canvas shoes for all workers working at height, Rubber Gum Boots for workers working in rainy season and concreting job, Use of Twin Lanyard Full body Safety Harness with attachment of light weight such as aluminium alloy etc. and having features of automatic locking arrangement of snap hook, by all workers working at height for more than three meters and also for horizontal movement on tower shall be ensured by contractor. The Contractor shall not use ordinary half body safety harness at site. The Contractor has to ensure use of Retractable type fall arrestors by workers for ascending / descending on suspension insulator string and other similar works etc., Use of Mobile fall arrestor for ascending / descending from tower by all workers. The contractor has to provide cotton / leather hand gloves as per requirement, Electrical Resistance Hand gloves for operating electrical installations / switches, Face shield for protecting eyes while doing welding works and Dust masks to workers as per requirement. **The Contractor shall also provide Reflective Jackets to all workmen working on the site including differently coloured such Jackets to the persons working at height.** The Contractor will have to take action against the workers not using Personal Protective Equipment at site and those workers shall be asked to rest for that day and also their Salary be deducted for that day. RECTPCL may issue warning letter to Project Manager of contractor in violation of above norms.

THAT the Contractor shall prepare a detailed list of PPEs, activity wise, to commensurate with manpower deployed, which is enclosed at **Annexure – 3 (SP)** for review and approval of Engineer In-charge/Project Manager. It shall also be

ensured that the sample of these equipment shall be got approved from RECTPCL supervisory staff before being distributed to workers. The contractor shall submit relevant test certificates as per IS / International Standard as applicable to PPEs used during execution of work. All the PPE's to be distributed to the workers shall be checked by RECTPCL supervisory staff before its usage.

The Contractor also agrees for addition / modification to the list of PPE, if any, as advised by Engineer In-Charge/Project Manager.

9. THAT the Contractor shall procure, if required sufficient quantity of Earthing Equipment / Earthing Devices complying with requirements of relevant IEC standards (Generally IECs standards for Earthing Equipments / Earthing Devices are – 855, 1230, 1235 etc.) and to the satisfaction of Engineer In-Charge/ Project Manager and contractor to ensures to maintained them in healthy condition.

   THAT the Contractor has prepared / worked out minimum number of healthy Earthing Equipments with Earthing lead confirming to relevant IS / European standards per gang wise during stringing activity/as per requirement, which is enclosed herewith at **Annexure – 4 (SP)** for review and acceptance of Engineer In-Charge/ Project Manager prior to execution of work.

10. THAT the Contractor shall provide communication facilities i.e. Walky – Talkie / Mobile Phone, Display of Flags / whistles for easy communication among workers during Tower erection / stringing activity, as per requirement.

11. THAT the Contractor undertakes to deploy qualified safety personnel responsible for safety as per requirements of Employer/Statutory Authorities.

    THAT the Contractor employing more than 250 workmen whether temporary, casual, probationer, regular or permanent or on contract, shall employ at least one full time officer exclusively as qualified safety officer having diploma in safety to supervise safety aspects of the equipment and workmen who will coordinate with Engineer In-charge /Project Manager/Safety Co-ordinator of the Employer. In case of work being carried out through sub contractors the sub – contractor's workmen / employees will also be considered as the contractor's employees / workmen for the above purpose. If the number of workers are less than 250 then one qualified safety officer is to be deployed for each contract. He will report directly to his head of organization and not the Project Manager of contractor He shall also not be assigned any other work except assigning the work of safety. The curriculum vitae of such person shall be got cleared from RECTPCL Project Manager / Construction staff.

    The Contractor shall deploy one dedicated Safety Staff(s) for every 200 kms of a Transmission Line Project.

    The name and address of such safety officers/staff(s) of contractor will be promptly informed in writing to Engineer In-charge with a copy to safety officer -

In-charge before start of work or immediately after any change of the incumbent is made during the currency of the contract. The list is enclosed at **Annexure – 5A (SP)**.

THAT the Contractor has also prepared a list including details of Explosive Operator (if required), Safety officer / Safety Staff/ Safety supervisor / nominated person for safety for each erection / stringing gang, list of personnel trained in First Aid Techniques as well as copy of organisation structure of the Contractor in regard to safety. The list is enclosed at **Annexure – 5B (SP)**.

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

13. THAT, if, any Employer's Engineer/ supervisor at site observes that the Contractor is failing to provide safe working environment at site as per agreed Safety Plan / RECTPCL Safety Rule/ Safety Instructions / Statutory safety requirement and creates hazardous conditions at site and there is possibility of an accident to workmen or workmen of the other contractor or public or the work is being carried out in an un safe manner or he continues to work even after being instructed to stop the work by Engineer / Supervisor at site / RHQ / Corp. Centre, the Contractor shall be bound to pay a penalty of Rs. 10,000/ - per incident per day till the instructions are complied and as certified by Engineer / Supervisor of Employer at site. The work will remain suspended and no activity will take place without compliance and obtaining clearance / certification of the Site Engineer / Supervisor of the Employer to start the work.

14. THAT, if the investigation committee of Employer observes any accident or the Engineer In-charge/Project Manager of the Employer based on the report of the Engineer/Supervisor of the Employer at site observes any failure on the Contractor's part to comply with safety requirement / safety rules/ safety standards/ safety instruction as prescribed by the Employer or as prescribed under the applicable law for the safety of the equipment, plant and personnel and the Contractor does not take adequate steps to prevent hazardous conditions which may cause injury to its own Contractor's employees or employee of any other Contractors or Employer or any other person at site or adjacent thereto, or public involvement because of the Contractor's negligence of safety norms, the Contractor shall be liable to pay a compensation of Rs. 15,00,000/- (Rupees Fifteen Lakh only) per person affected causing death and Rs. 5,00,000/- (Rupees Five Lakh only) per person for serious injuries / 25% or more permanent disability to the Employer for further disbursement to the deceased family/

Injured persons. The permanent disability has the same meaning as indicated in Workmen's Compensation Act 1923. The above stipulations is in addition to all other compensation payable to sufferer as per workmen compensation Act / Rules

Notwithstanding above**, the Contractor shall also be responsible for payment of sum as indicated below additionally which shall be deposited in Safety Corpus Fund pursuant to GCC Sub-Clause 18.3.3.26:**

a.	**Upon 1st Fatal Accident due to negligence by the Contractor**	**Rs. 50,00,000/-**
b.	**Upon 2nd Fatal Accident due to negligence by the Contractor**	**Rs. 75,00,000/-**
c.	**Upon 3rd Fatal Accident due to negligence by the Contractor**	**Rs. 1,00,00,000/-**
d.	**Re-occurrence of Fatal Accident even after 3rd Fatal Accident due to negligence by the Contractor**	**Rs. 1,00,00,000/- per fatal accident**
e.	**Tower Collapse leading to more than one (01) death attributable to the Contractor as per the Accident Enquiry Committee Report**	**Rs. 1,00,00,000/- per fatal accident in addition to a, b, c or d above, as applicable**

THAT as per the Employer's instructions, the Contractor agrees that this amount shall be deducted from their running bill(s) immediately after the accident, That the Contractor understands that this amount shall be over and above the compensation amount liable to be paid as per the Workmen's Compensation Act /other statutory requirement/ provisions of the Bidding Documents.

15. THAT the Contractor shall submit Near-Miss-Accident report alongwith action plan for avoidance such incidence /accidents to Engineer – In-charge/ Project Manager. Contractor shall also submit Monthly Safety Activities report to Engineer – In-charge/ Project Manager and copy of the Monthly Safety Activities report also to be sent to Safety In-charge at RHQ of the Employer for his review record and instructions.

16. THAT the Contractor is submitting a copy of Safety Policy/ Safety Documents of its Company which is enclosed at **Annexure – 6 (SP)** and ensure that the safety Policy and safety documents are implemented in healthy spirit.

17. THAT the Contractor shall make available of First Aid Box [Contents of which shall be as per Building & other construction workers (Regulation of Employment and Conditions of Services Act and Central Rule 1998 / RECTPCL Guidelines)] to the satisfaction of Engineer In-Charge/ Project Manager with each gang at site and not at camp and ensures that trained persons in First Aid Techniques with each gang before execution of work.

18. THAT the Contractor shall submit an 'Emergency Preparedness Plan' for different incidences i.e. Fall from height, Electrocution, Sun Stroke, Collapse of pit, Collapse of Tower, Snake bite, Fire in camp / Store, Flood, Storm, Earthquake, Militancy etc. while carrying out different activities under execution i.e. foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc. which is enclosed at **Annexure – 7 (SP)** for approval of the Engineer In-Charge/ Project Manager before start of work.

19. THAT the Contractor shall organise Safety Training Programs on Safety, Health and Environment and for safe execution of different activities of works i.e. foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc. for their own employees including sub contractor workers on regular basis.

    The Contractor, therefore, submits copy of the module of training program, enclosed at **Annexure – 9 (SP)**, to Engineer In-charge/Project Manager for its acceptance and approval and records maintained.

20. THAT the Contractor shall conduct safety audit, as per Safety Audit Check Lists enclosed at **Annexure – 8 (SP)**, by his Safety Officer(s) every month during construction of Transmission Lines / Sub Stations / any other work and copy of the safety audit report will be forwarded to the Employer's Engineer In-charge / Site In-charge/Project Manager for his comments and feedback. During safety audit, healthiness of all Personal Protective Equipments (PPEs) shall be checked individually by safety officer of contractor and issue a certificate of its healthiness or rejection of faulty PPEs and contractor has to ensure that all faulty PPEs and all faulty lifting tools and tackles should be destroyed in the presence of RECTPCL construction staff. Contractor has to ensure that each gang be safety audited at least once in two months. During safety audit by the contractor, Safety officer's feedback from RECTPCL concerned shall be taken and recorded. The Employer's site officials shall also conduct safety audit at their own from time to time when construction activities are under progress. Apart from above, the Employer may also conduct surveillance safety audits. The Employer may take action against the person / persons as deemed fit under various statutory acts/provisions under the Contract for any violation of safety norms / safety standards.

21. THAT the Contractor shall develop and display Safety Posters of construction activity at site and also at camp where workers are generally residing.

22. THAT the Contractor shall ensure to provide potable and safe drinking water for workers at site / at camp.

23. THAT the Contractor shall do health check up of all workers from competent agencies and reports will be submitted to Engineer In-Charge within fifteen (15) days of health check up of workers as per statutory requirement.

24. THAT the Contractor shall submit information alongwith documentary evidences in regard to compliance to various statutory requirements as applicable which are enclosed at **Annexure – 10A (SP)**.

    The Contractor shall also submit details of Insurance Policies taken by the Contractor for insurance coverage against accident for all employees are enclosed at **Annexure – 10B (SP)**.

25. THAT a check-list in respect of aforesaid enclosures alongwith the Contractor's remarks, wherever required, is attached as **Annexure – Check List** herewith.

THE CONTRACTOR shall incorporate modifications/changes in this 'Safety Plan' necessitated on the basis of review/comments of the Engineer In-Charge/Project Manager within fourteen (14) days of receipt of review/comments and on final approval of the Engineer In-Charge/Project Manager of this 'Safety Plan', the Contractor shall execute the works under the Contract as per approved 'Safety Plan'. Further, the Contractor has also noted that the first progressive payment towards Supply of Supply of Services Contract shall be made on submission of 'Safety Plan' alongwith all requisite documents and approval of the same by the Engineer In-Charge/Project Manager.

IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorised representative under the common seal of the Company, the day, month and year first above mentioned.

For and on behalf of

M/s……..…..…..……

WITNESS

1. Signature…….. Signature……..

   Name…….. Name……..

   Address…….. Address……..

2. Signature…….. Authorised representative

   Name…….. (Common Seal)

   Address…….. (In case of Company)

Note:
All the annexure referred to in this "Safety Plan" are required to be enclosed by the contractor as per the attached " Check List "

1. Safety Plan is to be executed by the authorised person and (i) in case of contracting Company under common seal of the Company or (ii) having the power of attorney issued under common seal of the company with authority to execute such contract documents etc., (iii) In case of (ii), the original Power of Attorney if it is specifically for this Contract or a Photostat copy of the Power of Attorney if it is General Power of Attorney and such documents should be attached to this Safety Plan.

2. For all safety monitoring/ documentation, Engineer In-charge / Regional In-charge of safety at RHQ will be the nodal Officers for communication.

CHECK LIST FOR SEFETY PLAN

S. N.	Details of Enclosure	Status of Submission of information/ documents	Remarks
1.	**Annexure – 1A (SP)** Safe work procedure for each activity i.e. foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc. to be executed at site.	Yes/No	
2.	**Annexure – 1B (SP)** Manpower deployment plan, activity wise foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc.	Yes/No	
3.	**Annexure – 2 (SP)** List of Lifting Machines i.e. Crane, Hoist, Triffor, Chain Pulley Blocks etc. and Lifting Tools and Tackles i.e. D shackle, Pulleys, come along clamps, wire rope slings etc. and all types of ropes i.e. Wire ropes, Poly propylene Rope etc. used for lifting purposes along with test certificates.	Yes/No	
4.	**Annexure – 3 (SP)** List of Personal Protective Equipment (PPE), activity wise including the following along with test certificate of each as applicable: 1. Industrial Safety Helmet to all workmen at site. (EN 397 / IS 2925) with chin strap and back stay arrangement. 2. Safety shoes without steel toe to all ground level workers and canvas shoes for workers working on tower.	Yes/No	

S. N.	Details of Enclosure	Status of Submission of information/ documents	Remarks
	3. Rubber Gum Boot to workers working in rainy season / concreting job. 4. Twin lanyard Full Body Safety harness with shock absorber and leg strap arrangement for all workers working at height for more than three meters. Safety Harness should be with attachments of light weight such as of aluminium alloy etc. and having a feature of automatic locking arrangement of snap hook and comply with EN 361 / IS 3521 standards. 5. Mobile fall arrestors for safety of workers during their ascending / descending from tower / on tower. EN 353 -2 (Guided type fall arresters on a flexible anchorage line.) 6. Retractable type fall arrestor (EN360: 2002) for ascending / descending on suspension insulator string etc. 7. Providing of good quality cotton hand gloves / leather hand gloves for workers engaged in handling of tower parts or as per requirement at site. 8. Electrical Resistance hand gloves to workers for handling electrical equipment / Electrical connections. IS : 4770 9. Dust masks to workers handling cement as per requirement. 10. Face shield for welder and Grinders. IS : 1179 / IS : 2553 11. Reflective Jackets 12. Other PPEs, if any, as per requirement etc.		
5.	**Annexure – 4 (SP)** List of Earthing Equipment / Earthing devices with Earthing lead conforming to IECs for earthing equipments are – (855, 1230, 1235 etc.) gang wise for stringing activity/as per requirement	Yes/No	
6.	**Annexure – 5A (SP)** List of Qualified Safety Officer(s)/Safety Staff(s)	Yes/No	

S. N.	Details of Enclosure	Status of Submission of information/ documents	Remarks
	alongwith their contact details		
7.	**Annexure – 5B (SP)** Details of Explosive Operator (if required), Safety officer / Safety Staff(s)/ Safety supervisor for every erection / stinging gang, any other person nominated for safety, list of personnel trained in First Aid as well as brief information about safety set up by the Contractor alongwith copy of organisation of the Contractor in regard to safety	Yes/No	
8.	**Annexure – 6 (SP)** Copy of Safety Policy/ Safety Document of the Contractor's company	Yes/No	
9.	**Annexure – 7 (SP)** 'Emergency Preparedness Plan' for different incidences i.e. Fall from height, Electrocution, Sun Stroke, Collapse of pit, Collapse of Tower, Snake bite, Fire in camp / Store, Flood, Storm, Earthquake, Militancy etc. while carrying out different activities under execution i.e. foundation works including civil works, erection, stringing (as applicable), testing & commissioning, disposal of materials at site / store etc.	Yes/No	
10.	**Annexure – 8 (SP)** Safety Audit Check Lists (Formats to be enclosed)	Yes/No	
11.	**Annexure – 9 (SP)** Copy of the module of Safety Training Programs on Safety, Health and Environment, safe execution of different activities of works for Contractor's own employees on regular basis and sub contractor employees.	Yes/No	

S. N.	Details of Enclosure	Status of Submission of information/ documents	Remarks
12.	**Annexure – 10A (SP)** Information alongwith documentary evidences in regard to the Contractor's compliance to various statutory requirements including the following:		
(i)	Electricity Act 2003 _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
(ii)	Factories Act 1948 _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
(iii)	Building & other construction workers (Regulation of Employment and Conditions of Services Act and Central Act 1996) and Welfare Cess Act 1996 with Rules. _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
(iv)	Workmen Compensation Act 1923 and Rules. _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
(v)	Public Insurance Liabilities Act 1991 and Rules. _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
(vi)	Indian Explosive Act 1948 and Rules. _____ [*Name of Documentary evidence in support of*	Yes/No	

S. N.	Details of Enclosure	Status of Submission of information/ documents	Remarks
	compliance]		
(vii)	Indian Petroleum Act 1934 and Rules. _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
(viii)	License under the contract Labour (Regulation & Abolition) Act 1970 and Rules. _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
(ix)	Indian Electricity Rule 1956 and amendments if any, from time to time. _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
(x)	The Environment (Protection) Act 1986 and Rules. _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
(xi)	Child Labour (Prohibition & Regulation) Act 1986. _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
(xii)	National Building Code of India 2005 (NBC 2005). _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
(xiii)	Indian standards for construction of Low/ Medium/ High/ Extra High Voltage	Yes/No	

S. N.	Details of Enclosure	Status of Submission of information/ documents	Remarks
	Transmission Line _____ [*Name of Documentary evidence in support of compliance*]		
(iv)	Any other statutory requirement(s) [*please specify*] _____ [*Name of Documentary evidence in support of compliance*]	Yes/No	
13.	**Annexure – 10B (SP)** Details of Insurance Policies alongwith documentary evidences taken by the Contractor for the insurance coverage against accident for all employees as below:		
(i)	Under Workmen Compensation Act 1923 and Rules. _____ [*Name of Documentary evidence in support of insurance taken*]	Yes/No	
(ii)	Public Insurance Liabilities Act 1991 _____ [*Name of Documentary evidence in support of insurance taken*]	Yes/No	
(iii)	Any Other Insurance Policies _____ [*Name of Documentary evidence in support of insurance taken*]	Yes/No	

17. FORM OF JOINT DEED OF UNDERTAKING BY THE COLLABORATOR(S) ALONGWITH THE BIDDER

[AS STIPULATED IN Qualification Requirement in Section-III, VOL-I]

THIS DEED OF UNDERTAKING executed this …….. day of …….. Two Thousand and …… by M/s. ……..., a Company incorporated under the laws of …… and having its Registered Office at …….. (hereinafter called the "Collaborator(s)" which expression shall include its successors, executors and permitted assigns), and M/s. ……., a Company incorporated under the laws of …….. having its Registered Office at …….. (hereinafter called the "Manufacturer" which expression shall include its successors, executors and permitted assigns) and Ms/. ……., a Company incorporated under the laws of …….. having its Registered Office at …….. (hereinafter called the "Bidder" which expression shall include its successors, executors and permitted assigns) in favour of …….. *(insert names of the Employer)* ……., a Company incorporated under the Companies Act of 1956 having its registered office at ……*(insert registered address of the Employer)*…… (hereinafter called the "Employer" which expression shall include its successors, executors and permitted assigns)

WHEREAS the "Employer" invited Bid as per its Specification No. …….. for the execution of ……*(insert name of the package alongwith project name)*……..

AND WHEREAS Clause No. ……., Section ……, of ……., Vol.–… forming part of the Bidding Documents inter-alia stipulates that the Bidder and/or Manufacturer alongwith its Collaborator(s) 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 Employer resulting in a Contract.

AND WHEREAS the Bidder has submitted its Bid to the Employer vide Proposal No. ……..…….. dated …….. based on the collaboration/association of the Collaborator(s) with the Manufacturer and as per the bid, it has offered to supply #……nos. *…….. ("the Equipment") manufactured in the Manufacturer's works in India.

NOW THEREFORE THIS UNDERTAKING WITNESSETH as under:

1.0 In consideration of the award of Contract by the Employer to the Bidder (hereinafter referred to as the "Contract") we, the Collaborator(s) and the Bidder/Contractor and/or Manufacturer do hereby declare that we shall be jointly and severally bound unto the …… *(insert name of the Employer)* ……., for the successful performance of the *…….. and shall be fully responsible for the design, manufacture, testing, supply on FOR destination delivery at site basis and supervision of unloading at site, storage, erection, testing & commissioning and successful performance of the *…… in accordance with the Contract Specifications. We (Collaborator(s)) hereby confirmed that #……nos. of *…… shall be manufactured and supplied from works in India.

2.0 Without in any way affecting the generality and total responsibility in terms of this Deed of Undertaking, the Collaborator(s) in particular hereby agrees to depute their technical experts from time to time to the Bidder's/ Contractor's/

Manufacturer's Works/ Employer's Project site as mutually considered necessary by the Employer, Bidder/ Contractor, Manufacturer and the Collaborator(s) to ensure:

(i) Design of the Equipments manufactured in India shall be identical to the design of equipments of Collaborator(s)/Parent Company.

(ii) Adequate up gradation of the testing facilities including quality systems at Indian works

(iii) Training to staff of Indian Manufacturer and certification to its trained personnel for carry out each activity

(iv) Involvement and supervision during all phases of manufacturing by expert of collaborator / parent company for the Equipments.

(v) MQP of Indian Manufacturer shall be same as that of Collaborator(s)

(vi) Source of raw material / major bought out components shall be same as that of Collaborator(s).

(vii) Timely supply on FOR destination delivery at site basis. In the event, the development is taking time and not meeting time schedule, Collaborator(s) shall supply all the equipments from their works to meet the completion schedule without any additional liability to the Employer.

(viii) Supervision of unloading at site, storage, erection, testing & commissioning and successful performance of the equipment in accordance with contract specifications

(ix) If necessary the Collaborator(s) shall advise the manufacturer / Contractor suitable modifications of designs and implement necessary corrective measures to discharge the obligations under the Contract.

(x) warranty obligations for five (05) years for the entire quantity to be supplied from the Indian Manufacturer.

3.0 This Deed of Undertaking shall be construed and interpreted in accordance with the laws of India and the Courts in Visakhapatnam shall have exclusive jurisdiction in all matters arising under the Undertaking.

4.0 As a security, the Collaborator(s) and the Manufacturer shall apart from the Contractor's performance guarantee, furnish a Contract Performance Guarantee from its Bank in favour of the Employer in a form acceptable to the Employer. The value of such guarantee shall be equivalent to 10% of the cost of such equipment(s) manufactured in India as identified in the Contract awarded by the Employer 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 Defect Liability Period of *…….. under the Contract. The Bank Guarantee amount shall be payable to the Employer on demand without any reservation or demur. This shall be in addition to the Contract Performance Guarantee furnished by the Contractor.

5.0 We, the Collaborator(s) and Bidder agree that this Undertaking shall be irrevocable and shall form an integral part of the Contract and further agree that this Undertaking shall continue to be enforceable till the Employer discharges it. It shall become operative from the effective date of Contract.

IN WITNESS WHEREOF the Collaborator(s), the Manufacturer and/or the Bidder/Contractor have through their Authorised Representatives executed these presents and affixed Common seals of their respective Companies, on the day, month and year first above mentioned.

WITNESS	(For Collaborator/Parent Company)
Signature ……..	(Signature of the authorized representative)
Name ……..	Name ……..
Office Address ……..	Common Seal of Company …….
WITNESS	(For Indian Manufacturer)
Signature ……..	(Signature of the authorized representative)
Name ……..	Name ……..
Office Address ……..	Common Seal of Company …….
WITNESS	(For Bidder)
Signature ……..	(Signature of the authorized representative)
Name ……..	Name ……..
Office Address ……..	Common Seal of Company …….

Note:

1. For the purpose of executing the Deed of Joint Undertaking, the non-judicial stamp papers of appropriate value shall be purchased in the name of executant(s) parties.
2. The Undertaking shall be signed on all the pages by the authorised representatives of each of the partners and should invariably be witnessed.
3. This Deed of Joint Undertaking duly certified by the Company Secretary shall be submitted alongwith the bid. Further, the Deed of Joint Undertaking attested by Notary Public of the place(s) of the respective executant(s) or registered with the Indian Embassy/High Commission in that country shall be submitted by the bidder within ten (10) days from the date of intimation of post-bid discussion.
4. In the event the Bidder is a Manufacturer and the Collaboration is between Collaborator/Parent Company and the Bidder, then the Joint deed of undertaking shall be modified accordingly.

5. *The name(s) of equipment viz., 220/33 kV GIS Equipment, SAs and Disconnectors (as applicable) for which Joint deed of undertaking is to be submitted is to be inserted.
6. The manufacturer may be having ongoing collaboration agreement or had collaboration agreement in the past with the collaborator.
7. # Quantity to be filled by bidder

18. FORM OF BANK GUARANTEE FOR CONTRACT PERFORMANCE (TO BE SUBMITTED BY COLLABORATOR / PARENT COMPANY / SUBSIDIARY)

(For the purpose of verification/confirmation of this Bank Guarantee by the Employer, the Bank shall indicate 2 official email ids of the authorized signatories from Issuing Branch and also of the designated higher office (Corporate Office, Zonal Office etc)in the covering letter of the Bank forwarding the Bank Guarantee.)

Bank Guarantee No. …… Date.....

NOA/Contract No.....

……..[Name of Contract]……

To: *[Name and address of Employer]*

Dear Ladies and/or Gentlemen,

We refer to the Contract ("the Contract") signed on .....*(insert date of the Contract)*..... between **M/s REC Transmission Projects Company Limited**, New Delhi having its Registered Office at _____ ("the Employer"/ RECTPCL**")** , and M/s ..... *(Name of Contractor)* .....,

(OR)

Vide Notification of Award issued on.....*(insert date of the notification of award)*..... by M/s. **REC Transmission Projects Company Limited**., having its Registered Office at _____ ("the Employer"/ RECTPCL**") , to M/s ..... *(Name of Contractor)* .....,** having its Principal place of business at ……*(Address of Contractor)* ..... and Registered Office at ……*(Registered address of Contractor)* ..... ("the Contractor") concerning …….. *(Indicate brief scope of work)* ..... for the complete execution of the …… *(insert name of Package alongwith name of the Project)*……. Whereas, the Contractor has agreed to supply the ……@..... in collaboration with M/s. ..... (Name of Parent Company / Collaborator / Subsidiary) ....., having its Principal place of business at ……(Address of Parent Company / Collaborator / Subsidiary) ..... and Registered Office at ……(Registered address of Parent Company / Collaborator / Subsidiary) ..... (hereinafter referred to as the "Parent Company / Collaborator / Subsidiary"), as a pre-requisite for qualification of the Bidder/Contractor and have submitted a deed of joint undertaking declaring that they are jointly and severally bound and responsible for ensuring a valid technology transfer agreement including license to manufacture in India, between the Parent Company / Collaborator / Subsidiary(the technology provider) and the Contractor for the successful performance of the said equipment in accordance with the Contract Specifications and that the Parent Company / Collaborator / Subsidiary having agreed to furnish a

Contract Performance Guarantee for the faithful performance/compliance of the Deed of Undertaking equivalent to (10%) ten per cent of the Ex-works cost of ____@____ to be supplied by the Contractor under the Contract, in addition to Contract Performance Guarantee equivalent to 10% (ten per cent) of the value of the Contract to be provided by the Contractor for the faithful performance of the entire Contract.

By this letter we, the undersigned, ……*(insert name & address of the issuing bank)* ……., a Bank (or Company) organized under the laws of ..... and having its Registered/Head Office at ……*(insert address of registered office of the bank)*……..... do hereby irrevocably guarantee payment to the Employer up to …….. i.e., ten percent (10%) of the Ex-works cost of ……@..... to be supplied by the Contractor under the Contract until ninety (90) days beyond the Defect Liability Period i.e., upto and inclusive of …….. *(dd/mm/yy)*.

We undertake to make payment under this Letter of Guarantee upon receipt by us of your first written demand signed by the Employer duly authorized officer or the authorized officer of **Owner** declaring the Contractor/ Parent Company / Collaborator / Subsidiary to be in default under the Contract and without cavil or argument any sum or sums within the above named limits, without your need to prove or show grounds or reasons for your demand and without the right of the Contractor/ Parent Company / Collaborator / Subsidiary to dispute or question such demand.

Our liability under this Letter of Guarantee shall be to pay to the Employer whichever is the lesser of the sum so requested or the amount then guaranteed hereunder in respect of any demand duly made hereunder prior to expiry of the Letter of Guarantee, without being entitled to inquire whether or not this payment is lawfully demanded.

This letter of Guarantee shall remain in full force and shall be valid from the date of issue until ninety (90) days beyond the Defect Liability Period of the said equipment i.e. upto and inclusive of …….. *(dd/mm/yy)* and shall be extended from time to time for such period (not exceeding one year), as may be desired by M/s. …… on whose behalf this Letter of Guarantee has been given.

Except for the documents herein specified, no other documents or other action shall be required, notwithstanding any applicable law or regulation.

Our liability under this Letter of Guarantee shall become null and void immediately upon its expiry, whether it is returned or not, and no claim may be made hereunder after such expiry or after the aggregate of the sums paid by us to the Employer shall equal the sums guaranteed hereunder, whichever is the earlier.

All notices to be given under shall be given by registered (airmail) posts to the addressee at the address herein set out or as otherwise advised by and between the parties hereto.

We hereby agree that any part of the Contract may be amended, renewed, extended, modified, compromised, released or discharged by mutual agreement between you and

the Parent Company / Collaborator / Subsidiary, and this security may be exchanged or surrendered without in any way impairing or affecting our liabilities hereunder without notices to us and without the necessity for any additional endorsement, consent or guarantee by us, provided, however, that the sum guaranteed shall not be increased or decreased.

No action, event or condition which by any applicable law should operate to discharge us from liability hereunder shall have any effect and we hereby waive any right we may have to apply such law so that in all respects our liability hereunder shall be irrevocable and, except as stated herein, unconditional in all respects.

"Notwithstanding anything contained herein:

1. ***Our liability under this Bank Guarantee shall not exceed _____ (value in figures)_____ [_____ (value in words)_____].***
2. ***This Bank Guarantee shall be valid upto _____(validity date)_____.***
3. ***We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only & only if we receive a written claim or demand on or before _____ (validity date) _____."***

For and on behalf of the Bank

[*Signature of the authorised signatory(ies)*]

Signature_____

Name_____

Designation_____

POA Number_____

Contact Number(s): Tel._____

Mobile_____

Fax Number_____

email _____

Common Seal of the Bank_____

Witness:

Signature_____

Name_____

Address_____

Contact Number(s): Tel._____
Mobile_____

email _____

Note :

1. For the purpose of executing the Bank Guarantee, the non-judicial stamp papers of appropriate value shall be purchased in the name of Bank who issues the 'Bank Guarantee'.
2. The Bank Guarantee shall be signed on all the pages by the Bank Authorities indicating their POA nos. and should invariably be witnessed.
3. @ Insert name of the Equipment viz., 220kV GIS
4. The Bank Guarantee should be in accordance with the proforma as provided. However, in case the issuing bank insists for additional paragraph regarding applicability of ICC Publication No. 758, the following may be added at the end of the proforma of the Bank Guarantee *[i.e. end paragraph of the Bank Guarantee preceding the signatures of the issuing authoritiy(ies) of the Bank Guarantee]*:

   "This Guarantee is subject to Uniform Rules for Demand Guarantee, ICC Publication No. 758 except that Article 15(a) is hereby excluded."

19. FORM FOR INFORMATION TO BE FURNISHED BY THE CONTRACTOR IN RESPECT OF THE PROCUREMENT MADE FROM MSE VENDORS

The Contractor shall furnish the details of items, components, raw materials, services etc. procured from MSEs and consumed for completion of scope of works under the contract directly or through our sub-suppliers/sub-vendors as per the details given herein below:

Sl. No.	Contract Agreement No.	Name of Contractor	Item Description as per contract Agreement	Qty	Total Value (In Rs.)	Executing Region	Items/components/raw materials sourced from MSE vendor for production of item at column 4	Total Value of the items/components/raw materials used for item at column 4 (In Rs.)	Name of MSE Vendor	Category (only Micro or Small)	Whether MSE owned by persons belonging to SC/ST category
1	2	3	4	5	6	7	8	9	10	11	12

Further, we hereby declare and confirm that the information mentioned above is correct and complete to best of our knowledge and the category of MSE vendors, as mentioned in the table above, has been ascertained at our end.

Note:

1. The Contractor shall be required to furnish the aforesaid information (contract-wise) on semi-annual basis i.e for period from 1st April to 30th September and from 1st October to 31st March for each Financial Year.
2. Submission of aforesaid information for the preceding 6 months, in respect of all the contracts in the Corporate Office of RECTPCL, shall be a condition for processing of bills by RECTPCL for payment after 30th September /31st March, as the case may be.
3. Only those items of Contract Agreement may be included which involve sourcing of items/components/raw materials/ services from MSEs.

Name of Contractor ----------
Name of Authorised Person ----------
Designation ----------
Signature ----------

REC TRANSMISSION PROJECTS COMPANY LIMITED

On Behalf of POWER DEVELOPMENT DEPARTMENT J&K GOVERNMENT

As Project Implementation Agency

(Invites bid through e-Tendering mode only)

FOR
TURNKEY CONTRACT PACKAGE OF

"Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15".

Tender Specification No- RECTPCL/PIA/JKPDD/SS -02 dt: 18.11.17

VOL-II

November 2017

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

TECHNICAL SPECIFICATION

FOR

220/33 kV, 160MVA LASSIPORA GIS SUBSTATION

TECHNICAL SPECIFICATION
VOL-II, SEC-I
PROJECT

SECTION –I
PROJECT

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SECTION-I
PROJECT

1.0 GENERAL

1.1. Power Development department, J&K is responsible for Transmission and distribution of electrical energy in the entire J&K state.

1.2. In order to provide reliable Power Supply in Jammu, Srinagar and Ladakh region, No. of 220,132kV New Sub stations and transmission lines, Augmentation of Sub stations, Up-gradation of transmission lines in the state is planned and to be executed.

1.3. 220/33kV Lassipora Substation in Srinagar Region has been entrusted to RECTPCL by J&K, PDD for complete implementation including Bidding, Engineering, Project Management, Quality assurance and Commissioning of Projects. The Ownership of the said substation shall however, remain vested with J&K, PDD.

2.0 INTENT OF SPECIFICATION

2.1 The specification broadly covers the following substation works:-

220/33kV Lassipora (New) GIS Substation including 4X53.3 MVA, 220/33-33kV, 1-Phase Power Transformer.

2.2 It is the intent of this specification to describe primary features, materials, and design & performance requirements and to establish minimum standards for the work. The specification is not intended to specify the complete details of various practices of manufactures/ bidders, but to specify the requirements with regard to performance, durability and satisfactory operation under the specified site conditions.

3.0 SCOPE OF WORK

The scope of this specification broadly covers the following:

Establishment of 4 X 53.33MVA (One bank + one spare unit), 220/33-33kV Lassipora (GIS) Substation with the following:-

- 4 Nos. of 220kV Line bays for termination of LILO of 220kV D/C Mirbazar – Wagoora D/C transmission line
- 1 no. of 220kV bay for 4x53.33MVA, 220/33-33kV, Single Phase Power Transformers (One bank + one spare unit)
- 1 no. 220kV Bus Coupler bay
- 6 nos. 33kV Line bay
- 1 no. 33kV Bus Sectionalizer bay
- 2 no. 33kV Transformer bay i.e. one for each 33 kV windings of 4x53.33MVA, 220/33-33kV, Single Phase Power Transformers (One bank + one spare unit)
- 2 no. of 33kV Auxiliary Transformer bay

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

4.1 Design, engineering, manufacture, testing, supply including transportation & insurance, storage, erection, testing and commissioning of following equipments and items complete in all respect:

4.1.1 **<u>245 kV Gas Insulated Switchgear</u>**

245 kV SF6 gas insulated switch gear shall have Double Main bus bar arrangement. The Switchgear shall be complete with all necessary terminal boxes, SF_6 gas filling, interconnecting power and control wiring, grounding connections, gas monitoring equipment & piping and support structures along with necessary base plate & foundation bolts.

The SF6 gas insulated switch gear shall be of the indoor metal-enclosed type, comprising of following modules:-

a) Three/Single isolated phase, **3000A, 40kA** for 1 second, SF_6 gas-insulated metal enclosed **bus bar of 245kV along with bus PT**, each set comprising of the following:-

(i) Three (3) individual 1-phase / one (1) 3-phase **bus bars** enclosures running the length of the switchgear to interconnect each of the circuit breaker bay modules in **Double Bus bar** system.
(ii) One (1) number 3-phase, 1600A, group operated isolator switches, complete with manual and motor driven operating mechanisms.
(iii) One (1) number 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.
(iv) Three (3) numbers 1-phase Potential Transformers.
(v) Gas monitoring devices, barriers, pressure switches, UHF PD Sensors etc. as required.
(vi) End Piece module with the test link for Future extension of Bus bar module. The end piece module may be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. In case, 245kV Main Bus bar is offered with 3-ph enclosure, extension piece module shall include Adapter module to convert it to three individual 1-ph bus bar enclosures and same shall be deemed to be included in 245kV Bus Bar module.
(vii) Local control cubicle, if required separately.

b) **245kV, 40kA** for 1 second, SF6 gas-insulated metal enclosed **ICT bay module** each set comprising of the following:-

(i) One (1) number 3-phase, 1600A, SF6 insulated circuit breaker without PIR complete with operating mechanism.
(ii) Three (3) numbers 1-phase, 1600A, 5-core, multi ratio, current transformers duly distributed on both side of circuit breaker.
(iii) Two (2) numbers 3-phase, 1600A, group operated isolator switches, complete with manual and motor driven operating mechanisms.
(iv) Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

(v) Three nos. 1-phase, 1600A, 40kA individual pole operated isolator switches complete with manual and motor driven operating mechanisms.

(vi) Three nos. 1-phases, 1600A, 40kA individual operated safety grounding switches complete with manual and motor driven operating mechanisms.

(vii) Three nos.1-phase, 1600A, 40 kA, individual pole operated , isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare ICT through 220kV Auxiliary bus . The isolator must meet the operational requirement in terms of Phase to Phase insulation withstand requirement for connecting the same to auxiliary bus.

(viii) Gas monitoring devices, barriers, pressure switches UHF PD Sensors etc. as required.

(viii) Local control cubicle.

c) **245kV** Auxiliary Bus to connect spare unit of Transformer.

(i) One number 1-phase (isolated) SF6 ducts inside GIS hall (up to outer edge of wall) for connection of spare unit with one ICT bay.

(ii) One nos. 1-phases, 1600A individual operated safety grounding switches complete with manual and motor driven operating mechanisms.

(iii) End Piece module with the test link for Future extension of Auxiliary Bus module at end. The end piece module may be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

(iv) Gas monitoring devices, barriers, pressure switches, UHF based Partial Discharge measurement Sensors etc. as required

(v) Local control cubicle, if required separately.

d) **245kV, 40kA** for 1 second, SF6 gas-insulated metal enclosed **Line bay module** each set comprising of the following:-

(i) One (1) number 3-phase, 1600A, SF_6 insulated circuit breaker without PIR complete with operating mechanism.

(ii) Three (3) numbers 1-phase, 1600A, 5-core, multi ratio, current transformers duly distributed on both side of circuit breaker.

(iii) Three (3) numbers 3-phase, 1600A, group operated isolator switches, complete with manual and motor driven operating mechanisms.

(iv) Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

(v) One (1) number 3-phase, high speed fault make grounding switch, complete with group operated manual and motor driven operating mechanisms.

(vi) Three (3) numbers 1-phase Potential Transformers with motorized isolating link.

(vii) Gas monitoring devices, barriers, pressure switches UHF PD Sensors etc. as required.

(viii) Local control cubicle.

e) **245kV, 40kA** for 1 second, SF6 gas-insulated metal enclosed **Bus Coupler bay module** each set comprising of the following:-

(i) One (1) number 3-phase, 2500A, SF_6 insulated circuit breaker without PIR complete with operating mechanism.
(ii) Three (3) numbers 1-phase, 2500A, 5-core, multi ratio, current transformers duly distributed on both side of circuit breaker.
(iii) Two (2) numbers 3-phase, 2500A, group operated isolator switches, complete with manual and motor driven operating mechanisms.
(iv) Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.
(v) Gas monitoring devices, barriers, pressure switches UHF PD Sensors etc. as required.
(vi) Local control cubicle.

f) **245kV Gas Insulated SF6 to Air Bushing:-**

245kV, 1600A, 1-phase SF_6 to air bushings for outdoor overhead connections. The cantilever strength of the 245kV SF_6 to air bushings shall be of minimum 8kN.

g) **245kV Gas Insulated Bus (GIB) Ducts:-**

245kV Gas Insulated Single phase / 3 Phase enclosure Bus Duct (Including support structure, gas monitoring device, gas barrier, UHF PD Sensor etc.) from GIS building (outer edge of GIS Hall Wall) to Centre line of SF6/Air Bushing along with support structure shall be as per BPS. SF6 gas duct inside GIS building are part of respective GIS Module and deemed to be included in respective module.

A tentative layout /GA drawing drawing. No. (**RECTPCL/ J&K/LAS/GA/04)** of the switchyard is enclosed with this specification for 220/33kV Lassipora (GIS) Substation. The GIB duct length shall be optimized further without affecting the switchyard arrangement and bay orientation and also any of the functional requirements specified.

h) Testing and Maintenance Equipments as per **BPS** (Bid Price Schedule).
i) Mandatory Spares as per **BPS** (Bid Price Schedule).
j) Any other equipment/material required to complete the specified GIS scope of work.

4.1.2. <u>36kV Indoor Switchgear (GIS Type):-</u>

36kV SF6 gas insulated switch gear shall be 3-phase metal enclosed type and have Single Main bus bar arrangement with Bus sectionalizer along with controls and protection relays as specified in Section-IV of Tech. Specs.

11 Nos. Bays (6 No. Line Bays, 2 No. transformer Bays, 1 no. Bus sectionalizer and 2 no. LT Transformer Bays)

a) Three phase, **2500A, 25kA** for 3 second, SF_6 gas-insulated metal enclosed **bus bar of 36kV along with Bus Sectionalizer with bus PT on both bus sections**, comprising of the following:-

(i) **Bus bars** enclosures to interconnect each of the circuit breaker bay modules in **Single bus bar system.** For individual 36kV Bays, 2500A, 25kA for 3 second Bus bars shall be mounted in respective bay module and quoted accordingly.
(ii) One (1) number 3-phase, 2500A, Vacuum type circuit breaker complete with operating mechanism.
(iii) Two (2) number 3-phase, **2500A**, isolator switches, complete with manual and motor driven operating mechanisms.
(iv) Two (2) number 3-phase, safety grounding switches, complete with manual and motor driven operating mechanisms.
(v) Six (6) number 1-phase Potential Transformers (Three for each section of bus).
(vi) Gas monitoring devices, barriers, pressure switches etc. as required.
(vii) Suitable bus bar extension provision to be kept for future extension.
(viii) Integrated Local Control Cubicle, if required.

b) Three phase **1250A, 25kA** for 3 second, **36kV** SF6 gas-insulated metal enclosed **Line bay module** each set comprising of the following:-

(i) One (1) number 3-phase, **1250A**, Vacuum type circuit breaker complete with operating mechanism.
(ii) Three (3) numbers 1-phase, **1250A**, 3-core, multi ratio, current transformers.
(iii) One (1) number 3-phase, **1250A**, group operated isolator switches, complete with manual and motor driven operating mechanisms.
(iv) One (1) number 3-phase, group operated grounding switches, complete with manual and motor driven operating mechanisms.
(v) Gas monitoring devices, barriers, pressure switches etc. as required.
(vi) GIS Cable termination enclosure with isolating link, cable termination kit for making connection to 36kV XLPE cable. 36kV cable termination arrangement is to be finalized considering cable sizes and no. of runs per phase for 500Amps. current rating for line feeders.
(vii) Integrated Local Control Cubicle, if required.

c) Three phase **1600A, 25kA** for 3 second, **36kV** SF6 gas-insulated metal enclosed **Transformer bay module** each set comprising of the following:-

(i) One (1) number 3-phase, **1600A**, Vacuum type circuit breaker complete with operating mechanism.
(ii) Three (3) numbers 1-phase, **1600A**, 3-core, multi ratio, current transformers.
(iii) Two (2) numbers 3-phase, **1600**A, group operated isolator switches, complete with manual and motor driven operating mechanisms.
(iv) Two (2) number 3-phase, group operated grounding switches, complete with manual and motor driven operating mechanisms.
(v) Gas monitoring devices, barriers, pressure switches etc. as required.
(vi) GIS Cable termination enclosure with isolating link, cable termination kit for making connection of 36kV XLPE cable to 220/33kV transformer secondary. 36kV cable termination arrangement is to be finalized considering cable sizes and no. of runs per phase for 1600Amps. current rating.
(vii) Local Control Cubicle, if applicable.

d) Three phase **100A, 25kA** for 3 second, **36kV** SF6 gas-insulated metal enclosed **L.T Transformer bay module** each set comprising of the following:-

(i) One (1) number 3-phase, **100A**, Vacuum type circuit breaker complete with operating mechanism.
(ii) Three (3) numbers 1-phase, **100A**, 3-core, multi ratio, current transformers.
(iii) Two (2) numbers 3-phase, **100**A, group operated isolator switches, complete with manual and motor driven operating mechanisms.
(iv) Two (2) number 3-phase, group operated grounding switches, complete with manual and motor driven operating mechanisms.
(v) Gas monitoring devices, barriers, pressure switches etc. as required.
(vi) GIS Cable termination enclosure with isolating link, cable termination kit for making connection of 36kV XLPE (185 Sq. mm Copper / 300 Sq.mm Aluminium Conductor cable) cable to LT transformer.
(vii) Local Control Cubicle, if applicable.

e) Testing and Maintenance Equipment's as per **BPS** (Bid Price Schedule).
f) Mandatory Spares as per **BPS** (Bid Price Schedule).
g) Any other equipment/material required to complete the specified GIS scope of work.

4.1.3 <u>Air insulated switchgear(AIS) and Other Main Equipments</u>

a) **4X53.33MVA, 220kV/33-33kV**, 1-Phase Power Transformers (One bank + One Spare) including all materials/fittings/accessories/Digital RTCC panel/Common MB/Individual MB, Cables including special cable (if any), Neutral (for HV & two LV) formations, Neutral Bus etc. 53.33MVA, 220/33-33kV Power Transformer will have Two Secondary Winding each rated for 26.67MVA. Technical parameters requirement of 53.33MVA, 220/33-33kV Power Transformer shall be as per Technical specification enclosed as per **Annexure-VII.** Digital RTCC panel shall have three RTCC relays where each Digital RTCC relay shall control 1 bank (i.e. 3 Single Phase units)

b) 36kV Outdoor Cable termination kit as per BPS

c) Surge Arrestors, SF6/Air Bushing, and Isolator & Bus Post Insulators as per BPS.

d) Complete sub-station automation system (SAS) based on IEC 61850 including hardware and software for remote control station along with associated equipments for following bays (bay as defined in Technical Specification, Section - Substation Automation):

- 220kV: 6 Bays
- 33kV: 11 Bays

For 33kV system, **One BCU for two bays** having facility of connecting all required digital I/O & analogue signal for both bays shall also be acceptable.

The Contractor shall also supply separate BCU for monitoring and control of auxiliary system including LT Transformer. SAS panels shall be placed in 220/33kV Control room

e) Complete relay and protection system for 220kV bays as per Section–Control and Relay panels.

The protection to be provided on 220kV Lines shall be as under:-

Main-I & Main II Protection shall be distance Protection Scheme as per specification Clause no. 18.8 of section control & Relay Panel.

All relay panels shall be placed in relay room of GIS hall.

For 33kV GIS Bays, the requirement & specification for complete relay and protection system shall be as specified in Section-IV of Tech. Specs.

f) Digital protection couplers (DPCs) for both ends of 220kV Lines as per BPS. Scope includes cable required for connecting DPC with the Communication (SDH) equipment in the substation control room building /relay panel room. 220V & 48 DC supply available at the substation shall be provided to power the DPCs at Lassipora Substation, any other voltage, if required, shall be derived from the same.

g) Erection Hardware:- Insulator strings and hardware, Clamps & connectors, terminal connector including terminal connectors for Transformers, conductor, earth wire and earthing materials, spacers, cable supporting angles/channels, cable trays & covers, Junction box, cable sealing system, buried cable trenches etc as required.

h) 36kV kV Grade HT Power Cable for rating as Specified in BPS along with all accessories including termination kit for Power Transformer application, 36kV Line feeder application as well as for Auxiliary transformer. All the Single Phase 220/33kV Power transformers shall be connected with GIS through Power Cable except Single Phase Spare Transformer. Cable from Spare Transformer shall be kept ready with termination etc. so that as and when required, Spare transformer is connected with 36kV GIS in minimum possible time. Length of the cables shall be sufficient to connect with any of R,Y, B of 36kV GIS transformer Bay module. For 36kV Line Feeders, Cable shall be required up to take off gantry for termination with State feeders.

i) Direct Stroke Lightning Protection (DSLP).

j) Nitrogen based Fire Protection System (NIFPS) is also envisaged for 220kV class transformers as per Technical specification. Underground oil storage tank associated with Nitrogen based Fire Protection System is also included in the scope. All civil works for NFPS shall be as per contractor's design.

k) Fire Protection system: Portable Fire Extinguishers as per BPS.

l) Auxiliary LT Transformers and associated equipments:-

250kVA, 33/0.433kV, Auxiliary Transformer with associated 36kV Isolators, with associated terminal connectors, Bus Post Insulators, conductor, clamps, connectors etc. complete in all respect for connection with GIS bay.

m) LT switchgear (AC/DC Distribution boards).

n) 100KVA Silent type Outdoor DG Set with AMF Panel. Net Rated Output at 40°C temperature & 1700m of altitude after reducing DG Set auxiliaries load shall be 100 kVA. Other general parameters will be as specified in Annexure-A of Section DG set.

o) Batteries & Battery Chargers: The capacity for batteries and battery chargers shall be worked out by the Contractor for the present and future bays as shown in the Single Line Diagram of the substation and shall be subject to Owner's approval. However, the capacity for battery & ratings for battery chargers shall not be less than the capacity & rating mentioned below.

   i) 220V Battery – 600 AH
   ii) 48V Battery – 300 AH
   iii) 220V Float cum Boost Charger – 80A/80A
   iv) 48V Float cum Boost Charger – 40A/40A

p) 1.1 kV grade Power & Control cables along with complete accessories for Substation and 1.1kV grade Power Cable with complete accessories for all buildings including Security room, Store and Control Room cum Administrative Building etc.

q) Air Conditioning System for the Control Room Building and Relay Panel room of 220/33kV GIS buildings. The requirement of air conditioning system for relay panel room of GIS building shall be as per **Annexure-III**.

r) Ventilation system for 220kV GIS Buildings. The Ventilation Requirement shall be as per Annexure – IV. For 36kV GIS Room , adequate no. of exhaust fans shall be required

s) Earth mat design & laying inside the GIS buildings and in the outdoor yard is in the scope of Contractor.

t) Lattice structures (galvanized): 220kV LM, 220kV & 36kV Outdoor Equipment support structures, Support structures for 220 kV & 36 kV GIS equipment's, its ducts, H.T Power Cable support structure and 220kV & 36kV SF6 to air bushing shall be supplied and designed by the GIS manufacturers / Contractor.

u) Complete lighting and illumination of the switchyard area, Street lighting, control room building cum administrative building, GIS Building, security room, Store etc.

v) Any other equipment/material required to complete the specified scope.

w) Design of all Structures (to be developed by vendor for approval).

Note: - PDD, J&K intends to procure type tested equipment's under the scope of this specification. Type tests shall not be required to be carried out for which valid type test certificates are available. If the offered design has not been tested earlier, bidder shall be required to carry out the testing. However, no extra payment shall be made to the contractor.

4.1.4 Mandatory Spares - Design, engineering, manufacture, Testing, and Supply on site basis including transportation & insurance, storage at site as per detail given in BPS (Bid price schedule).

4.1.5 Testing and Maintenance Equipments as per **BPS** (Bid Price Schedule).

4.1.6 Civil works - The work shall include but not limited to the following:-

a) **Design, Engineering and civil work (as per Contractor supplied drawings) for** :-

i) PEB GIS Building for 220/33kV GIS. The size of 220 kV & 36kV GIS Building shall be suitable to accommodate 220kV & 36kV bays respectively including space of maintenance bay, extension piece module, Space for future Bays etc.

ii) EOT crane shall be provided in the 220kV GIS Building as per relevant section of technical specification. The Relay room shall be provided for 220kV GIS Building. Panels shall be kept in air-conditioned enclosure.

iii) All civil works including foundations associated with SF6 gas insulated metal enclosed switchgear along with its ducts.

iv) Foundation for Bus duct supporting structures, GIS (SF6 to Air) bushing, lighting poles, panels and control cubicles of equipments wherever required.

v) Foundations of 53.33MVA, 220/33-33kV Transformers with jacking pads and pylon supports, rail cum road & fire resistant walls.

vi) Cable trenches inside Control Room, Relay Room, GIS buildings and in switchyard area. Contractor shall develop the Cable Trench layout drawing based on standard sections of cable trenches provided with the tender and take approval from Employer.

vii) Drainage system in the substation including culverts

viii) External water supply arrangement for control room cum Administrative building & other buildings etc.

ix) External sewerage system.

x) Foundation of towers and Lightning Mast.

xi) Construction of septic tank & soak pit for control room, Security Room

xii) Construction of Boundary wall and main Boundary wall gate

xiii) Control room cum Administrative building. Adm. Building will accommodate office of Executive Engineer, Engineer (Maintenance), Conference room, Maintenance & Testing Room, Administrative staff room etc. Control Room building will accommodate Control Room cum SAS Room, Battery Room, ACDB/DCDB/battery Charger Room, Testing Lab etc.

xiv) Foundations for all equipment structures, Cable Support structure etc.

xv) All concrete roads including culverts in the Substation area.

xvi) Cable trench crossings with roads, rail tracks, culverts etc. as required.

xvii) Buried cable trench for laying power cables as per requirement.

xviii) Switchyard Fencing along with Gate for substation.

xix) Stone spreading and antiweed treatment including PCC.

xx) Rain water Harvesting.

xxi) Foundation for DG set & LT transformer.

xxii) Geotechnical/Soil investigation including earth resistivity measurement

xxiii) Contouring and Levelling of Plot including Earthwork filling with borrowed Earth

xxiv) Construction of Security room, Store, Parking Shed etc.

4.2 Before proceeding with the construction of substation, the Contractor shall fully familiarize himself with the site conditions and General arrangements & scheme etc. Though the Employer shall endeavor to provide the information, it shall not be binding for the Employer 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, enclosed in the bidding document.

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

4.5 Design of substation and its associated electrical & mechanical auxiliaries systems includes preparation of single line diagrams, GIS duct layout and electrical layouts, protection single line diagram, erection key diagrams, electrical and physical clearance diagrams, design calculations for Earth mat, Design calculation for direct stroke lightning (DSLP) control & protection schematics, wiring & termination schedules, civil designs (as applicable) & drawings, design of fire fighting system, air conditioning system, indoor/outdoor lighting/illumination and other relevant drawings & documents required for engineering of all facilities under the scope of this contract.

4.6 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 elsewhere.

The contractor shall arrange all T&P (such as necessary supports, cranes, ladders, platforms etc.) for erection, testing & commissioning of the system at his own cost. Further, all consumables, wastage and damages shall be to the account of Contractor.

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

5 Specific Exclusions

The following items of work are specifically excluded from the scope of the specifications for all substations:

a) Transmission line side tension clamp for earth wire termination.
b) Approach Road upto Substation entrance.

6 PHYSICAL AND OTHER PARAMETERS

6.1 **Location of the Substation** – The location of sub-stations are as under;

Sl. No	Name of substation	Name of State	Nearest rail Station
1.	220/33kV GIS Lassipora Substation	J&K	Jammu

6.2 **Meteorological data**

The meteorological data of the substations shall be furnished to successful bidder**.** However for design purposes and other details as below:

Parameters	220/33kV Lassipora GIS S/S
Altitude	1700 meter above Mean Sea Level
Seismic Zone	As per IS 1893
Wind Zone	As per IS 875
Max. Ambient Temperature	50^{o}C
Max. Ambient Temperature	-15^{o}C

All Outdoor Equipment shall be designed for altitude of 1700m above MSL as well as for above Conditions.

7 SCHEDULE OF QUANTITIES

The requirement of various items /equipments and civil works are indicated in Bid price Schedules (Vol. III).

All equipments/items and civil works for which quantities has been given in the BPS (Vol. III) 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 indicated in lot/ set, 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 is given in the bid price Schedules (Vol-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 Employer.

8 BASIC REFERENCE DRAWINGS

Switching Scheme & Fault Level for the Substations is as under:-

Sl.No.	Name of S/S	Switching Scheme		Fault Level	
		220kV	33kV	220kV	33kV
1	Lassipora GIS SS	DM	SM	40kA for 1 sec	25kA for 3 sec

DM- Double Main Scheme
SB – Single Main Bus with Sectionalizer

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, GA 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 Employer.

9 DIFFERENT SECTIONS OF TECHNICAL SPECIFICATION

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

Sl. No.	Description
1.	Section-I Project
2.	Section-II General technical Requirement
3.	Section-III 220kV Gas Insulated Switchgear (GIS)
4.	Section-IV 36kV Indoor Switchgear (GIS)
5.	Section-V Switchgear Isolator
6.	Section-VI Switchgear SA
7.	Section-VII LT Switchgear
8.	Section-VIII Battery & Battery Charger
9.	Section-IX Lighting System
10.	Section-X LT Transformer
11.	Section-XI Fire Protection System
12.	Section-XII Power & Control Cable
13.	Section-XIII Air Conditioning System
14.	Section-XIV DG Set
15.	Section-XV Switchyard Erection
16.	Section-XVI Structure
17.	Section-XVII Civil Works

18.	Section-XVIII Control & Relay Panel
19.	Section-XIX Substation Automation System
20.	Section-XX Transformer (Upto220 kV Class)
21.	Section-XXI Technical Specifications for Tele Communication Equipment

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.

10 MANDATORY SPARES

The Mandatory Spares shall be included in the bid proposal by the bidder. The prices of these spares shall be given by the Bidder in the relevant schedule of BPS and shall be considered for evaluation of bid. It shall not be binding on the Employer 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.

11. Training of Employer's Personnel.

The contractor shall organize and conduct complete and thorough training programme (to be conducted in English language) providing necessary training material at no extra cost to the Employer. However, the traveling and living expenses of owner's personnel, if any, shall be borne by Employer. The training shall be carried out at the place of manufacture or as the case may require and as agreed by Employer so as to ensure the complete adequacy of the programme and imparting of detailed knowledge of system/equipment design engineering and operation and maintenance aspects.

The duration of the training shall be as follows:

Design, operation and maintenance of GIS Substation including procedures for fault attending for the Power Transformer, Circuit Breaker, Isolators, Instruments Transformers , Relay & Protection system and substation automation at manufacturers'/suppliers' works for 20 personnel of Employer for 5 days. Further training on FO based Communication equipment at manufacturers'/suppliers' works for 10 personnel of Employer for 5 days.

12 SPECIFIC REQUIREMENT

12.1 The broad scope of the procurement of Communication Equipment shall include planning, designing , engineering , factory testing , supply , transportation, insurance, delivery at site , unloading, handling, storage , installation termination, testing training and demonstration for acceptance , commissioning and documentation for:

- SDL Equipment along with suitable interfaces and line cards.
- All Cabling, wiring, Digital Distribution frame patch facilities and interconnection to the supplied equipment at the defined interfaces.
- System integration of all supplied subsystems

12.2 Ventilation system shall be completely operational before starting the erection work of 220kV GIS.

12.3 Fire detection and Alarm (FDA) system shall be conventional type.

12.4 The Contractor shall be responsible to select and verify the route, mode of transportation and make all necessary arrangement with the appropriate authorities for the transportation of the equipment. The dimension of the equipment shall be such that when packed for transportation, it will comply with the requirements of loading and clearance restrictions for the selected route. It shall be the responsibility of the contractor to coordinate the arrangement for transportation of the transformers & reactors for all the stages from the manufacturer's work to site.

12.5 The plinth height of outdoor GIS shall be decided during detailed engineering stage. The miscellaneous structural steel and foundation bolts required to fix the GIS module shall be deemed to be included in the item of GIS module and shall not be payable separately.

12.6 The Contractor shall have option to use post installed anchor bolts in place of normal anchor bolts for fixing GIS module and GIS bus duct support structures without cost implication to Employer. Galvanizing of post installed anchor bolts shall be as per clause no. 1.0 of Section-Structures of technical specification.

12.7 The toewall of Switchyard Chain link fencing shall be 300 mm below FGL and 300 mm above ground, irrespective of height mentioned in the relevant clause of Technical specification.

12.8 Fasteners, Nuts, Bolts and washers for all equipment structures shall be payable as per BPS.

12.9 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 Employer.

12.10 Erection, Testing and Commissioning of Transformer, Relay & protection panels, sub-station automation system and Tele-protection equipments shall be done by the contractor under the supervision of respective equipment manufacturers. Such supervision charges shall be included by the bidder in the erection charges for the respective equipment in the BPS.

12.11 The duct connections should be such that it is possible to remove transformer for repair and maintenance conveniently

12.12 The price of Bus-duct inside the GIS hall shall be integral part of the respective bay module and it will not be paid separately. However, the payment of bus-duct for outside the GIS hall alongwith support structure shall be paid as per running meters in line with provision of Bid Price schedule. Therefore, bidder is required to quote for 220kV GIB (SF6 Gas insulated Bus Duct) of Transformer, feeder module required outside GIS hall with support structure and SF6/Air bushing for interconnecting with its respective gantry / equipment (Overhead connection) separately as per provision of Bid price schedule.

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

12.14 The empty gas Cylinders may be taken back by the contractors after filling the gas in GIS compartments. However, in view of the future maintenance requirement, the contractor shall provide the Gas storage capacity equivalent to the Gas used in largest Gas tight GIS Module. Further, the spare Gas shall be supplied in Gas storage cylinders.

12.15 Floor of GIS Building shall have Polyurethane paintings and walls shall have synthetic enamel painting for easy maintenance, proper cleaning & dust free environment inside.

12.16 The contractor shall provide outdoor power receptacle (with 400A rating) suitable for oil filtration unit near 220/33kV transformer Area of switchyard. The cable from Main switchboard to oil filtration units shall also be in the scope of contractor.

12.17 Lightning Mast is indicated in Bid Price Schedules; however location of the same is not marked on General Arrangement drawing. The requirement & location of the same shall be decided during detailed engineering based on DSLP layout & calculations submitted by the contractor for approval.

12.18 In the Sub-station automation system, each gas tight compartments of 220kV & 33kV GIS shall be monitored individually. In case it is not possible to monitor the gas tight compartment individually in one BCU, the contractor shall supply additional BCU for the monitoring without any additional cost implication to RECTPCL.

12.19 In specification all parameters mentioned are corresponding to less than 1000 Mts MSL. However all equipments (including transformer), all design parameters including air clearances, external insulation etc. shall be corresponding to altitude as mentioned in metrological data for respective substations with more than 1000mtr altitude (accordance to IEC) unless specifically mentioned elsewhere.

12.20 The Switchgear shall be complete with all necessary terminal boxes, SF_6 gas filling, interconnecting power and control wiring, grounding connections, gas monitoring equipment and piping, support structures. In addition all necessary supports, ladders and seizer lifts etc. for operation & maintenance work shall also be supplied.

12.21 The requirement of **digital protection coupler** (for both end of 220 kV lines) shall be as **Annexure-VI** of Section-Project.

12.22 220kV Class Transformers are being provided with optical temperature sensor & online Dissolved Gas Analyzer (DGA) – multi gas. These equipments are IEC 61850 compliant & required to be integrated with Substation Automation System (SAS).

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

13 In Section-GTR and other technical specifications, the word 'Purchaser' and/or 'Owner' may be read as 'Employer'.

LIST OF MANDATORY SPARES

Annexure-1

S. No.	Description	Unit	220/33kV GIS Lasipora S/S
I	**Spares for 220/33kV, 53.33MVA Single Phase Power Transformer**		
(i)	Bushing of each rating with metal parts & gaskets and lifting tools	Set	1
(ii)	Oil Cooler pump with motor	Set	1
(iii)	Cooler fan with Motor	No.	1
(iv)	Buchholz Relay(Main Tank) complete with floats and contacts	Set	1
(v)	Local and Remote WTI with sensing device and contact(each)	Set.	1
(vi)	Oil temperature indicator (OTI) with sensing device in contact (Each)	Set	1
(vii)	Magnetic oil level gauge	No.	1
(viii)	Starters, contactors, switches & Relays for Electrical control panels(One set of each type)	Set	1
(ix)	Remote Tap position Indicator	No.	1
(x)	Oil Flow Indicator with Flow Switch	Set	1
(xi)	Spare insulating oil to be handed over to PDD, J&K after commissioning for O&M requirement	KL	10
(xii)	Fire Detectors of Nitrogen Injection type Fire Prevention System	No.	2
(xiii)	Thermostat of Nitrogen Prevention System	No.	1
II	**Spares for 220kV GIS**		
1	**General**		
1.1	SF6 gas Pressure Relief Devices, 1 Nos. of each type	Set	1
1.2	SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable (1 no. of each type)	Set	1
1.3	Coupling device for pressure gauge cum switch for connecting Gas handling plant	Set	1
1.4	Rubber Gaskets, “O” Rings and Seals for SF6 gas of each type	Set	1
1.5	Molecular filter for SF6 gas with filter bags	Kg	20% of total weight
1.6	All types of Control Valves for SF6 gas of each type	Set	1

LIST OF MANDATORY SPARES

Annexure-1

S. No.	Description	Unit	220/33kV GIS Lasipora S/S
1.7	SF6 gas	Kg	20 % of total gas quantity
1.8.	All types of coupling for SF6 gas (1 no. of each type)	Set	1
1.9	Pipe length (Copper or Steel as applicable) for SF6 Circuit of each type	Set	1
1.10	Covers with all accessories necessary to close a compartment in case of dismantling of any of any part of the Enclosure to ensure the sealing of this compartment		
1.10.1	For three phase enclosure if applicable	Nos.	1
1.10.2	For Single phase enclosure if applicable	Nos.	1
1.11	Locking device to keep the Dis-connectors (Isolators) and Earthing switches in close or open position in case of removal of the driving Mechanism.	Set	1
1.12	Bus Support insulator each type for 3 phase/Single phase enclosure.	Nos.	1
1.13	SF6 to air bushing (220kV of each type & rating) as applicable	Set	1
2	**245 kV SF6 CIRCUIT BREAKER**:		
2.1	Complete Circuit Breaker pole of each type & rating complete with interrupter, main circuit, enclosure and Marshalling Box with operating mechanism	Nos.	1
2.2	Rubber gaskets, `O' rings and seals for SF6 gas of each type	Set	1
2.3	Trip coil assembly with resistor as applicable	Set	1
2.4	Closing coil assembly with resistor as applicable	Set	1
2.5	Relays, Power contactors, push buttons, timers & MCBs etc. of each type & rating	Set	1
2.6	Closing assembly/ valve	Set	1
2.7	Trip assembly/ valve	Set	1
2.8	Auxiliary switch assembly of each type	Set	1
3	**220 kV ISOLATORS** :		
3.1	Complete set of 3-phase dis-connector of each type & rating including main circuit, enclosure and driving mechanism.	Set	1
3.2	3-phase Earthing switch of each type & rating including main circuit, enclosure, driving mechanism.	Set	1

LIST OF MANDATORY SPARES

Annexure-1

S. No.	Description	Unit	220/33kV GIS Lasipora S/S
3.3	Copper contact fingers for dis-connector male & female contact – for one complete (3 phase) dis-connector of each type and rating	Set	1
3.4	Copper contact fingers for earthing switch male & female contacts, for one complete earthing switch of each type and rating	Set	1
3.5	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
3.6	Push button switch.-each type, as applicable	Set	1
3.7	Limit switch and Aux. Switches for complete 3 phase equipment		
3.7.1	For isolator	Set	1
3.7.2	For earth switch	Set	1
4	**220kV CURRENT TRANSFORMER**		
4.1	Gas Insulated complete CT of each type and rating with enclosure.	Nos.	1
4.2	Secondary bushing of each type	Set	1
5	220 kV Voltage Transformer		
5.1	Gas Insulated complete PT of each type and rating with enclosure	Nos.	1
III.	**Spares for 36kV GIS**		
1	General		
1.1	SF6 gas Pressure Relief Devices, 1 Nos. of each type	Set	1
1.2	SF6 Pressure gauge cum switch OR Density monitors and pressure switch as applicable (1 no. of each type)	Set	1
1.3	Coupling device for pressure gauge cum switch for connecting Gas handling plant	Set	1
1.4	Rubber Gaskets, “O” Rings and Seals for SF6 gas of each type	Set	1
1.5	Molecular filter for SF6 gas with filter bags	Kg	20% of total weight
1.6	All types of Control Valves for SF6 gas of each type	Set	1
1.7	SF6 gas	Kg	20 % of total gas quantity
1.8	All types of coupling for SF6 gas (1 no. of each type)	Set	1

LIST OF MANDATORY SPARES

Annexure-1

S. No	Description	UNIT	GIS Lasipora S/S
1.9	Pipe length (Copper or Steel as applicable) for SF6 Circuit of each type	Set	1
1.1	Covers with all accessories necessary to close a compartment in case of dismantling of any of any part of the Enclosure to ensure the sealing of this compartment		
1.11	For three phase enclosure	Nos.	1
1.11.1	Locking device to keep the Dis-connectors (Isolators) and Earthing switches in close or open position in case of removal of the driving Mechanism.	Set	1
1.12	Bus Support insulator each type for 3 phase/Single phase enclosure.	Nos.	1
2	**36kV CIRCUIT BREAKER:**		
2.1	Complete Circuit Breaker pole of each type & rating complete with interrupter, main circuit, enclosure and Marshalling Box with operating mechanism	Nos.	1
2.2	Rubber gaskets, `O' rings and seals of each type	Set	1
2.3	Trip coil assembly with resistor as applicable	Set	1
2.4	Closing coil assembly with resistor as applicable	Set	1
2.5	Relays, Power contactors, push buttons, timers & MCBs etc. of each type & rating	Set	1
2.6	Closing assembly/ valve	Set	1
2.7	Trip assembly/ valve	Set	1
2.8	Auxiliary switch assembly of each type	Set	1
3	**36KV ISOLATORS** :		
3.1	Complete set of 3-phase dis-connector of each type & rating including main circuit, enclosure and driving mechanism.	Set	1
3.2	3-phase Earthing switch of each type & rating including main circuit, enclosure, driving mechanism.	Set	1
3.3	Copper contact fingers for dis-connector male & female contact – for one complete (3 phase) dis-connector of each type and rating	Set	1
3.4	Copper contact fingers for earthing switch male & female contacts, for one complete earthing switch of each type and rating	Set	1

LIST OF MANDATORY SPARES

Annexure-1

S. No.	Description	Unit	220/33kV GIS Lasipora S/S
3.5	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
3.6	Push button switch.-each type, as applicable	Set	1
3.7	Limit switch and Aux. Switches for complete 3 phase equipment		
3.7.1	For isolator	Set	1
3.7.2	For earth switch	Set	1
4	**36kV CURRENT TRANSFORMER**		
4.1	Gas Insulated complete CT of each type and rating with enclosure.	Nos.	1
4.2	Secondary bushing of each type	Nos.	1
5	**36 kV Voltage Transformer**		
5.1	Gas Insulated complete PT of each type and rating with enclosure	Nos.	1
IV.	**Spares for 220kV AIS**		
1	216 kV Surge Arrestor with insulating base terminal connector, surge counter & accessories	Set	1
V.	**Spares for 36kV AIS**		
1	36kV Isolator		
1.1	One complete pole including support Insulator, motor operating mechanism (MOM) but excluding structure (Highest rating)	Pole	-
1.2	Copper contact fingers for male & female contacts	Set	-
1.3	Open/Close contactor assembly, timers, key interlock ,push button switch & auxiliary switches	Set	-
1.4	Limit switch	Set	-
1.5	Terminal Pads and connectors	Nos.	-
1.6	Corona shield ring	Nos.	-
3	20kV Surge Arrester		
3.1	Complete LA	Nos.	-
3.2	Surge counter/monitor	Nos.	-
VI.	**Emergency DG Set**		
1	Self Starter assembly	Nos.	1
2	AVR(Auto Voltage Regulator)	Set	1
VII.	**Battery Charger**		

LIST OF MANDATORY SPARES

Annexure-1

S. No.	Description	Unit	220/33kV GIS Lasipora S/S
1	**Battery**		
1.1	Cells of 600AH	Nos.	5
1.2	Cells of 200AH	Nos	2
2	**Spares of 220V Battery Charger**		
2.1	Set of control cards	Set	1
2.2	Set of relays	Set	1
2.3	Rectifier transformer	Nos.	1
2.4	Thyristor/diode	Set	1
2.5	Fuses of Thyristor with indicator	Set	6
3	**Spares of Battery 48 V charger**		
3.1	Set of control cards	Set	1
3.2	Set of relays	Set	1
3.3	Rectifier transformer	Nos.	1
3.4	Thyristor/diode	Set	1
3.5	Fuses of Thyristor with indicator	Set	6
VIII.	**Relay & Protection**		
1	Line Protection Panel Equipment Spares		
1.1	Numerical distance relay Main I for 220kV	Set	1
1.2	Numerical distance relay Main II for 220kV	Set	
1.3	Numerical distance relay Main I for 33kV	Set	1
1.4	Back Up Over Current & Earth Fault Relay (33kv)	Set	1
2	Transformer Protection Panel		
2.1	Transformer differential protection relay	Nos.	1
2.2	Restricted earth fault protection relay with non-linear resistor	Nos.	1
IX.	**Digital Protection Coupler**		
1	Set of prints for Digital protection coupler	Set	1
X.	**Substation Automation System**		
1	Bay Control Unit (IED) of each type	Set	1
2	Ethernet Switch of each type	Set	1
XI.	**LT Switchgear**		
1	MCCB & MCBs of each type & rating	Nos.	4
2	Relays of each type	Nos.	1
3	Push Buttons and Indicating lamps of each type	Nos.	5
XII.	**COMMOM SPARES**		

LIST OF MANDATORY SPARES

Annexure-1

S. No.	Description	Unit	220/33kV GIS Lasipora S/S
1	Power Supply module for Bus Bar Protection	Nos.	1
2	Bay unit Module for Bus Bar Protection	Set	1

XIII	**LT Transformer**		
1	Bushings	No.	1no. of each type
2	OTI & WTI with sensing device	No	1no. of each type
3	Diaphragm for pressure relief vent	No.	1
4	Silica gel container	No.	1
5	Set of Valves	No.	1no. of each type
6	Buchholz relay (if applicable)	No.	1

XIV	**Illumination system**		
	5% of each type of lighting fixture supplied	set	1
XV	**Erection Hardware Items**		
	5% spares of the actual quantities for Insulator strings & hardwares, clamps & connectors (including equipment connectors), spacers, corona bell and welding sleeves,	set	1
XVI	**Tele Communication**		
A	SDH Equipment (STM-4 MADM upto 5MSP Protected directions)		
(i)	Common cards, Cross-connect/control cards, Optical base card, power supply card, power cabling, other hardware & accessories(each)	Set	1
(ii)	Optical Interface Cards/SFP#		
a	S4.1 SFP	Nos.	1
b	L4.1 SFP	Nos.	1
(iii)	Tributary Cards		
a	E1 interface Card(Min. 16 interfaces per card)	Nos.	1
b	Ethernet Interface 10/100 Base T with layer-2 switching (Min 8 Interfaces per card)	Nos.	1
B	VOIP Telephone Instrument	Nos.	1
C	Pre Connectorised Optical Fibre Patch cords(10 Mtrs)- pack of six patch cords	Set	1

D	Approach cable(24)		
	Lassipora		
(a)	24 Fibre (DWSM)	Km	0.5
(b)	Installation hardware set for above 24f,fibre optic approach cable	Set	1
	Mirbazar		
(a)	24 Fibre (DWSM)	Km	0.5
(b)	Installation hardware set for above 24f,fibre optic approach cable	Set	1
	Wagoora		
(a)	24 Fibre (DWSM)	Km	0.5
(b)	Installation hardware set for above 24f,fibre optic approach cable	Set	1
XVII	**EOT Crane**		
a	Motor	No.	1
b	As recommended by manufacturer	Set	1

ANNEXURE-II

220/33kV GIS LASSIPORA SS

DWG NO	TITLE OF DWG	
01	Single Line Diagram	RECTPPL/J&K/DRG/C
02	General Arrangement	RECTPPL/J&K/DRG/C
03	Boundary wall drawing	RECTPPL/J&K/DRG/C
04	Cable Trench Layout	RECTPPL/J&K/DRG/C
05	Details of Roads, drainage	RECTPPL/J&K/DRG/C
06	Control Room Drawing	RECTPPL/J&K/DRG/C
07	Fire Fighting Pump House drawing	RECTPPL/J&K/DRG/C
08	Fencing drawing	RECTPPL/J&K/DRG/C
09	Gate and security room drawing	RECTPPL/J&K/DRG/C
10	Retaining wall drawings	RECTPPL/J&K/DRG/C
11	415V MSB	RECTPPL/J&K/DRG/C
12	415V MLDB	RECTPPL/J&K/DRG/C
13	415V ELDB	RECTPPL/J&K/DRG/C
14	415V ACDB	RECTPPL/J&K/DRG/C
15	220V DCDB	RECTPPL/J&K/DRG/C
16	48V DCDB	RECTPPL/J&K/DRG/C

HEATING & 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. It shall be a closed cycle with fresh air intake limited to a maximum of 20% of the total air requirement. 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. GIS hall shall be provided with motorized exhaust dampers with local control.

Heating system

The scope of work shall include design, supply, erection, testing and commissioning of an up to date state of the art heating system in order to maintain the required environmental conditions inside the GIS Hall. An advanced & reliable heating system with redundant capacity to be operated in main and standby mode is required to maintain the uniform temperature inside the GIS Hall within the prescribed limits for proper functioning of GIS Installation. It is desired that at no point of time during the operation of GIS installation, temperature inside the GIS hall shall go below -10° Celsius.

Temperature maintained by heating system inside the GIS hall shall be continuously monitored with multiple temperature sensors and shall be integrated to SAS. Necessary heat load calculations shall also be submitted by the contractor along with the general layout drawings for Employers approval.

Heating system shall be provided with controller to control and monitor the healthiness of heating system and shall be able to generate alarms and necessary signals (analogue and digital) which may be integrated to substation SAS and CRP system. Any fault or condition which may lead to drop of temperature inside the GIS hall below the limit beyond which GIS installation is not designed to operate shall be communicated well before to the substation protection system to electrically isolate the GIS. The purpose of providing the heating system is trouble free operation of GIS installation. Under no circumstances there should be a possibility of damage or mal operation of GIS because of the heating system.

HEATING & VENTILATION SYSTEM FOR GIS HALL

Local and Remote start/stop facility of all electrical equipment's/drives shall be made

available in the control panels. The equipment offered shall be suitable for continuous, safe, efficient and trouble free services in the climate **prevailing** at the subject substation. The system shall be of highest quality requiring least maintenance (at most once a year).

Any other item/nature of work which is specifically not appearing in the technical specification but is directly or indirectly associated with the efficient working/completion of the system is considered to be included in the present scope of supply of the contractor."

Heating & Ventilation system provided for GIS hall shall be suitably engineered to meet the functional climatic requirement of GIS.

ANNEXURE -IV

Technical specifications for "Transformer Oil Filtration Plant"

1.1 **Performance Requirement**

1.1.1 The Ultra High Vacuum type oil treatment plant of capacity of 10KLPH / 6KLPH (Kilo litre per hour) shall be mobile and shall be suitable for treatment of new oil and reconditioning of used oil in EHV class transformer, shunt reactor and other oil filled equipment in order to achieve properties of treated oil within specified limits at the rated capacity.

1.1.2 The plant shall be capable of treatment of new oil (as per IEC 296/IS:335) and reconditioning of used oil (as per IS:1865/IEC:422 for oil in-service) at rated capacity on single pass basis as follows:

(i) Removal of moisture from 100 ppm to 3 ppm (max.)
(ii) Removal of dissolved gas content from 10% by Vol. to 0.1% by vol.
(iii) Improvement of dielectric strength break down voltage from 20 KV to 70 KV (min).
(iv) Vacuum level of degassing chamber at rated flow and at final stage :- not more than 0.15 torr (0.2 m bar) max.
(Degassing chambers of different degree of vacuum should have sufficient surface areas to achieve the final parameters. A detailed justification as to how end parameters shall be met with detailed calculations and test reports in support of the same shall be submitted along with the offer.
(v) Filtering capacity: Max. particle size less than 0.5 micron in the filtered oil.
(vi) Processing temperature :- 40º C to 60ºC (Maximum allowed temp. in oil to prevent oxidation (when oil is at atmospheric pressure) :- 60ºC)

1.1.3 Bidder is to furnish along with the bid detailed calculation to establish the sizing and capability of the vacuum pumping system with respect to moisture and gas removal as above.

1.1.4 Bidder is to submit along with the bid test reports, test methodology to prove the capability of the plant offered.

1.1.5 The plant shall also have two independent vacuum pumping systems one for evacuating the transformer for vacuum filling of oil in transformer and the other for degassing chamber. The blank off vacuum of each pumping system shall be 10^{-3} torr or less.

1.1.6 The plant shall be provided with control and indication panel with full automation.

1.1.7 The plant shall be fitted with hoses for connection of oil lines and vacuum lines to transformers and reactors. Hoses shall have leakage rate of 10^{2} torr-ltr/sec. (max.)

1.1.8 The Ultra High Vacuum Type oil purification plant shall be complete with oil pumps for drawing oil for transformers and reactors, oil heater (max. heating rate = 2.0W/cm^2) of adequate rating, suitable filter or centrifuge as required to ensure oil quality, degasifier

complete with vacuum pumps, oil extraction pump etc. of adequate capacity such that throughout from the purification plant is of guaranteed purity.

1.1.9 The plant shall also be suitable for cleaning and degassing of the oil stored in the storage tanks.

1.1.10 All equipment's required as above shall be mounted on a tow-able road worthy trailer unit with 4 nos. pneumatic tyres. The equipment shall be suitable for outdoor use.

1.2 **Design & Construction**

The features and construction details of each 10KLPH / 6KLPH mobile outdoor type oil filtration & purification plant shall be in accordance with the requirements stated hereunder.

1.2.1 **Oil Pump (Inlet Side)**

1.2.1.1 Two (2) nos. electrically driven oil pumps with one (1) working and one (1) standby shall be provided. Selection switch is to be provided for selection of either of pumps. The pumps shall be single stage positive displacement gear type. Suitable mechanical seals shall be provided to ensure vacuum tightness. A built-in pressure relief valve to re-circulate the oil to suction side in case of accidental pressure rise shall be provided. Suction lift of the pump shall be at least 5 meters of transformer oil at atmospheric pressure & temperature. A separate by pass valve is provided across the gear pump so that the flow rate through the filter can be adjusted as required. The pump should be controlled by frequency drive. This should help to set the flow rate of filter plant from 4000 – 6000 LPH for 6KLPH machine and from 8000-10000 LPH for 10KLPH machine.

1.2.1.2 The pumps shall be provided with an interlock with delay such that if there is no oil flow of 30 sec. through the heater, the pump shall trip automatically and also if the pump is not operating the heater will not be energized.

1.2.2 **Magnetic Strainer**

The plant shall be provided with suitable magnetic strainer with wire mesh to filter all particles of sizes above 0.5 mm and all magnetic particles. The strainer shall be installed at the suction of the oil pump described above.

1.2.3 **Heater**

a) An oil heater for heating up inlet oil shall be provided at the discharge side of the oil pump.
b) The oil heater vessel shall be of mild steel welded construction & insulated with glass/mineral wool.
c) The vessel shall be constructed for ultra high vacuum & pressure application.
d) Electric heater shall be provided inside the heater vessel to heat up oil from lowest ambient temperature to temperature required for filtration/degasification operation in single pass. The heater shall also be rated for heating the inlet oil from lowest ambient temperature at 70°C in single pass during filling up of transformers. Two separate temperature settings with thermostatic controllers shall be provided for this purpose.
e) The heating shall be indirect type and specific heat load shall not exceed 2.0 watt/cm^2 in order to avoid local overheating.

f) The total heating capacity shall be divided into three independent thermostatically controlled heating stages evenly balancing the three phases of power supply. The control switches and knobs shall be housed on a control panel.

g) An additional preset temper proof safety thermostat set at the highest temperature shall be provided on the heater to put off the heater and give audio and visual alarm to take care of accidental overheating.

h) The heater body shall be so designed as to allow replacement of heating elements without draining of oil. Suitable pressure relief valve, vent and drain valves & two (2) dial type temperature gauges at inlet & outlet of heater shall be provided.

1.2.4 **Filter**

a) Cartridge filter as may be required to ensure maximum particle size to less than 0.5 micron in the filtered oil shall be provided.

b) The filter body shall be fabricated of mild steel & designed for leak tightness at full vacuum & high pressures. The oil will flow from dirty oil chamber to clean oil chamber through filter elements.

c) Cartridge type element used shall be suitable for transformer oil in service and submicronic filtration, the media shall be non hygroscopic and of high dirt holding capacity.

d) The filter elements shall be easily removable for replacement when required. Compound gauge to indicate pressure across the filter, vent and drain with valves & other necessary accessories shall be mounted on the filter for each operation.

1.2.5 **External Solenoid Operated valves**

Two valves should be provided at the inlet and outlet of the plant. The moment inlet and outlet pumps are switched on these valves open thus making way for oil to pass. In case of power failure, oil from the transformer will not enter the plant and vacuum system.

1.2.6 **Degassing Chamber**

a) The degassing chamber shall be of welded construction and shall be suitable for operation under full vacuum. The fill of rasching rings & trays for distribution shall be designed for efficient distribution of oil over large areas. Incoming transformer oil should be spread over these rings in the form of film and over a longer surface area, thus achieving better degassing and dehumidification.

b) The degassing chamber shall be multistage (minimum 02 stages) type suitable for ensuring the desired oil properties. Arrangement for condensing back lighter fraction (aromatics) of the insulating oil into the system shall be provided.

c) The degassing channels shall have adequate height to allow long enough free fall for complete degassing. Design shall be such as to minimize foam formation.

d) The degassing chambers shall be provided with suitable level monitor for oil or foam level in the chamber and shall trip the inlet gear pump when the level rises above the designed maximum level in order to prevent foam/oil to enter the vacuum pumping system. The oil inlet pump starts again automatically once the oil level in the degassing chamber falls below the preset oil level.
e) Necessary illuminated sight glass shall be provided through which oil flow through the degasser can be viewed clearly.
f) The degasser shall be provided with vacuum gauges, vacuum breaking valves, main and auxiliary vacuum connections and other necessary accessories.

1.2.7 **Vacuum Pumping System**

a) The pump shall be provided with a suitable vacuum pumping system for creating adequate high vacuum in the degassing chambers. The pumping system shall consist of suitable combination of Roots Blowers and Rotary vane vacuum pumps with inter-stage condensing units.
b) The roots blowers shall be of reputed make. Suitable built in labyrinth packing system, slinger rings, oil return chambers shall be provided between bearings and working chambers to prevent penetration of lubricating oil to the working chamber. The pumps motor shall be dynamically balanced. The pumps shall be suitable for starting evacuation from atmospheric pressure and shall be applied with necessary overflow valve.
c) The rotary vane vacuum pumps shall be installed after the roots blower. An automatic by pass valve across the roots blower shall permit operation of rotary vane pump alone to operate when so required. The rotary vane pumps are provided with gas ballast valve to prevent contamination of vacuum pump oil with moisture. The vacuum pump shall also be provided with suitable non-return valve device such that in the event of power failure the vacuum in the degassing chamber shall be maintained and the vacuum pump oil is not sucked back into the degassing chamber. A high vacuum safety valve (piston type) to prevent back streaming of oil and air intrusion shall be provided. The pump motors shall be having return stop device.
d) Necessary water cooled condensing units to condense the light faction (aromatics) and return the same to the transformer oil shall be provided to reduce the loss of aromatics. Condensing units shall also be suitable for operation with broken ice for remote location operation where cooling water connection is not available.

1.2.8 **Vacuum Pumping system for TRANSFORMER Evacuation**

An independent vacuum pumping system shall be provided for evacuating the transformer for oil filling. The vacuum level required for transformer evacuation for oil transfer is about 0.76 torr (1 m bar) for transformer oil heated to 70-80°C. The pumping system shall be identical to that of the degassing vacuum system. The capacity shall be adequate for evacuation of:

a) 60KL Tank in one hour from 1 atm to 1mbar. (For 6KLPH Machine)
b) 90KL Tank in one hour from 1 atm to 1mbar. (For 10KLPH machine)

The vacuum systems for degasser and transformer evacuation shall be inter connected in such a way that it shall be possible to use either or both the systems for any of the purpose. A reinforced hose of 10 mts. length should be provided. The hoses must be for vacuum leakage rate of 10^2 torr-litre/sec.

1.2.9 Oil Extraction Pump

Suitable pumping system shall be provided for extracting oil from degasser under vacuum and supplying to transformer/reactor etc., at discharge pressure of 1.5 kg/cm^2 at the outlet hose nozzle of the plant, the pump shall be either glandless centrifugal type with canned motors or a combination of gear pump and centrifugal pump with mechanical seals suitable for extracting oil from high vacuum degassing chamber. The oil extraction pump shall be located at a suitable level below the degasser chamber so as to ensure adequate suction head for the pump. The pump shall be supplied with double check valve assembly and solenoid operated non return valve. In order to stop reverse flow of oil in case of power failure, the pumping system shall preferably be self priming type alternatively priming device with safety interlock to protect pump against dry running shall be provided. Sampling valves shall be provided at the discharge of extraction pump for testing of oil properties. A recirculation line with valves shall be provided to re-circulate a part of the purified oil to the inlet point if necessary during operation. The pump should be controlled by frequency drive .This should help to set the flow rate of filter pant from 4000 – 6000 LPH for 6KLPH machine and from 8000-10000 LPH for 10KLPH machine

1.2.10 **Hoses For Transformer Oil, Vacuum, Air And Water**

a) Separate reinforced rubber hoses shall be provided for each operation for oil suction, oil discharge, transformer vacuum connection and cooling water supply and return. The hoses shall be at least 15 meter long each and shall be complete with hose quick connect couplers for connection to installations under operation.
b) Hose pipes for oil service shall be suitable for transformer oil application up to temperature of 100° C, full vacuum and pressure up to 2.5 kg/cm^2. All oil hoses shall be built up around an earthed core or have built in earthed conductor to avoid static electricity accumulation. Inlet and outlet nozzles of purification plant and corresponding hoses shall be of 50 NB/40 NB size respectively in order to avoid error in connecting.
c) Vacuum hoses shall be of braided nitrile rubber suitable for full vacuum without collapsing and kinking. The vacuum hoses shall be transparent construction such that accidental oil flow can be easily detected.

1.2.11 Oil sampling valve: Suitable valve shall be provided for taking sample during filtration.

1.2.12 **Material of construction and painting**

a) Oil heater, filter vessel, degasser shall be of mild steel construction. The internal and external surfaces including oil heater, filter vessel, degasifier and structural steel work to be painted shall be shot or sand blasted to remove all rust and scale of foreign adhering matter or grease. All steel surface in contact with insulating oil shall be painted with two coats of heat resistant oil insoluble, insulating varnish.

b) All internal paints steel surfaces shall be given a primary coat of zinc chromate, second coat of oil and weather resistant varnish of a color distinct from primary and final two coats of glossy oil and weather resisting paint.

c) All paints shall be carefully selected to withstand heat and extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

d) Bolts & Nuts: All bolts and nuts exposed to weather shall be hot dip galvanized/cadmium plated and passivated /zinc plated and passivated.

e) Material of construction for vacuum pumps air compressor, air drying plant, air receiver shall be steel of suitable grade.

f) All piping and equipment carrying transformer oil shall be insulated with glass wool/mineral wool insulation.

1.3 **Instrumentation and Control**

1.3.1 Following minimum instruments shall be provided on the oil purification plant:

a) Compound gauge at oil pump discharge

b) Compound gauge at filter inlet.

c) Compound Gauge at filter outlet

d) Pressure Gauge at discharge pump outlet

e) Pressure Gauge at degasifier

f) Vacuum Gauge at transformer evacuation line

g) Vacuum Gauge in between roots, vacuum pump and rotary vane vacuum pump.

h) Panel mounted vacuum indicators at degasser

i) Panel mounted vacuum indicators at transformer evacuating line.

j) Separate fine vacuum gauge for measurement of vacuum for transformer evacuation system and oil line degassing chamber evacuation system should be provided. This vacuum gauge should be electronic type having range from 0.01 torr to 20 torr and should be of any of these reputed manufacturers' (Wika/ Hasting/ Edwards) make.

k) Oil Filtration Machine should be fitted with on-line moisture in oil-PPM indicator.

l) Sight glass at degassifier

m) Temperature indicator cum controller at heater inlet

n) Temperature indicator cum controller at heater outlet

o) Voltmeter

p) Oil flow meter (Positive displacement type)

q) Ammeter

1.3.2 **Control Panel :**

A centralized electrical panel with auxiliary step down transformer, contractors, back up protection fuses, indicating lamps etc. to be provided with following minimum audio and visual alarms:

a) High temperature at heater outlet

b) High differential pressure across filters
c) Oil pump trip
d) Vacuum pump trip
e) Loss of vacuum in degassing chamber
f) Loss of vacuum in transformer evacuation line
g) No oil flow through heater
h) High oil level in degasser.

All controls and annunciation equipment should be suitable for 240 V AC.

1.3.3 Suitable interlock as described against each equipment shall be provided for safe and trouble free operation.

1.3.4 All instruments, control hardware and alarms shall be mounted on a suitable control panel. A mimic diagram with indication lamps showing on-off status of various equipment's shall be provided on the control panel.

1.3.5 The plant shall be fully equipped with adequate instrumentation having provision of manual operation, if required. All necessary control and indicating panel shall be provided.

1.3.6 It shall be possible to use the oil transfer pump for the purpose of loading oil to transformers or reactors from tankers and vice versa by by-passing to purification plant, if required.

1.3.7 There shall be independent vacuum pump for creating and holding the transformer/ reactor winding under vacuum for vacuum drying and filling of winding when required. The vacuum pump shall have capacity to develop and maintain adequate vacuum in the oil space of the 60KL tank within 1 hour time.

1.4 **Electrical System:**

1.4.1 The plant shall receive 415V, 3 phase, 50 Hz, 4 wire power supply through flexible cable in the distribution panel located on the plant. The incomer of the distribution panel shall be switch fuse unit.

1.4.2 One length of 50 meters of core 1100V grade flexible cable with crimped lugs at one end shall be provided for connection of the unit to the mains. The length of the cable will be covered in a suitable cable drum.

1.4.3 Provision for earthing the plant at the operating locations with earthing terminals for safety shall be provided.

1.4.4 The plant shall be suitably illuminated and ventilated for comfort of operator.

1.5 **Capacity Demonstration**: The supplier has to submit the detailed calculations in support of meeting the desired vacuuming capacity in prescribed time along with their technical offer. The capacity calculations submitted by the supplier shall be evaluated as per below mentioned method:

Pumping Down Time (PDT) = V/S ln (P1/P2)

PDT = 1.2 x (PDT1 + PDT2) ; Considering 1.2 as service factor

PDT1: V= Volume of Tank to be evacuated (90KL or 60KL),

S= Capacity of Vacuum pump in LPM, P1= 760mm of Hg, P2=50 mm of Hg

PDT2: V= Volume of Tank to be evacuated (90KL or 60KL),

S= Capacity of Roots pump in LPM, P1= 50 mm of Hg, P2=0.76 mm of Hg

If the supplier offers the capacity of vacuum pump and roots pump different than the capacity derived from above mentioned method, it has to demonstrate the machine at his Works for required capacity by achieving desired vacuum within prescribed time and this will be the part of technical evaluation i.e. pre-award demonstration of vacuuming capacity has to be arranged by supplier within 45 days of intimation by PDD, J&K without any financial implication to PDD.

The supplier, who offers the vacuuming capacity in line with the above method, shall have to demonstrate the machine (Post-Award) at his Works for required capacity by achieving desired vacuum within prescribed time.

The tank required for the demonstration at his Works is to be arranged by the supplier. The supplier who has already successfully demonstrated the desired vacuuming capacity in the region needs not to repeat again.

1.6 **Gaurantee:** Min 01 year from the date of successful & complete commissioning at PDD, J&K sub-station. All the materials, including accessories, cables, components etc. are to be covered under warranty/guaranty period. If any component of the plant needs to be shifted to supplier's works for repairs within warranty/guaranty period, suppliers will have to bear the cost of spares, transportation of component/plant for repair at works.

1.7 Commissioning, handing over the Instrument: Successful bidder will have to commission the plant to the satisfaction of PDD, J&K. The equipment failed during the demo shall be rejected and no repairs are allowed.

1.8 **Training:** Supplier shall have to ensure that the plant is made user friendly. Apart from the detailed demonstration at site, the supplier shall also have to arrange necessary training to PDD, J&K engineers.

ANNEXURE –V

SPECIFICATION FOR DIGITIAL PROTECTION COUPLER

1.0 Digital protection coupler for protection signalling through optical fibre cable system.

1.1 The Digital protection signalling equipment is required to transfer the trip commands from one end of the line to the other end in the shortest possible time with adequate security and dependability. It shall also monitor the healthiness of the link from one end to the other and give alarms in case of any abnormality. The protection signalling equipment shall have a proven operating record in similar application over EHV systems and shall operate on 48V DC (+15%/-20%). It shall provide minimum four commands. These commands shall be suitable for Direct tripping, Intertripping and Blocking protection schemes of EHV lines.

The protection signalling equipment shall communicate to the remote end interfacing with SDH terminal equipment at its 2Mbps port. It shall provide suitable interfaces for protective relays, which operate at 220V DC. Power supply points shall be immune to electromagnetic interface.

1.2 Principle of operation

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

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

1.3 Loop testing

An automatic loop testing routine shall check the teleprotection channel.
It shall also be possible to initiate a loop test manually at any station by pressing a button on the front of the equipment. Internal test routine shall continuously monitor the availability of the protection signaling equipment. Proper tripping signal shall always take the priority over the test procedure. The high speed digital protection signalling equipment shall be designed and provided with following features.

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

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

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

High security and dependability shall be ensured by the manufacturer. Probability of false tripping and failure to trip shall be minimum. Statistical curves/figures indicating above mentioned measures shall be submitted along with the bid.

The DPC can be either housed in offered Control & Protection Panel / PLCC Panel or in separate panel.

Reports of the following tests as per clause 9.2 of Section-GTR shall be submitted for approval for protection signalling equipment and relays associated with the protection signalling equipment and interface unit with protective relay units, if any.

i) **General equipment interface tests**:

a) Insulated voltage withstand tests
b) Damped oscillatory waves disturbance test
c) Fast transient bursts disturbance test
d) Electrostatic discharge disturbance test
e) Radiated electromagnetic field test
f) RF disturbance emission test

ii) **Specific power supply tests**

a) Power supply variations
b) Interruptions
c) LF disturbance emission
d) Reverse polarity

ii) Tele-protection system performance tests

a) Security
b) Dependability
c) Jitter
d) Recovery time
e) Transmission time

f) Alarm functions
g) Temperature and Humidity tests (As per IEC 68-2)

- Dry heat test (50°C for 8 hours)
- Low temperature test (-5°C for 8 hours)
- Damp heat test (40°C/95%RH for 8 hours)

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

iv) **Relays**

a) Impulse voltage withstand test as per clause 6.1 of IS:8686 (for a test voltage appropriate to clause III as per clause 3.2 of IS:8686)
b) High frequency disturbance test as per clause 5.2 of IS:8686 (for a test voltage appropriate to clause III as per clause 3.2 of IS:8686)

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

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

1.4 **Major technical Particulars**

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

i) Power supply 48V DC +15% /-20%
ii) Number of commands 4 (four)
iii) Operating time <7 ms
iv) Back to back operate time without propagation delay ≤ 8 ms
v) Interface to Protection relays

Input:		Contact Rating:
Rated voltage	:	250 volts DC
Maximum current rating:		5 amps
Output	:	Contact Rating:
Rated voltage	:	250 volts DC
Rated current	:	0.1 A DC
Other parameters	:	As per IEC-255-0-20

vi) Alarm contact

	Rated voltage	:	250 volts DC
	Rated current	:	0.1 A DC
	Other parameters	:	As per IEC-255-0-20

vii) Digital communication interface: G 703(E1)

ANNEXURE - VI

1.0 Technical Particulars / Parameters of Transformers ((220/√3) / (33/√3) kV 1-Phase Power Transformer)

Cl. No.	Description	Unit	TECHNICAL PARAMETERS
1.1	Rated Capacity		
	HV	MVA	53.33
	LV	MVA	53.33
1.2	Voltage ratio	kV	(220/√3) / (33/√3)
1.3	Single / Three Phase Design		Single
1.4	Applicable Standard		IEC 60076
1.5	Frequency	Hz	50
1.6	Cooling & Percentage Rating at different cooling		ONAN/ONAF: 80%/100%
1.7	HV-LV Impedance at 75 Deg C		
i)	Max. Voltage tap	%	13.2
ii)	Principal tap	%	12.5
iii)	Min. Voltage tap	%	11.8
iv)	Tolerance on Impedance	%	As per IEC
1.8	Service		OUTDOOR
1.9	Duty		CONTINUOUS
1.10	Overload Capacity		IEC 60076-7
1.11	Temperature rise over 50 deg C Ambient Temp		
i)	Top oil measured by thermometer	O C	50
ii)	Average winding measured by resistance method	O C	55
1.12	Windings		
i)	System Fault level		
	HV	kA	40
	LV	kA	25
ii)	Lightning Impulse withstand Voltage		
	HV	kVp	950
	LV	kVp	170
	HV Neutral	kVp	95
	LV Neutral	kVp	170
iii)	Switching Impulse withstand Voltage		
	HV	kVp	750
iv)	One Minute Power Frequency withstand Voltage		

	HV	kVrms	395
	LV	kVrms	70
	HV Neutral	kVrms	38
	LV Neutral	kVrms	70
v)	Neutral Grounding		Solidly grounded
vi)	Insulation		
	HV		GRADED
	LV		UNIFORM
vii)	Tan delta of winding	%	<0.5%
1.13	Vector Group (3 –ph) (unless specified differently elsewhere)		YNyn0
1.14	Tap Changer		OLTC
i)	Tap Range & No. of steps		–15% to +5% of HV variation in the step of 1.25%, 16 Steps
ii)	Location of Tap changer		On the neutral end of 220kV side
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I
iv)	Tap control		Full capacity - on load tap changer suitable for group / independent, remote /local electrical and local manual operation and bi-directional power flow
1.15	Bushings		
i)	Rated voltage		
	HV	kV	245
	LV	kV	36
	Neutral	kV	36
ii)	Rated current (Min.)		
	HV	A	1250
	LV	A	2000
	HV / LV Neutral	A	2000
iii)	Lightning Impulse withstand Voltage		
	HV	kVp	1050
	LV	kVp	170
	HV / LV Neutral	kVp	170
iv)	Switching Impulse withstand Voltage		
	HV	kVp	850
v)	One Minute Power Frequency withstand		

	Voltage		
	HV	kVrms	505
	LV	kVrms	77
	HV / LV Neutral	kVrms	77
vi)	Minimum total creepage distances		
	HV	mm	6125
	LV	mm	900
	HV / LV Neutral	mm	900
vii)	Tan delta of bushing		
	HV	%	<0.4%
viii)	Max Partial discharge level at U_m		
	HV	pC	10
1.16	Max Partial discharge level at 1.5Um/$\sqrt{3}$	pC	100
1.17	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	80

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be "**Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

5. **LV terminals in Cable termination box shall be suitable for cable size and no. of cables run for 1600 Amps current rating**

2.0 Technical Particulars / Parameters of Transformers ((220/√3) / (33/√3) - (33/√3) kV 1-Phase Power Transformer)

Cl. No.	Description	Unit	TECHNICAL PARAMETERS
2.1	Rated Capacity		
	HV	MVA	53.33
	LV1	MVA	26.67
	LV2	MVA	26.67
2.2	Voltage ratio	kV	(220/√3) / (33/√3) - (33/√3)
2.3	Single / Three Phase Design		Single
2.4	Applicable Standard		IEC 60076
2.5	Frequency	Hz	50
2.6	Cooling & Percentage Rating at different		ONAN/ONAF: 80%/100%
	cooling		
2.7	HV to LV1, HV to LV2 Impedances at		@53.33MVA Base
	75 Deg C		
i)	Principal tap	%	28.5
2.8	LV1 to LV2 Impedances at 75 Deg C	%	51% (min)
	@53.33MVA Base		
2.9	Tolerance on Impedance	%	As per IEC
2.10	Service		OUTDOOR
2.11	Duty		CONTINUOUS
2.12	Overload Capacity		IEC 60076-7
2.13	Temperature rise over 50 deg C Ambient		
	Temp		
i)	Top oil measured by thermometer	O_C	50
ii)	Average winding measured by resistance	O_C	55
	method		
2.14	Windings		
viii)	System Fault level		
	HV	kA	40
	LV	kA	25
ix)	Lightning Impulse withstand Voltage		
	HV	kVp	950
	LV1 & LV2	kVp	170
	HV Neutral	kVp	95
	LV1 & LV2 Neutral	kVp	170
x)	Switching Impulse withstand Voltage		
	HV	kVp	750

xi)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	395
	LV1 & LV2	kVrms	70
	HV Neutral	kVrms	38
	LV1 & LV2 Neutral	kVrms	70
xii)	Neutral Grounding		Solidly grounded
xiii)	Insulation		
	HV		GRADED
	LV1 & LV2		UNIFORM
xiv)	Tan delta of winding	%	<0.5%
2.15	Vector Group (3 –ph) (unless specified differently elsewhere)		YNynyn0
2.16	Tap Changer		OLTC
i)	Tap Range & No. of steps		–10% to +10% of HV variation in the step of 1.25%, 16 Steps
ii)	Location of Tap changer		On the neutral end of 220kV side
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I
iv)	Tap control		Full capacity - on load tap changer suitable for group / independent, remote /local electrical and local manual operation and bi-directional power flow
2.17	Bushings		
i)	Rated voltage		
	HV	kV	245
	LV1 & LV2	kV	36
	HV, LV1 & LV2 Neutral	kV	36
ii)	Rated current (Min.)		
	HV	A	1250
	LV1 & LV2	A	2000
	HV, LV1 & LV2 Neutral	A	2000
iii)	Lightning Impulse withstand Voltage		
	HV	kVp	1050
	LV1 & LV2	kVp	170
	HV, LV1 & LV2 Neutral	kVp	170
iv)	Switching Impulse withstand Voltage		

	HV	kVp	850
v)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	505
	LV1 & LV2	kVrms	77
	HV, LV1 & LV2 Neutral	kVrms	77
vi)	Minimum total creepage distances		
	HV	mm	6125
	LV1 & LV2	mm	900
	HV, LV1 & LV2 Neutral	mm	900
vii)	Tan delta of bushing		
	HV	%	<0.4%
viii)	Max Partial discharge level at U_m		
	HV	pC	10
2.18	Max Partial discharge level at $1.5Um/\sqrt{3}$	pC	100
2.19	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	80

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be "**Copper Loss (Load Loss) > Iron Loss** (**No Load Loss) > Cooler Loss (Auxiliary Loss)".**

5. **LV terminals in Cable termination box shall be suitable for cable size and no. of cables run for 1600 Amps current rating**

ANNEXURE-VII

3.0 Technical Particulars / Parameters of Transformers ($220/\sqrt{3}$) / ($66/\sqrt{3}$) / 11 kV 1-Phase Power Transformer)

Cl. No.	Description	Unit	TECHNICAL PARAMETERS
3.1	Rated Capacity		
	HV	MVA	53.33
	IV	MVA	53.33
	LV (Tertiary: Active Loading)	MVA	1
3.2	Voltage ratio (HV/IV/LV) (Line to line)	kV	($220/\sqrt{3}$) / ($66/\sqrt{3}$) / 11
3.3	Single / Three Phase Design		SINGLE
3.4	Applicable Standard		IEC 60076
3.5	Frequency	Hz	50
3.6	Cooling		ONAN/ONAF
3.7	Rating at different cooling	%	80 / 100
3.8	HV – IV Impedance at 75 Deg C		@ 53.33 MVA base
i)	Max. Voltage tap	%	13.2
ii)	Principal tap	%	12.5
iii)	Min. Voltage tap	%	11.8
3.9	HV – LV Impedance at 75 Deg C		@ 53.33 MVA base
i)	Max. Voltage tap	%	22 (Min)
ii)	Principal tap	%	24 (Min)
iii)	Min. Voltage tap	%	28 (Min)
3.10	IV – LV Impedance at 75 Deg C @ 53.33 MVA base	%	30 (Min)
3.11	Service		OUTDOOR
3.12	Duty		CONTINUOUS
3.13	Overload Capacity		IEC 60076-7
3.14	Temperature rise over 50deg C Ambient Temp		
i)	Top oil measured by thermometer	^{0}C	50
ii)	Average winding measured by resistance method	^{0}C	55
3.15	Windings		
i)	System Fault level		
	HV	kA	40
	IV	kA	31.5
	LV	kA	25
ii)	Lightning Impulse withstand Voltage		
	HV	kV_p	950
	IV	kV_p	325

	LV	kV_p	75
	HV Neutral	kV_p	95
	IV Neutral	kV_p	325
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	750
iv)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	395
	IV	kVrms	140
	LV	kVrms	28
	HV Neutral	kVrms	38
	IV Neutral	kVrms	140
v)	Neutral Grounding		Solidly grounded
vi)	Insulation		
	HV		GRADED
	IV		UNIFORM
	LV		UNIFORM
vii)	Tertiary Connection (3Ph Bank)		Ungrounded Delta
viii)	Tan delta of winding	%	<0.5%
3.16	Vector Group (3 –ph) (unless specified differently elsewhere)		YNyn0d11
3.17	Tap Changer		OLTC
i)	Tap Range & No. of steps		–10 to +10% of HV variation in the step of 1.25%, 16 steps
ii)	Location of Tap changer		Neutral end of 220kV winding
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I
iv)	Tap control		Full capacity - on load tap changer suitable for group / independent, remote /local electrical and local manual operation and bi-directional power flow
3.18	Bushings		
i)	Rated voltage		
	HV	kV	245

	IV	kV	72.5
	LV	kV	12
	HV Neutral	kV	36
	IV Neutral	kV	72.5
ii)	Rated current (Min.)		
	HV	A	1250
	IV	A	2000
	LV	A	1000
	HV Neutral	A	2000
	IV Neutral	A	2000
iii)	Lightning Impulse withstand Voltage		
	HV	kVp	1050
	IV	kVp	325
	LV	kVp	75
	HV Neutral	kVp	177
	IV Neutral	kVp	325
iv)	Switching Impulse withstand Voltage		
	HV	kVp	850
v)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	505
	IV	kVrms	155
	LV	kVrms	28
	HV Neutral	kVrms	77
	IV Neutral		155
vi)	Minimum total creepage distances		
	HV	mm	6125
	IV	mm	1813
	LV	mm	300
	HV Neutral	mm	900
	IV Neutral	mm	1813
vii)	Tan delta of bushing		
	HV	%	<0.4
	IV	%	<0.4
viii)	Max Partial discharge level at U_m HV	pC	10
	IV & IV Neutral	pC	10
3.19	Max Partial discharge level at 1.5Um/√3	pC	100
3.20	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	80

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.
2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.
3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.
4. The criteria for Transformer losses shall be "**Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

4.0 Technical Particulars / Parameters of Transformers (132/33 kV, 3-Phase Power Transformer)

Cl. No.	Description	Unit	TECHNICAL PARAMETERS
4.1	Rated Capacity		
	HV	MVA	50
	LV	MVA	50
4.2	Voltage ratio (HV/LV) Line to line	kV	132/33
4.3	Single / Three Phase Design		3 (THREE)
4.4	Applicable Standard		IEC 60076
4.5	Frequency	Hz	50
4.6	Cooling		ONAN/ONAF
4.7	Rating at different cooling	%	80 / 100
4.8	HV-LV Impedance at 75 Deg C		
i)	Max. Voltage tap	%	13.2
ii)	Principal tap	%	12.5
iii)	Min. Voltage tap	%	11.8
iv)	Tolerance on Impedance	%	As per IEC
4.9	Service		OUTDOOR
4.10	Duty		CONTINUOUS
4.11	Overload Capacity		IEC 60076-7
4.12	Temperature rise over 50deg C Ambient Temp		

i)	Top oil measured by thermometer	^{0}C	50
ii)	Average winding measured by	^{0}C	55
	resistance method		
4.13	Windings		
i)	System Fault level		
	HV	kA	31.5
	LV	kA	25
	Neutral	kA	-
ii)	Lightning Impulse withstand Voltage		
	HV	kV_p	650
	LV	kV_p	170
	Neutral	kV_p	95
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	540
iv)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	275
	LV	kVrms	70
	Neutral	kVrms	38
v)	Neutral Grounding		Solidly grounded
vi)	Insulation		
	HV		GRADED
	LV		UNIFORM
vii)	Tan delta of winding	%	<0.5%
4.14	Vector Group (3 –ph) (unless specified differently elsewhere)		YNynO

4.15	Tap Changer		OLTC
i)	Tap Range & No. of steps		–10% to +10% of HV variation in the step of 1.25%, 16 stpes
ii)	Location of Tap changer		On Neutral side of 132 kV winding
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I
iv)	Tap control		Full capacity on load tap changer suitable for group/independent, remote /local electrical and local manual operation and bi- directional power flow.
4.16	Bushings		
i)	Rated voltage		
	HV	kV	145
	LV	kV	36
	Neutral	kV	36
ii)	Rated current (Min.)		
	HV	A	1250
	LV	A	1250
	Neutral	A	1250
iii)	Lightning Impulse withstand Voltage		
	HV	kVp	650
	LV	kVp	170
	Neutral	kVp	170
iv)	One Minute Power Frequency withstand Voltage		

	HV	kVrms	305
	LV	kVrms	77
	Neutral	kVrms	77
v)	Minimum total creepage distances		
	HV	mm	3625
	LV	mm	900
	Neutral	mm	900
vi)	Tan delta of bushing		
	HV	%	<0.4
vii)	Max Partial discharge level at U_m		
	HV	pC	10
4.17	Max Partial discharge level at $1.5Um/\sqrt{3}$	pC	100
4.18	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	75

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be "**Copper Loss (Load Loss) > Iron Loss**

   (No Load Loss) > Cooler Loss (Auxiliary Loss)".

ANNEXURE –VII

TECHNICAL REQUIREMENTS FOR MAINTENANCE & TESTING EQUIPMENTS

1. Megohm meter– 5KV Digital Battery operated.

Sr.NO	Description	Specifications
1.	Type	5 KV Digital Battery Operated.
2.	Insulation test voltage	5 KV in steps of 0.5,1,2.5,5 KV DC
3.	Short Circuit Current	1.5 mA minimum
4.	Accuracy(test voltage)	±3% of nominal voltages or better
5.	Range of Measurement	0 to 200 G Ohm minimum
6.	Additional features	Shall be able to compute and display Polarisation Index and Dielectric Absorption Ratio as per Indian Standards.
7.	Accuracy(resistance)	±5% of reading±3 digits or better
8.	Operation	Motor Driven by mains/batteries
9.	Display & scale length	Digital and Analog in bargraph, with auto switch off feature
10.	Power Supply	230±10% ,50 Hz
11.	Batteries	12 V/1.2 AH Rechargeable
12.	Battery Charger	Automatic Inbuilt for AC voltage 110 to 240 V
13.	Response time	Less than 3 sec
14.	Capacitive Discharge	Automatic after insulation test is over,<
15.	Guard termination	To be provided
16.	Accessories	Test leads, Power supply leads, charger leads, Carrying case, Manual etc. required for testing
17.	Demonstration	Acceptance of kit subject to successful demonstration in charged switchyard environment to the satisfaction of PDD.
18.	Calibration Certificate	Calibration Certificate from NABL accredited lab or internationally reputed lab, shall be submitted. Date of calibration shall not be older than one month from the date of supply of Kit.
19.	Environmental and Statutory requirement	Shall conform EMI/EMC and environmental protection requirement as per relevant International standard. Copy indicating conformation shall be enclosed. • Temp- -5 to 50 deg C. • Humidity-upto 95% non-condensing
20.	Functional requirement.	The instrument shall work in charged

		switchyard environment conditions.
21.	Additional safety Requirement	The kit and accessories shall be robust and rugged enough, so that it can be transported safely at different locations .The transportation case and packing of the kit shall be such that the transportation from one station to other will not affect the performance and accuracy of measurement of kit.

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2. Digital Multimeter

i) Heavy Duty, shock proof, splash proof, dust proof.

ii) Measurement Range:

Description		Range	Accuracy
a)	DC Voltage	0 – 1000 Volts	±0.25%
b)	AC Voltage	0 – 750 Volts	±0.75%
c)	DC Current	0 – 10 Amp	±0.75%
d)	AC Current	0 – 10 Amp	±1.5%
e)	Resistance	0 – 30 Mohms min.	±1.0%
f)	Continuity Check	0 – 250 Ohms min	
g)	Diode Test Unit		±1%

iii)	Display	3 and ½ digit, LCD,Bar graph.
iv)	Polarity	Automatic, No indication for positive polarity, Minus (-) sign for negative polarity. With Capacitance, frequency and Temp. measurement features
v)	Over range indication –	Half digit display with other digits blank.
vi)	Low battery indication	
vii)	Power Supply –	Single Standard 9 V Battery.
viii)	Transient Protection:	2 KV (DCV / ACV and Ohm Ranges).
ix)	Environment:	Operating 0 – 55 degree Centigrade, 80% RH at 35 degree C, Storage –20 to 60 deg.C, 70% RH at 40 deg. C.
x)	Accessories:	Test leads set, temp. probe, High Voltage probe, Carrying case, spare fuses, Manual etc.

xi) The instrument shall work in charged switchyard environment conditions.

xii) Instrument shall confirm to International/Indian safety and EMC standards

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3. Portable SF6 Gas Refilling Device

Sr. No	Description	Specification
1.	Functional Requirement	Equipment shall be able to evacuate and fill the SF6 gas in breakers, cylinder etc. Mobile unit shall be mounted on a cart provided with wheels for easy movement. The cart shall have provision for carrying a SF6 gas cylinder.
2.	Assembly parts	The equipment shall basically consist of a vacuum pump, vacuum gauge, SF6 gas regulator with H.P and L.P manometers, Three way valve and hoses of sufficient length with couplings for connecting to SF6 gas cylinder and to equipment
3.	Accessories	It shall consist of pressure reducer for SF6, Indicating instruments (gauge indication in bar), Hose DN8/6 m long, Hose DN8/ 0.7 m long , Coupling tongue part DN8 and DN20, SF6 bottle connection W21.8 x1/14" ,Power Supply cable with three pin ,Opearting Instruction manual, Or equivalent accessories that is all required for carrying out specified work.
4.	Vacuum Pump	Pump 10 m3 /h (final vacuum<1mbar)
5.	Operating Voltage	230±10% ,50 Hz
6.	Packing	The Cart along with wheels shall be robust and rugged enough, so that it can be transported safely at different locations. The transportation case and packing of the kit shall be such that the transportation from one station to other will not affect the performance.

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4. Automatic Capacitance and Tan Delta Kit

The equipment shall be suitable to measure capacitance and tan delta of EHV class transformers (1/2/3 windings), bushings, CT, windings of shunt reactors, bus & line CVT's and grading capacitors of CB's at site in a charged switchyard up to 400 kV AC. The kit should have the feature of suppression of electrical and magnetic interference due to line frequency and it should also have the feature of measuring tan delta and capacitance at different frequencies than line frequency.

The kit shall be capable of measuring capacitance and tan delta of each winding of 315 MVA transformers in suitable switching mode so that capacitance of other windings does not affect the reading etc.

An optional arrangement if available for measurement of inductance, transformer turns ratio, transformer leakage reactance and loss ,winding resistance etc may be included in offer, However the tech/financial evaluation will be made for the basic kit which have facility of measurement of tan delta and capacitance with induction suppression feature as detailed above in para-1
The kit shall be able to measure the ambient temperature and relative humidity with inbuilt/optional arrangement.

The equipment shall be complete with measuring bridge, HV power supply unit of 12 KV, Standard Capacitor, PC/Video Screen etc. The effects of induced voltage on instrument during testing for getting final measurement should be compensated automatically. The kit shall be capable of measuring excitation current of transformer winding at 12 KV.
The kit should have the facility of generation of test frequency independent of power line frequency for measurement of tan delta and capacitance
The equipment shall be robust enough to sustain the jerks during the transportation in local condition.

The kit should be light weight, its packing and transportation cases/trolley shall be such that the shifting of kit from one substation to other will not affect its performance and accuracy in measurement of the kit

Sr,No	Description	Specification
1.	Output Voltage and Current	0 - 12 KV and 100 mA (Min) continues and 200mA & above intermittent @ frequency range 45 Hz to 70 Hz
2.	Tan Delta (DF)	Range - 0 to 100%min Accuracy -1% or better, of the reading Resolution - 4 digit or better
3.	Power Factor	Range - 0 to 100%min Accuracy - 1% or better of the reading Resolution - 4 digit or better
4.	Capacitance	Range - 1pf to 2µf min Accuracy - 0.5 % min + 0.1 pf of the reading. Resolution - 6 digit
5.	Power supply(Input)	230V±10% AC, 50Hz±5%
6.	Induction suppression	Fully automatic
7.	Display/Operation	VGA LCD, Front panel/key pad mounted on control Unit
8.	Data Store	Facility for data storing in the kit & down loading to PC
9.	Safety features	Short circuit protection Over voltage protection Interlock for HV output. Reliable ground connections etc.

10.	Indications	HV supply ON, Ground open, Power supply ON etc.
11.	Cables and	▯ HV/LV screened cable set – 20 meters (min) with clamps & connectors. ▯ Power supply cable ▯ Grounding cable with clamps ▯ One set of interconnecting cables. ▯ Other cables and accessories required for carrying out measurement. ▯ One set of fuses and indicating lamps and other consumables shall be supplied with kit.
12.	Software	Data analysis software in windows 98/2000/latest version with the features of ▯ Storing and downloading of files in data base for further analysis in PC. ▯ Facility of drawing graphs between voltages tan δ with temperature correction of tan δ values, frequencies etc. ▯ Comparing of different value of same parameter at different period/time
13.	Repeatability	It should offer repeatability of test results in charged switchyard.
14.	Environment	The kit shall be compatible for EMI / EMC requirement as per relevant IEC .
15	Operating conditions	Shall operate at Temperature -5 to 50 deg C, Humidity not condensing up to 95%,
16	Demonstration/ Inspection	Acceptance of the kit shall be subjected to the arrangement of successful demonstration by supplier to the satisfaction of PDD, J&K at prescribed site.
17.	Calibration	Calibration certificate from/traceable to, NABL accredited lab or internationally reputed lab, shall be submitted. Date of calibration shall not be older than one month from the date of supply of Kit.

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5. Dew Point Kit for SF6 gas

Sr.No	Item	Specification
1.	Functional Requirement	The Instrument shall be able to measure the dew point of SF6 and Nitrogen available in the electrical equipment or Cylinders.

2.	Measuring Range	-80 to 0 ˚C minimum @ +/-2% or better Accuracy
3.	Display	Digital
4.	Accessories	Compatible inlet and out let couplings, Hoses, carrying case, Instruction manual, Power supply chord, Charger, The accessories shall be suitable to the equipments in PDD, J&K
5.	Pressure during Measurement	Atmospheric to 30 Mpa max.
6.	Flow Rate during Measurement	0.5 to 5 L/min
7.	Power Supply	Internal rechargeable battery pack with charger. To be operated on 220 +/- 10% V AC, 50+/-10% Hz. Or Equivalent
8.	Operating Temperature	-20 to 50 deg C.
9.	Calibration	Calibration certificate from/traceable to, NABL accredited lab or internationally reputed lab, shall be submitted. Date of calibration shall not be older than one month from the date of supply of Kit.
10.	Demonstration.	Acceptance of kit subject to successful demonstration in charged switchyard environment to the satisfaction of PDD.
11.	Packing and	The kit and accessories shall be robust and transport cases rugged enough, so that it can be transported safely at different locations .The transportation case and packing of the kit shall be such that the transportation from one station to other will not affect the performance and accuracy of measurement of kit.

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6. Circuit Breaker Test Kit (Circuit Breaker analyzer with DCRM including transducer

Sr.no	Description	Specifications
1	Functional Requirement	This instrument shall have microprocessor-based operation with LCD display for testing of EHV Circuit Breakers in the charged switchyard environment. (420 kV AC and 500 kV DC). To measure the CB contact movement during opening, closing, auto-reclosing and make/break operation, contact speed at various stages of operation, travel of contacts, Main and auxiliary contacts (wet and dry), opening time, closing time

		and make break time, closing resistor pre-insertion time etc. Dynamic contact resistance measurement of Arcing and Main Contact with minimum 100 Amp DC current while closing/opening of CB. The kit should also be capable of indicating trip/closing coil currents (analogue values).DCR measurements shall be shall be carried out for minimum one pole (two breaks) at a time. In case, to meet the functional requirements as mentioned above if more than one units are required, the facility to co-relate/interface various parameters, shall be supplied along with the kit.
2	Channels	Contact channels :24 (4 each for main and PIR) Auxiliary contacts: 2 dry + 2 wet Current and Voltage: 3 each .
3.1	Ranges & Accuracy	Main/Auxiliary Contacts: 0 to 4000 ms minimum
	Accuracy	: ± 0.1 % or better
	Resolution	: ±0.1 ms at 10 Kc.
3.2	Contact Travel:	0 to 10 m/s speed, 350 mm minimum
	Accuracy	: ± 0.1 % or better
	Resolution	: ± 2mm or better
3.3	Dynamic Contact Resistance	: 0 to 2000 microhm
	Accuracy	: ± 2 % or better
3.4	Coil currents	: 0 to 25 Amps
	Accuracy	: ± 1 % or better
4	Sampling rate	Selectable – 100 Hz,1 Khz,10 KHz or better.
5	Power Supply	230VAC±10%, 50Hz±5% with variations in voltage and frequency respectively.
6	Software	Window based software for analysis of data shall be supplied along with the equipment.
7	Data Storage	The kit should have enough data storage capacity not less than 2 MB with battery backup.
8	Repeatability	The instrument should have proven for repeatability of test results in charged switchyard conditions. Documentary evidence for this should be furnished along with the bid.
9	Kit output	Rs 232 port to down load data to external PC .The kit should have facility to get hard copy through plain paper printer by directly connecting printer to test kit

10	Travel Adapter and	Travel adapter and Transducers (Rotary/Linear) along with various clamps/fixtures to suit any type of model of CB. The details of CB existing at PDD, J&K S/Stn will be furnished to the successful Bidder
11	Accessories	All standard accessories including test leads of 15 meters with suitable clamps, connectors, cables, power supply cords, printer, travel transducers, fuses, carrying case, manual etc. all those required for carrying out testing of CB and DCRM
12	Environment	Temp- 0 to 50 Deg C. Humidity – 95 % non Condensing The test kit shall be compatible for EMI / EMC environment as per relevant IEC
13	Demonstration	The acceptance of kit is subjected to successful demo to the satisfaction of PDD, J&K at prescribed site.
14	Calibration certificate	Calibration certificate from/traceable to, International/govt. approved lab shall be submitted.

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7. Primary Injection Kit

i) Ranges a) 0 – 500 Amps.AC
b) 0 – 1000 Amps.AC

ii) Open circuit Voltage- 0 to 6 Volts(minimum) at 1000 Amp.

iii) Ranges selectable by change of link connections.

iv) Continuous Current control by variable Auto Transformer

v) Current measurement by Ammeter of accuracy 1%

vi) Input Power Supply 230 V±10% ac 50 ± 5%Hz

vii) Provided with metallic enclosure.

viii) Mobility – Kit should be sturdy and mobile on metal surface in switchyard.

ix) Kit shall be supplied along with all accessories and cable set (15 mtr. length), clamps ,connectors, spare fuses ,indication lamps, power supply cable, etc. all that is required for carrying out measurement for one unit.

x) Kit shall have safety features like fuses/MCBs, ON indications etc.

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8) SECONDARY INJECTION KIT

i) Ranges a) 0 – 1 Amps.AC

b) 0 – 5 Amps.AC
c) 0 – 10 Amps.AC
d) 0 ¬ - 30 Amps AC

ii) Resolution - 0.01Amp

iii) Should have digital time interval meter 0 to 99.99 sec with 1 ms resolution.

iv) Continuous Current control by variable Auto Transformer

v) Current & Voltage measurement by Digital Ammeter and Voltmeter.

vi) Input power supply 230 V±10% ac 50 ± 5%Hz

vii) Output variable voltages 0 –250 V AC

viii) Provided with metallic enclosure.

ix) Kit shall be supplied along with all accessories and cable set(3 mtr. length),spare fuses ,indication lamps, power supply chord etc. all that is required for carrying out measurements.

x) Kit shall have safety features like fuses/MCBs, ON indications etc.

xi) It should have overload and short-circuit protection

---

9. DIGITAL LEVEL METER

Sr.no	Description	Specification
1.	Functional requirement	Equipment shall be used for measurement of strength of PLCC signal It should include impedance & return loss measuring attachment compatible with level generator The kit and accessories shall be robust and rugged enough, so that it can be transported safely at different locations .The transportation case and packing of the kit shall be such that the transportation from one station to other will not affect the performance and accuracy of measurement of kit.
2.	Frequency	200 Hz to 620 kHz (balanced) 50Hz to 620 kHz (unbalanced)
3.	Input Impedance's	75, 125, 150, 600 ohm
4.	Min readable level	-90db/dbm
5.	Sensitivity in step of 10 db	Sensitivity in step of 10 db: with balanced input –60 to +20 db/dbm with unbalanced input –70 to +10 db/dbm
6.	Automatic tuning	Between level meter and generator to be provided
7.	Power supply	230 V, single phase, AC 50Hz supply with variations of ±10% and ±5% in voltage & frequency respectively.
8.	Error of level measurement	< 0.1 db at 0 db level at 0 scale division.
9.	Resolution	1Hz

10.	Impedence Measurement	i)Frequency Range : 300Hz to 600 kHz ii)Measuring Range : 50 to 3000 ohms iii)Accuracy : ±10%
11.	Balance & return loss measurement	i)Frequency Range : 300Hz to 600 kHz ii)Impedance Limits : 60 to 1200 ohms iii)Return loss : 40 db iv)Accuracy : ±1 db
12.	Accessories	Measuring cable, power cable, synchroniser cable, Battery connecting cable, fuse, operating manual, and any other accessories required for use of the specified equipment.
13.	Calibration Certificate	Calibration certificate from/traceable to, NABL accredited lab or internationally reputed lab, shall be submitted. Date of calibration shall not be older than one month from the date of supply of Kit.

10. AUTOMATIC TRANSFORMER TURNS RATIO TESTER

The equipment offered shall be used for measurement of turns ratio of various power and distribution transformers automatically displaying the ratio without requiring any manual balancing of decades.

Technical Requirement

Input Supply Voltage: 230 Volts, 50 Hz, single phase a.c. with variations of ±15 % & ±5 % in voltage and frequency.

Measuring Principle

It should display actual turns ratio of different vector groups in three phase transformers without conversion.

Measuring range	1 to 200
Accuracy	+-5 % of FSD

The kit should be supplied with 15m of test lead.
General Requirements
It should offer repeatability of test results.
The test kit shall be compatible for EMI/EMC environment as per IEC 1000.

As per requirement of ISO-9001, calibration certificate for each testing instrument covering entire range shall be supplied with the test kit at the time of supply.
The testing equipments are generally meant for carrying out testing at site and movement from one place to another is unavoidable. Therefore equipment shall be robust in design so that it gives desired performance even in adverse site conditions.

Environmental conditions such as temperature, humidity, vibration, bump etc. shall be as per IS-9000 and IS 9001 or equivalent standards. Required certificates confirming to above standards shall be furnished along with the offer.
Necessary transport packing arrangement shall be supplied along with the equipment.

The equipment shall generally comply with the requirement of relevant Indian standard or equivalent International standard such as IEC, BS, ASTM, ISO, etc.
The supplier should have adequate "After Sales Service" facility in India.

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11. TRANSFORMER DC WINDING RESISTANCE MEASUREMENT

The instrument shall be used for measuring DC winding resistance of the large transformers/reactors upto 400kV class where high inductance is present.

The test kit shall be able to withstand inductive kicks from transformer winding.

Variation in test current shall not result in loss of accuracy.

The display or resistance should be through LED/LCD without requiring any balancing of decades to obtain stable readings.

It should employ four wire method and no lead compensation shall be required for the measurement.

Built-in-discharge circuit should be provided to discharge the specimen when test is completed or when current lead accidentally disconnects or when instrument power supply is lost.

Technical Parameter

Test current	Min 25 Amp DC in range of 0-2000 milliohm
Resolution	1 milliohm
Range	0 to 10 ohms
Accuracy	+-0.5 % of full scale reading or better

Open circuit voltage minimum 30 volts DC.

The instrument shall contain all standard accessories including test leads of 20m with suitable clamps/connectors and carrying case.

It shall be suitable for 230V, single phase AC, 50 Hz supply with variations of ±15 % and ±5 % in voltage and frequency respectively.

General Requirements
It should offer repeatability of test results in charged switchyard.
The test kit shall be compatible for EMI/EMC environment as per IEC 1000.

As per requirement of ISO-9001, calibration certificate for each testing instrument covering entire range shall be supplied with the test kit at the time of supply.

The testing equipments are generally meant for carrying out testing at site and movement from one place to another is unavoidable. Therefore equipment shall be robust in design so that it gives desired performance even in adverse site conditions.
Environmental conditions such as temperature, humidity, vibration, bump etc. shall be as per IS-9000 and IS 9001 or equivalent standards. Required certificates confirming to above standards shall be furnished along with the offer.

Necessary transport packing arrangement shall be supplied along with the equipment.
The equipment shall generally comply with the requirement of relevant Indian standard or equivalent International standard such as IEC, BS, ASTM, ISO, etc.

The supplier should have adequate "After Sales Service" facility in India.

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12. SF6 GAS FILTERING, EVACUATING AND DRYING PLANT

The capacity of this plant shall be such that it shall not take appreciable time for filling or evacuating of the breaker. The required vacuum for complete evacuation shall be attained with the help of this plant.

- This shall include all the necessary devices for measurement of purity, moisture content, decomposition products etc. of SF6 gas. Mixing with air/oil/moisture during above process should be proved to be Nil during testing. The storage capacity of the reservoir should be sufficient for storing complete SF6 gas for at least one 420kV Circuit Breaker (3 poles) or 105 kgs whichever is higher.
- The plant shall be complete with accessories and fittings so that SF6 gas from the breaker can be directly filled in the plant storage reservoir.
- In case purging of the equipment before filling with SF6 gas is desirable, then the required equipment for dry gases etc. shall be furnished as a part of the plant.
- For heavy items within the plant, the lifting hooks shall be provided for lifting and moving with the overhead cranes.

The SF6 gas handling plants shall comply with following requirements:

i) The plant shall be complete with all the necessary pipes, couplings, flexible tubes and valves for coupling to the equipment for the filling or evacuating SF6 gas to be used with all necessary instructions for storage and handling of the plant.
ii) The design and construction of the plant, valves, couplings, and connections shall be such that leakage of SF6 gas shall be minimum. Similarly valves, couplings and pipe work shall be so arranged that accidental loss of gas to the atmosphere shall be minimum.
iii) Facilities shall be provided to reduce the gas pressure within the Circuit Breaker to a value not less than 8 mill bars.

SF6 gas composition analyzing equipment and instruments for the following functions shall be provided:

a) The moisture content measurement or alternatively dew point measurement.

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13. Relay Operation Timer

- Range : 1 m Sec. To 999.9 Sec.
- Resolution : 1 mSec (Range – 1 mS to 9.999 Sec.)
  : 10 mSec (Range– 10 mS to 99.99 Sec.)
  : 100 mSec (Range – 100 mS to 999.9 Sec.)
- Time base Accuracy : +/- 0.1%
- Accuracy : +/- 1 count +/- Time base accuracy
- Display : 4 digit LED/ LCD
- Power supply : 230 VAC +/- 10% at 50 Hz.
- Suitable for use in EHV S/S.
- Operating Modes:
  By Potential free open contact closing (Start/Stop)
  By Potential free close contact opening (Start/Stop)
  By step +ve voltage application (50 V to 250 V DC)
  By step +ve voltage removal (50 V to 250 V DC)
- Should have latching facility and reset facility.
- Calibration Certificate- Calibration certificate from/traceable to, NABL accredited lab or internationally reputed lab, shall be submitted. Date of calibration shall not be older than one month from the date of supply of Kit.

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14. THREE PHASE VARIAC

The three phase variac is required for testing and maintenance purpose in Substation.
Technical Parameters:
Type: Variable Transformer (Manual)
Primary voltage: 440 – 480 Volts AC
Frequency: 50 Hz
Phase: 3 (Three)
Secondary Voltage: 0 to 480 volts AC

Secondary Current: 5 Amps
Termination: Screw terminals
Cooling: Air cooled

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15. SF6 Gas Leak Detector

The following features are required:
Battery operated
Light weight
Quick response time
Portable and easy to use
Audible alarm

Sensitive to leakage of gas
Leak rate 1x $10^{-}6$ ml/sec
It should be complete with all leads, sensors, operating manual etc.

16.0 Earth Resistance Tester – For measurement of earth resistance

Technical Parameters:
Battery operated
Light Weight

Portable and easy to use
Measuring range: 0-20 Ohm / 0-200 Ohm / 0 – 2000 ohm
Accuracy: ±2%
Accessories: Test Leads
Auxiliary earth bars
Heavy duty case
Instruction manual
Battery
Indication: Low battery
Open circuit indication
Over range indication

17.0 Phase Sequence Meter - Required to check phase sequence

Operation Voltage: 60 to 600 Volts Three Phase
Operating frequency: 50 to 60 Hz
Accessories: Test Leads
Alligator clips
Instruction manual

18.0 Digital Micro ohm meter – For measurement of very low resistance

Range: 1μΩ - 200Ω
Accuracy: 0.02%
Output: Digital
Resolution: 1μΩ

Accessories: Leads, Instruction manual, Heavy duty clip

SERVO VOLTAGE STABLIZER

1.0 GENERAL

1.1 The Servo voltage stabilizer shall conform to IS 9815 with latest amendments

1.2 The unit shall comprise of an AC synchronous motor coupled with three phase transformer, panel, and protective devices for over current, short circuit, overload etc.

1.3 The contractor shall be responsible for complete design, manufacture, testing, supply, installation, testing and commissioning at Lassipora Sub Station

2.0 Technical Requirement

Rating	-	Three (3) phase, 250KVA
Input Voltage	-	350V-460 Volts AC, Three Phase
Output voltage	-	415V AC rms ± 2%
Operating frequency	-	50Hz ± 6%
Phase	-	3- phase 4 wire
Overload Capacity	-	10% for 10 minute
Method of Cooling	-	Oil cooled
Output Efficiency	-	> 98%
No load losses	-	< 1 %
Suitability	-	3 phase, 4 Wire, Unbalanced load & voltage
Operating Temperature	-	(0 to 50) degree Centigrade Ambient temperature
Waveform Distortion	-	NIL
Response time	-	Less than 10 Milli Sec
Control Circuit	-	Automatic IC Based Solid state
Acoustic level	-	< 50 dB

Operation Mode	-	Automatic / Manual
Transformer	-	Wound with Electrolyte Grade Copper of 99%purity With Low loss CRGO Lamination to be used.
Earthing	-	Suitable Earthing Thimble to be provided
High Voltage	-	Can withstand 2.5kV for 5 Sec
Insulation	-	Better than 5 Mega ohm, H Class
Indicator	-	Input / Output Voltage Per Phase Input / Output Current Per Phase Frequency High/Low Voltage with Buzzer Phase Sequence Indicator Oil level Indictor
Monitoring Facility	-	Input Voltage/Current Output Voltage/Current Frequency Power Factor Energy KWH KW/KVA
Oil Temperature		
Protection	- - -	LOW/HIGH Voltage Cut off Over Current / Over load Short Circuit
Testing	-	Testing shall be carried out as per relevant IS.
Inspection	-	Inspection shall be done before dispatch of material.

TECHNICAL SPECIFICATION

VOL-II, SEC-II

GENERAL TECHNICAL REQUIREMENT

SECTION-II
GENERAL TECHNICAL REQUIREMENT

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1.0 FOREWORD

1.1 The provisions under this section are intended to supplement general requirements for the materials, equipment's and services covered under other Sections of tender documents and is not exclusive.

2.0 GENERAL REQUIREMENT

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

2.2 It is recognised that the Contractor may have standardised 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 Employer.

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

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 / relevant IS / IEC standard or Acceptable International Standard.

3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the date of bid opening) of standard specified under Annexure-A of this 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 complement 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 or equivalent international standard.

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-A / individual Sections for various equipment shall also, be accepted, however the salient points of difference shall be clearly brought out in the Additional information schedule of the bid along with English language version of such standard. The equipment conforming to standards other than specified under Annexure-A / individual Sections for various equipment shall be subject to Employer's approval.

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 equipment 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 with the following:

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

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

4.6 Equipment's and system shall be designed to meet the following major technical parameters as brought out hereunder.

4.6.1 System Parameter

220kV System

SL No	**Description of parameters**	**220 kV System**
1.	System operating voltage	220kV
2.	Maximum operating voltage of the system(rms)	245kV
3.	Rated frequency	50Hz
4.	No. of phase	3
5.		
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	1050 kVp
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	-
iii)	One minute power frequency dry withstand voltage (rms)	-
iv)	One minute power frequency dry and wet withstand voltage (rms)	460kV
6.	Corona extinction voltage	156kV
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 156kV rms for 220kV system	1000 micro-volt
8.	Minimum creepage distance (25mm/kV)	6125 mm
9.		
i.	Phase to phase	2100 mm
ii.	Phase to earth	2100 mm
iii)	Sectional clearances	5000 mm

SL No	Description of parameters	220 kV System
10.	Rated short circuit current for 1 sec. duration	40kA
11.	System neutral earthing	Effectively earthed

132kV & 33kVSystem

SL No	Description of parameters	132 kV System	33 kV System
1.	System operating voltage	132kV	33kV
2.	Maximum operating voltage of the system(rms)	145kV	36kV
3.	Rated frequency	50Hz	50Hz
4.	No. of phase	3	3
5.	Rated Insulation levels		
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	650 kVp	170 kVp
ii)	One minute power frequency dry and wet withstand voltage (rms)	275kV	70kV
6.	Corona extinction voltage	105kV	-
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 92KV rms for 132KV system	500 micro-volt	-
8.	Minimum creepage distance (25mm/kV)	3625 mm	900 mm
9.	Min. Clearances		
i.	Phase to phase	1300 mm	320 mm
ii.	Phase to earth	1300 mm	320 mm
iii)	Sectional clearances	4000 mm	3000 mm
10.	Rated short circuit current	31.5 kA for 1 Sec	25 kA for 3 Sec
11.	System neutral earthing	Effectively earthed	Effectively earthed

Note :

1. **The above parameters are applicable for installations up to an altitude of 1000m above mean sea level. For altitude exceeding 1000m, necessary altitude correction factor shall be applicable.**
2. The insulation and RIV levels of the equipment's shall be as per values given in the respective Section of the equipment's.

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

220kV System

S.N.	Parameters	220 kV

(a)	Max. System voltage Um(kV)	245
(b)	Impulse withstand voltage (dry & wet) (kVp)	± 1050
(c)	Power frequency withstand voltage (dry and wet) (kV rms)	460
(d)	Total creepage distance (min) (mm)	6125

132kV & 33kV System

S.N.	Parameters	**132 kV**	**33kV**
(a)	Max. System voltage Um(kV)	145	36
(b)	Impulse withstand voltage (dry & wet) (kVp)	± 650	± 170
(c)	Power frequency withstand voltage (dry and wet) (kV rms)	275	75
(d)	Total creepage distance (min) (mm)	3625	900

4.6.3 Major Technical Parameters

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

4.6.3.1

(A) For 245 kV & 145 kV Circuit Breaker and Isolator

Rated voltage kV (rms)	245	145
Rated frequency (Hz)	50	50
No. of Poles	3	3
Design ambient temperature (°C)	50	50

Rated insulation levels :

1) Full wave impulse withstand voltage (1.2/50 micro sec.)

- between line terminals and ground	± 1050 kVp	±650 kVp
- between terminals with circuit breaker open	± 1050 kVp	±650 kVp
- between terminals with isolator open	± 1200 kVp	±750 kVp

2) One minute power frequency dry and wet withstand voltage

- between line terminals and ground	460 kV (rms)	275 kV (rms)
- between terminals with circuit breaker open	460 kV (rms)	275 kV (rms)
- between terminals with Isolator open	530 kV (rms)	315kV (rms)

Max. radio interference voltage (microvolts) for frequency between 0.5 MHz and 2 MHz in all positions of the equipments.	1000 (at 156 kV rms)	500 (at 92 kV rms)
Minimum creepage distance:-		
Phase to ground (mm)	6125	3625
Between CB Terminals (mm)	6125	3625
System neutral earthing	Effectively earthed	Effectively earthed
Seismic acceleration	- 0.5g horizontal -	
Rating of Auxiliary Contacts	10 A at 220/110 V DC (as applicable)	
Breaking capacity of Auxiliary Contacts	2 A DC with circuit time constant of not less than 20ms.	
Phase to phase spacing (mm)	4500 or 4000	3000 or 2700

Auxiliary Switch shall also comply with other clauses of this Section.

(B) FOR 245 kV & 145 kV CT/CVT/SA

Rated voltage kV (rms)	245	145
Rated frequency (Hz)	50	50
No. of poles	1	1
Design ambient temperature (°C)	50	50
Rated insulation levels :		
1) Full wave impulse withstand voltage (1.2/50 micro sec.)		
- between line terminals and ground for CT and CVT	± 1050 kVp	±650 kVp
- for arrester housing	± 1050 kV peak	±650 kVp
2) One minute power frequency dry and wet withstand voltage		
- between line terminals and ground for CT and CVT	460 kV rms	275 kV rms
- for arrester housing	460 kV rms	275kV rms
Max. radio interference voltage (microvolts) for frequency between 0.5 MHz and 2 MHz in all positions of the equipment.	1000 for CT/CVT 500 for SA (at 156 kV rms)	500 (at 92 kV rms)
Minimum creepage distance :-		
Phase to ground (mm)	6125	3625
System neutral earthing	- Effectively earthed -	
Seismic acceleration	- 0.5g horizontal -	
Partial discharge for :-		

-	Surge arrester at 1.05 COV	- Not exceeding 50 pc. -
-	for CT/CVT	- Not exceeding 10 pc. –

(C) **For 33 kV Vacuum Circuit Breaker and Isolator**:

Rated voltage kV (rms)	36
Rated frequency (Hz)	50
No. of Poles	3
Design ambient temperature (°C)	50

Rated insulation levels :

1) Full wave impulse withstand voltage (1.2/50 micro sec.)

-	between line terminals and ground	±170 kVp
-	between terminals with circuit breaker open	±170 kVp
-	between terminals with isolator open	±170 kVp

2) One minute power frequency dry and wet withstand voltage

-	between line terminals and ground	70kV(rms)
-	between terminals with circuit breaker open	70kV(rms)
-	between terminals with Isolator open	70kV(rms)

Minimum creepage distance:

Phase to ground (mm)	900
Between CB Terminals (mm)	900

System neutral earthing	Effectively earthed
Seismic acceleration	0.5 g
Rating of Auxiliary Contacts	10 A at 250 V DC
Breaking capacity of Auxiliary Contacts	2 A DC with circuit time constant of not less than 20ms

Auxiliary Switch shall also comply with other clauses of Section-GTR.

(D) FOR 33kV CT/VT/SA

Rated voltage kV (rms)	36
Rated frequency (Hz)	50
No. of poles	1
Design ambient temperature (°C)	50

Rated insulation levels :

1) Full wave impulse withstand voltage (1.2/50 micro sec.)

-	between line terminals and ground	±170 kVp
-	for arrester housing	±170 kVp

2) One minute power frequency dry and wet withstand voltage

-	between line terminals and ground	70kV rms
-	for arrester housing	70kV rms

Minimum creepage distance :

Phase to ground (mm)	900
Between Terminals (mm)	900
System neutral earthing	- Effectively earthed -
Seismic acceleration	0.5 g
Cantilever strength of bushing	350 kg (minimum)

(E) Technical Parameters of Bushings/Hollow Column Insulators/support insulators for 33kV:

(a)	Rated Voltage (kV)	36
(b)	Impulse withstand voltage (Dry & Wet) (kVp)	±170
(c)	Power frequency withstand voltage (dry and wet) (kV rms)	75
(d)	Total creepage distance (mm)	900

(e) Pollution Class-III Heavy (as per IEC 71) and as specified in Section-2 for all class of equipment.

The requirement of alternate long & short sheds stated in model technical specification shall not be applicable in case of 33 kV.

5.0 ENGINEERING DATA AND DRAWINGS

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

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

5.2 The Contractor shall submit 4 (four) sets of drawings/ design documents /data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Employer. The contractor shall also submit the softcopy of the above documents in addition to hardcopy.

5.3 Drawings

5.3.1 All drawings submitted by the Contractor 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 Drawings submitted by the Contractor shall be clearly marked with the name of the Employer, the unit designation, the specifications title, the specification number and the name of the Project. Employer/Consultant has standardized few drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings alongwith type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

5.4 The review of these data by the Employer will cover only general conformance of the data to the specifications and documents interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Employer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Employer shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

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 Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

5.6 All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

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 Employer 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 Employer on initial submission	As per agreed schedule
ii)	Resubmission (whenever required)	Within 3 (three) weeks from date of comments
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission.
iv)	Furnishing of distribution copies (5 hard copies per substation and one scanned	2 weeks from the date of approval

	copy (pdf format) for Corporate Centre)	
v)	Furnishing of distribution copies of test reports	
	(a) Type test reports (one scanned softcopy in pdf format per substation plus one for corporate centre & one hardcopy per substation)	2 weeks from the date of final approval
	(b) Routine Test Reports (one copy for each substation)	-do-
vi)	Furnishing of instruction/ operation manuals (2 copies per substation and one softcopy (pdf format) for corporate centre & per substation)	As per agreed schedule
(vii)	As built drawings (two sets of hardcopy per substation & one softcopy (pdf format) for corporate centre & per substation)	On completion of entire works

NOTE:

(1) The contractor may please note that all resubmissions must incorporate all comments given in the earlier submission by the Employer or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

(2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.

(3) 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.

(4) 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 Employer.

(5) The Contractor shall furnish to the Employer catalogues of spare parts.

(6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

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

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 Employer.

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 re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

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.

6.2 Provisions for Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipment's 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 230V 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-60947 (Part-I) / IS 12063 / IEC-60529. Type test report for degree of protection test, 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 Employer. The rating plate of each equipment shall be according to IS/IEC requirement.

6.3.2 All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, Capacitor Banks, C & R panels and PLCC/Communication equipment's shall be provided with English inscriptions.

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 Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the Employer & 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 equipment's 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, sub-assemblies 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 Employer. 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 Employer (if any) during the period of Contract. The Contractor shall attend such meetings at his own cost at Employer's Corporate Centre, at New Delhi or at Site office in Srinagar, J&K 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 Employer's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be broadly outlined by the contractor and finalised after discussions before the award of contract. The detailed programme shall be submitted by the contractor after the award for reference. 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 programme:

(b) Documentation control system;

(c) Qualification data for bidder's key personnel;

(d) The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

(e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;

(f) Control of non-conforming items and system for corrective actions;

(g) Inspection and test procedure both for manufacture and field activities.

(h) Control of calibration and testing of measuring instruments and field activities;

(i) System for indication and appraisal of inspection status;

(j) System for quality audits;

(k) System for authorising release of manufactured product to the Purcahser.

(l) System for maintenance of records;

(m) System for handling storage and delivery; and

(n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The Employer or his duly 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 Employer's inspection of equipment/material

9.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective Sections.

9.2 The reports for all 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 Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the originally Scheduled date of bid opening. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the originally Scheduled date of bid opening, the contractor shall repeat these test(s) at no extra cost to the Employer.

However, in case of instrument transformers, the following type tests should have been conducted within 5 (five) years prior to the originally Scheduled date of bid opening.

i) Lightning Impulse Test

ii) Switching Impulse Test

iii) Multiple Chopped Impulse Test (For CT)

iv) Chopped Impulse Test (For CVT)

In case the test reports are of these tests (for instrument transformers) as mentioned above are conducted earlier than 5 (five) years prior to the originally Scheduled date of bid opening, the contractor shall repeat these test(s) at no extra cost to the Employer.

Further, 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 type tests not carried out, same shall be carried out without any additional cost implication to the Employer.

The Contractor shall intimate the Employer the detailed program about the tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

Further, in case type tests are required to be conducted / repeated and the deputation of Inspector/Employer's representative is required, then all the expenses shall be borne by the contractor.

9.3 The Employer, his duly authorised representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times free access to the Contractor's/sub-vendors premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Engineer and for his duly 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 Employer and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

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

9.5 The Employer or Inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Employer /Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

9.6 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Employer/inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Employer /Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Engineer/Inspector. Failure of the Employer /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Employer to accept the equipment should, it, on further tests after erection, is found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of CIP by the Employer.

9.7 In all cases where the Contract provides for tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where

otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Employer /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer /Inspector or to his authorised representative to accomplish testing.

9.8 The inspection by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.

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

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

10.0 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 Employer and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed is given in respective Sections and shall be included in the Contractor's quality assurance programme.

10.2 Commissioning Tests

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

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

10.2.3 The specific tests requirement on equipment has been brought out in the respective Sections 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 on production of requisite documents.

11.0 PACKAGING & PROTECTION

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

11.2 All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and piping 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 Equivalent International Standards.

12.2 HOT DIP GALVANISING

12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. 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 discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. 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/Equivalent International standard “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 and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective Sections of the equipment's. Glossy white colour inside the equipment's /boards /panels/junction boxes is also acceptable. The exterior colour for panels shall be matching with the existing panels in case of extension of a substation. 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 equipment's.

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 Employer's review & approval.

12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

S.No.	PIPE LINE	Base colour	Band colour
Fire Protection System			
1	Hydrant and Emulsifier system pipeline	FIRE RED	-
2	Emulsifier system detection line – water	FIRE RED	Sea Green
3	Emulsifier system detection line – Air	FIRE RED	Sky Blue
4	Pylon support pipes	FIRE RED	
Air Conditioning System			
5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-
6	Refrigerant gas pipeline – at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	-
9	Condenser water pipeline	Sea Green	Dark Blue

The direction of flow shall be marked by → (arrow) in black colour.

Base Colour Direction of flow Band Colour

12.3.7 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting.

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

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

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

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

13.5 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.

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

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

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

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

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

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

13.12 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 4.6 the Contractor shall immediately proceed to correct the discrepancy at his risks and cost.

13.13 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 Employer. 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, Telecommunication and PLCC system shall also conform the parameters as indicated in the following.

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
400V	$\pm$ 10	50 $\pm$ 2.5%	3/4 Wire	Solidly Earthed.

230V	± 10	50 ± 2.5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	-	Isolated 2 wire System
110V	95V to 120V	DC	-	Isolated 2 wire System
48V	_	DC	_	2 wire system (+) earthed

Combined variation of voltage and frequency shall be limited to ± 10%.

16.0 SUPPORT STRUCTURE

16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 5.9 meter and 4.6 meter from plinth level for 245 kV substations and 145kV respectively. All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.

16.2 Support structure shall meet the following mandatory requirements:

16.2.1 The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

17.1 All power clamps and connectors shall conform to IS: 5561/ANSI/NEMA CC1/ Equivalent International standard and shall be made of materials listed below:

For connecting ,ACSR conductors	Aluminum alloy casting conforming to IS: 5561/BS:1490/ Equivalent International Standard
For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from aluminum alloy casting conforming to IS: 5561/BS:1490/ Equivalent International Standard with 2mm thick bimetallic liner.
For connecting GI	Galvanized mild shield wire
i) Bolts nuts and plain washers	Electrogalvanised for sizes Plain, washers below M12, for thers hot dip galvanised.
ii) Spring washers for item 'a' to 'c'	Electrogalvanised mild steel

17.2 Necessary clamps and connectors shall be supplied for all equipment and connections. The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. 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.

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 or 2 mm thick bi-metallic strips shall be provided 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 blurred 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. Current carrying parts (500 A and above) of the clamp/connector shall be provided with minimum four numbers of bolts preferably for 132kV and above.

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.

17.11 Tests

17.11.1 Clamps and connectors should be type tested as per IS :5561/NEMA CC1/ Equivalent International Standard and shall also be subjected to routine tests as per IS :5561/NEMA CC1/ Equivalent International Standard. Following type test reports 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 ten 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) RIV(dry) test for 132kV 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-60439, 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 atleast 2.0 mm thick cold rolled or 2.5 mm hot rolled or alternately 1.6 mm thick stainless steel/Aluminum can also be used. 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 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/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149, IS:3400 / Equivalent International Standard. 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 above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

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

18.8 For illumination, LED based illumination of approximately 9 to 15 watts shall be provided. The switching of the fittings shall be controlled by the door switch. .

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

18.9 All control switches shall be of MCB/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/ IEC 60529/ Equivalent International Standard 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 / IEC 60529/ Equivalent International

Standard including application of, 2.0 KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.

19.0 TERMINAL BLOCKS AND WIRING

19.1 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.

19.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non-breakable type. 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 of Elmex or Phoenix or Wago or equivalent make.

19.3 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.

19.4 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.

19.5 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.

19.6 The terminal blocks shall be of extensible design.

19.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

19.8 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.

19.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

a)	All circuits except CT/PT circuits	Minimum of two of 2.5 sq mm copper flexible.
b)	All CT/PT circuits	Minimum of 4 nos. of 2.5 sq mm copper flexible.

19.10 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.

19.11 Atleast 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

19.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

19.13 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.

19.14 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.

20.0 LAMPS & SOCKETS

20.1 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round plug as per Indian Standard. They shall be switched sockets with shutters.

20.2 Hand Lamp:

A 230 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.

20.3 Switches and Fuses:

20.3.1 Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing 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 breaker / switch fuse 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.

20.3.2 All fuses shall be of HRC cartridge type conforming to IS: 9228 / Equivalent International Standard 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.

21.0 Bushings, Hollow Column Insulators, Support Insulators:

21.1 Bushings shall be manufactured and tested in accordance with IS 2099 / IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IS:5621 / IEC-62155. The support insulators shall be manufactured and tested as per IS: 2544 / IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable.

The bidder may also offer composite hollow insulators, conforming to IEC-61462.

21.2 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.

21.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

21.4 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.

21.5 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.

21.6 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.

21.7 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.

21.8 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/ Equivalent International Standard .

22.0 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.

22.1 Enclosures

a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691 / IEC 60529 / Equivalent International Standard. 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 / Equivalent International Standard.

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 or other means to facilitate lifting.

22.2 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.

22.3 Starting Requirements:

a) All induction motors shall be suitable for full voltage direct-on-line 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 rated full load current for all motors, subject to tolerance as given in IS:325/ Equivalent International Standard .

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.

22.4 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 / Equivalent International Standard (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/ Equivalent International Standard. 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.

22.5 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 Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Employer 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.

23.0 TECHNICAL REQUIREMENT OF EQUIPMENTS

Following equipment shall be offered from the Indian manufacturer(s) who meets the technical requirements as stipulated here, provided the same equipment are not covered under the Bidder's Qualifying requirement of the Bidding Documents.

Legend:

* : voltage class of respective equipment as applicable.

: satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.

@ : **Circuit Breaker Bay** means a bay used for controlling a line or a transformer or a reactor or a bus section or a bus coupler and comprising of

at least one circuit breaker, one disconnector and three nos. of single phase CTs / Bushing CTs

NOA: means Notification Of Award

23.1 Technical requirements for 220/132/110/33kV* Air Insulated Switchgear (AIS) Equipment* (i.e Circuit Breaker, Isolator, Current Transformer, Capacitive Voltage transformer, Inductive Voltage transformer, Surge Arrester and Wave Trap)

(i) The manufacturer(s) whose 220/132/110/33kV* equipment(s) are offered, must have, manufactured, type tested (as per IEC/IS or equivalent standard) and supplied 220/132/110/33kV* or higher voltage class equipment(s), which are in satisfactory operation# for atleast two (2) years as on the date of NOA.

(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India for the offered equipment and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) 220/132/110/33kV* or higher Voltage class equipment(s) must have been manufactured in the above Indian works & type tested (as per IEC/IS standard) and supplied as on the date of NOA.

b) Contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipments(s)* and this performance guarantee shall be in addition to the contract performance guarantee to be submitted by the contractor.

23.2 Technical Requirement for 220kV, 132kV and 110kV class Transformer

(i) The manufacturer whose transformer(s) are offered must have designed, manufactured, tested and supplied 220kV/132kV/110kV* or higher voltage class transformers. These Transformer(s) must have been in satisfactory operation# for atleast two (2) years as on the date of NOA.

(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) 220kV (applicable for supply of 220kV class Transformer)/ 132kV (applicable for supply of 132kV & 110kV class Transformer) or higher voltage class transformers must have been designed, manufactured in the above Indian works based on technological support of collaborator, type tested (as per IEC/IS standard) and supplied as on the date of NOA.

b) The collaborator meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 220kV/132kV/110kV* transformer in India, shall be submitted.

c) the collaborator shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor.

23.3 Technical Requirement for 220KV Grade XLPE Power Cables

(i) The manufacturer(s) whose XLPE Power Cables are offered must have designed, manufactured, type tested and supplied in a single contract atleast 5 (five) km of single core, 220kV or higher grade XLPE insulated cable which must be in operation for atleast 2 (two) years as on the date of NOA.

(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) The manufacturer must have designed, manufactured, type tested and supplied 220kV or higher grade XLPE insulated cable and which must be in satisfactory operation# for atleast one (1) year as on the date of NOA.

OR

b) The manufacturer must have designed, manufactured, type tested and completed Pre-qualification (PQ) tests as per IEC for 220kV or higher grade XLPE insulated Cable as on the date of NOA.

23.4 Technical Requirement for 132KV, 110kV, 66kV Grade XLPE Power Cables

(i) The manufacturer(s) whose XLPE Power Cables are offered must have designed, manufactured, type tested and supplied in a single contract atleast 5 (five) km of single core, 132KV/110kV/66kV* or higher grade XLPE insulated cable which must be in satisfactory operation# for atleast two (2) years as on the date of NOA.

(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) The manufacturer must have designed, manufactured, type tested and supplied 132KV/110kV/66kV* or higher grade XLPE insulated cable and which must be in satisfactory operation# for atleast one (1) year as on the date of NOA.

23.5 Technical Requirement for 1.1 KV Grade PVC Control Cable

The manufacturer(s), whose PVC control cables are offered, must have designed, manufactured, tested and supplied in a single contract atleast 100 Kms of 1.1kV grade PVC insulated control cables as on the originally scheduled date of bid opening. Further the manufacturer must also have designed, manufactured, tested and supplied atleast 1 km of 27C x 2.5 Sq.mm or higher size as on the date of NOA.

23.6 Technical Requirement for 1.1 KV Grade PVC Power Cable

The manufacturer(s), whose PVC Power Cables are offered, must have designed, manufactured, tested and supplied in a single contract atleast 100 Kms of 1.1kV or higher grade PVC insulated power cables as on the date of NOA/award. Further the manufacturer must also have designed, manufactured, tested and supplied atleast 1 km of 1C x 150 Sq. mm or higher size as on the date of NOA.

23.7 Technical Requirement for 1.1 KV Grade XLPE Power Cables

The manufacturer(s), whose XLPE Power cables are offered, must have designed, manufactured, tested and supplied in a single contract atleast 25 Kms of 1.1 KV or higher grade XLPE insulated power cables as on the date of NOA/award. Further the manufacturer must also have designed, manufactured, tested and supplied atleast 1 km of 1C x 630 Sq. mm or higher size as on the date of NOA.

23.8 Technical Requirement for LT Switchgear

i) The manufacturer whose LT Switchgear(s) are offered, must be a manufacturer of LT Switchboards of the type and rating being offered. He must have designed, manufactured, tested and supplied atleast 50 nos. draw out circuit breaker panels, out of which atleast 5 nos. should have been with relay and protection schemes with current transformer. He must have also manufactured atleast 50 nos. MCC panels comprising of MCCBs (i.e. Moulded Case Circuit Breakers) modules of the type offered which must be in satisfactory operation# as on the date of NOA.

ii) 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, atleast one hundred circuit breakers of the make and type being offered must have been in satisfactory operation# as on the date of NOA.

23.9 Technical Requirements for Battery

The manufacturer whose Batteries are offered, must have designed, manufactured and supplied DC Batteries of the type specified and being offered, having a capacity of atleast 600 AH and these must be in satisfactory operation# for atleast two (2) years in power sector or industrial installations as on the date of NOA.

23.10 Technical Requirements for Battery Charger

The manufacturer, whose Battery Chargers are offered, must 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 must have been in satisfactory operation# as on the date of NOA.

23.11 Technical Requirements for LT Transformer

i) The manufacturer, whose LT transformer(s) are offered, must have designed, manufactured, type tested including short circuit test as per IEC/IS or equivalent standards and supplied transformer(s) of atleast 33kV class of 630kVA or higher. The transformer must have been in satisfactory operation# for atleast two (2) years as on the date of NOA.

ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) At least 33kV class of 630 kVA or higher rating LT transformer(s) must have been designed, manufactured in the above Indian works, type tested (as per IEC/IS standard) including short circuit test and supplied as on the date of NOA.

b) the contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor.

23.12 **Technical Requirements for Control, Relay & Protection System and Sub-station Automation System**

The manufacturer whose Control, Relay & Protection System (Control & protection Intelligent Electronic Devices (IEDs)), and Sub-station Automation System (as applicable) are offered, must have designed, manufactured, tested, installed and commissioned Control, Relay & Protection system along with Sub-station Automation System which must have been in satisfactory operation# on (specified voltage level or above [applicable for 220kV & below substation] for atleast two (2) years as on the date of NOA.

AND

The Manufacturer or their joint venture or subsidiary company or parent company must be a manufacturer of control and protection IEDs and must have established repair, testing and integration (atleast for 4 bays) facilities for Control, Relay & Protection System and Sub-station Automation System in India.

23.13 Technical Requirements for analog and digital PLCC panels (220kV & 132kV)

(i) The manufacturer whose PLCC panels are offered, must have designed, manufactured, tested, supplied and commissioned PLCC panels for (i) 220 kV System or above [applicable for 220 kV Substation] & (iii) 132 kV system or above [applicable for 132 kV substation] and the same must have been in satisfactory operation# for atleast two (2) years as on the date of NOA.

(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) PLCC panels must have been manufactured in the above Indian works based on technological support of collaborator, type tested (as per IEC/IS standard) and supplied as on the date of NOA.

b) collaborator shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor.

c) The collaborator meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer/license to design, manufacture, test and supply PLCC panels in India, shall be submitted.

23.14 Technical Requirement of Communication Equipment

The SDH equipment shall be offered from a manufacturer(s) who has been manufacturing SDH equipments for the last three (3) years and SDH equipment manufactured by such manufacturer(s) shall have been in satisfactory operation in 110kV or higher voltage Power Substations for at least two (2) years as on the date of NOA.

23.15 Technical Requirement of Fire Fighting System

The bidder or his sub-vendor should have designed, supplied, tested, erected and commissioned at least one number fire protection system of the each type described in (i), (ii) and (iii) below in installations such as power plants, substations, refineries, fertilizer plants or other industrial or commercial installations. Such systems must have been designed and comply to International Standard code (FOC, LONDON or NFPA, USA etc) executed during last ten (10) years and should have been in successful operation for at least 2 years as on the originally Scheduled date of bid opening.

(i) Automatic hydrant type fire protection system.

(ii) Nitrogen injection Fire Protection System (NFPS)

(iii) Smoke detection system.

In case bidder himself do not meet the requirement of design, he can engage a consultant(s) who must have designed i) Automatic hydrant type fire protection system, ii) NFPS and iii) Smoke detection system, which must be in successful operation for at least two years as on the originally Scheduled date of bid opening.

ANNEXURE - A

LIST OF SPECIFICATIONS

GENERAL STANDARDS AND CODES

Indian Electricity Rules

Indian Electricity Act

Indian Electricity (Supply) Act

Indian Factories Act

IS-5	-	Colors for Ready Mixed Paints
IS – 335	-	New Insulating Oils
IS-617	-	Aluminium and Aluminium Alloy Ingots and casting For General Engineering Purpose
IS-1448 (P1 to P145)	-	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 P2:1983	-	Insulation Coordination
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-5578	-	Guide for marking of Insulated Conductors
IS-11353	-	Guide for uniform system of marking & Identification of Conductors & apparatus terminals
IS-8263	-	Methods of Radio Interference Test on High Voltage Insulators
IS-9224(Part 1 to P4)	-	Low Voltage Fuses
IEC-60060 (Part 1 to P4)	-	High Voltage Test Techniques
IEC 60068	-	Environmental Test
IEC-60117	-	Graphical Symbols
IEC-60156,	-	Method for the Determination of the Electrical Strength of Insulation Oils.
IEC-60270,	-	Partial Discharge Measurements.
IEC-60376	-	Specification and Acceptance of New Sulphur Hexafloride

IEC-60437	-	Radio Interference Test on High Voltage Insulators.
IEC-60507	-	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems.
IEC-62271-1	-	Common Specification for High Voltage Switchgear & Controlgear Standards.
IEC-60815	-	Guide for the Selection of Insulators in respect of Polluted Conditions.
IEC-60865 (P1 & P2)	-	Short Circuit Current - Calculation of effects.
ANSI-C.1/NFPA.70	-	National Electrical Code
ANSI-C37.90A	-	Guide for Surge Withstand Capability (SWC) Tests
ANSI-C63.21,	-	Specification for Electromagnetic Noise and
C63.3	-	Field Strength Instrumentation 10 KHz to 1 GHZ
C36.4ANSI-C68.1	-	Techniquest for Dielectric Tests
ANSI-C76.1/EEE21	-	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
ANSI-Z55.11	-	Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray
NEMA-107T	-	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-II	-	General Standards for Industrial Control and Systems Part ICSI-109
CISPR-1	-	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz
CSA-Z299.1-1978h	-	Quality Assurance Program Requirements
CSA-Z299.2-1979h	-	Quality Control Program Requirements
CSA-Z299.3-1979h	-	Quality Verification Program Requirements
CSA-Z299.4-1979h	-	Inspection Program Requirements

TRANSFORMERS AND REACTORS

IS:10028 (Part 2 & 3)	-	Code of practice for selection, installation and maintenance of Transformers (P1:1993), (P2:1991), (P3: 1991)
IS-2026 (P1 to P4)	-	Power Transformers
IS-3347 (Part 1 to Part 8)	-	Dimensions for Porcelain Transformer Bushings for use in lightly polluted atmosphere
IS-3639	-	Fittings and Accessories for Power Transformer
IS-6600	-	Guide for loading of Oil Immersed Transformers
IEC-60076 (Part 1 to 5)	-	Power Transformers
IEC-60214	-	On-Load Tap-Changers.

IEC-60289	-	Reactors.
IEC- 60354	-	Loading Guide for Oil - Immersed power trans formers
IEC-60076-10	-	Determination of Transformer and Reactor Sound Levels
ANSI-C571280	-	General requirements for Distribution, Power and Regulating Transformers
ANSI-C571290	-	Test Code for Distribution, Power and Regulation Transformers
ANSI-C5716	-	Terminology & Test Code for Current Limiting Reactors
ANSI-C5721	-	Requirements, Terminology and Test Code for Shunt Reactors Rated Over 500 KVA
ANSI-C5792	-	Guide for Loading Oil-Immersed Power Transformers upto and including 100 MVA with 55 deg C or 65 deg C Winding Rise
ANSI-CG,1EEE-4	-	Standard Techniques for High Voltage Testing

CIRCUIT BREAKERS

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

CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS

IS-2705 (P1 to P4)	-	Current Transformers
IS-3156 (P1 to P4)	-	Voltage Transformers
IS-4379	-	Identification of Contents of Industrial Gas Cylinders
IEC-60044-1	-	Current transformers.
IEC-60044-2	-	Inductive Voltage Transformers.
IEC-60044-5	-	Instrument transformers - Part 5: Capacitor voltage transformers
IEC-60358	-	Coupling capacitors and capacitor dividers.
IEC-60044-4	-	Instrument Transformes : Measurement of Partial Discharges
IEC-60481	-	Coupling Devices for power Line Carrier Systems.
ANSI-C5713	-	Requirements for Instrument transformers
ANSIC92.2	-	Power Line Coupling voltage Transformers
ANSI-C93.1	-	Requirements for Power Line Carrier Coupling Capacitors

BUSHING

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

SURGE ARRESTERS

IS-3070 (Part 2)	-	Lightning Arrestors for alternating current systems: Metal oxide lightning arrestors without gaps
IEC-60099-4	-	Metal oxide surge arrestors without gaps
IEC-60099-5	-	Selection and application recommendation
ANSI-C62.1	-	IEE Standards for S A for AC Power Circuits
NEMA-LA 1	-	Surge Arresters

CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS

IS-722, IS-1248 IS-3231, IS-3231 (P-3)	-	Electrical Relays for Power systems Protection
IS-5039	-	Distributed Pillars for voltages not exceeding 1000 volts
IEC-60068.2.2	-	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-60529	-	Degree of Protection provided by enclosures.
IEC-60947-4-1	-	Low voltage switchgear and control gear.
IEC-61095	-	Electromechanical Contactors for household and similar purposes.
IEC-60439 (P1 & 2)	-	Low Voltage Switchgear and control gear assemblies
ANSI-C37.20	-	Switchgear Assemblies, including metal enclosed bus.
ANSI-C37.50	-	Test Procedures for Low Voltage Alternating Current Power Circuit Breakers
ANSI-C39	-	Electric Measuring instrument
ANSI-C83	-	Components for Electric Equipment
NEMA-AB	-	Moulded Case Circuit and Systems
NEMA-CS	-	Industrial Controls and Systems
NEMA-PB-1	-	Panel Boards
NEMA-SG-5	-	Low voltage Power Circuit breakers
NEMA-SG-3	-	Power Switchgear Assemblies
NEMA-SG-6	-	Power switching Equipment
NEMA-5E-3	-	Motor Control Centers
1248 (P1 to P9)	-	Direct acting indicating analogue electrical measuring instruments & their accessories.

Disconnecting switches

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

ANSI-C37.34	-	Test Code for high voltage air switches
NEMA-SG6	-	Power switching equipment
PLCC and line traps		
IS-8792	-	Line Traps for AC Power Systems
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.
CIGRE	-	Guide on power line carrier 1979.
CCIR	-	International Radio Consultative Committee
CCITT	-	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 23)	-	Electrical relays.
IEC-60297		
(P1 to P4)	-	Dimensions of mechanical structures of the 482.6mm (19 inches) series.
IEC-60359	-	Expression of the performance of electrical & electronic measuring equipment.
IEC-60387	-	Symbols for Alternating-Current Electricity meters.
IEC-60447	-	Man machine interface (MMI) - Actuating principles.
IEC-60521	-	Class 0.5, 1 and 2 alternating current watt hour metres
IEC-60547	-	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)
ANSI-81	-	Screw threads
ANSI-B18	-	Bolts and Nuts
ANSI-C37.1	-	Relays, Station Controls etc.
ANSI-C37.2	-	Manual and automatic station control, supervisory and associated telemetering equipment
ANSI-C37.2	-	Relays and relay systems associated with electric power apparatus
ANSI-C39.1	-	Requirements for electrical analog indicating instruments
MOTORS		

IS-325	-	Three Phase Induction motors
IS-4691	-	Degree of protection provided by enclosure for rotating electrical machinery
IEC-60034 (P1 to P19:)	-	Rotating electrical machines
IEC-Document 2	-	Three phase induction motors
(Central Office) NEMA-MGI	Motors and Generators	
Electronic equipment and components		
MIL-21B, MIL-833 & MIL-2750		
IEC-60068 (P1 to P5)	-	Environmental testing
IEC-60326 (P1 to P2)	-	Printed boards
		Material and workmanship standards
IS-1363 (P1 to P3)	-	Hexagon Head Bolts, Screws and Nuts of product grades C
IS-1364(P1 to P5)	-	Hexagon Head Bolts, Screws and Nuts of products grades A and B
IS-3138	-	Hexagon Bolts and Nuts (M42 to M150)
ISO-898	-	Fasterners: 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 core Al Conductors for overhead transmission lines
IS-731	-	Porcelain Insulators for overhead power lines with a nominal voltage greater than 1000 volts
IS-2486 (P1 to P4)	-	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 volts
IEC-60120	-	Dimensions of Ball and Socket Couplings of string insulator units.
IEC-60137	-	Insulated bushings for alternating voltages above 1000 V.
IEC-60168	-	Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V.
IEC-62155	-	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC-60273	-	Characteristices of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
IEC-61462	-	Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than

		1000V – Definitions, Test methods, acceptance criteria and design recommendations
IEC-60305	-	Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for a.c. systems Characteristics of String Insulator Units of the cap and pintype.
IEC-60372 (1984)	-	Locking devices for ball and socket couplings of string insulator units : dimensions and tests.
IEC-60383 (P1 and P2)	-	Insulators for overhead lines with a nominal voltage above 1000 V.
IEC-60433	-	Characteristics of string insulator units of the long rod type.
IEC-60471	-	Dimensions of Clevis and tongue couplings of string insulator units.
ANSI-C29	-	Wet process proelain insulators
ANSI-C29.1	-	Test methods for electrical power insulators
ANSI-C92.2	-	For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8	-	For wet-process porcelain insulators apparatus, post-type
ANSI-G.8	-	Iron and steel hardware
CISPR-7B	-	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153	-	Zinc Coating (Hot-Dip) on iron and steel hardware
Strain and rigid bus-conductor		
IS-2678	-	Dimensions and 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
ASTM-B 231-81	-	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	-	Aluminum - Alloy extruded bar, road, wire, shape
ASTM-B 236-83	-	Aluminum bars for electrical purpose (Bus-bars)
ASTM-B 317-83	-	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)
Batteryand battery 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 and Storage Batteries
IS-3116	-	Specification for sealing compound for Lead Acid Batteries
IS-1248	-	Indicating Instruments
IS-10918	-	Vented type Nickel Cadmium Batteries
IEC:60896-21&22	-	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC: 60623	-	Vented type nickel Cadmium Batteries
IEC:60622	-	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC:60623	-	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC:60896-11	-	Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests
IEEE-485	-	Recommended practices for sizing of Lead Acid Batteries
IEEE-1115	-	Sizing of Ni-Cd Batteries
IEEE-1187	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	-	Guide for selection of VRLA Batteries
Battery Charger		
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 Transformer
IS-2959	-	AC Contractors 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 voltages not exceeding 1000 Volts AC or 1200Volts DC
IS-2147	-	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS-6005	-	Code of practice for phosphating of Iron and Steel
IS-3231	-	Electrical relays for Power System Protection
IS-3842	-	Electrical relays 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 1100Volts
IS-1255	-	Code of practice for installation and maintenance of power cables upto and including 33kV
IS-1554 (P1 and P2)	-	PVC Insulated (Heavy Duty) Electric Cables (Part 1) for working voltages upto and including 1100Volts
IS-1753	-	Aluminum 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	-	Electrometric 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 33kV
IS-8130	-	Conductors for insulated electric cables and flexible cords
IS-1753	-	Aluminum conductor 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)	-	Calculation 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.

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

HORIZONTAL CENTRIFUGAL PUMPS

IS-1520	-	Horizontal Centrifugal pumps for clear, cold and fresh water
IS-9137	-	Code for acceptance test for centrifugal and 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 for tests for internal combustion system
IS-10002	-	Specification for performance requirements for constant speed compression ignition engines for general purposes (above 20KW)
ISO-3046	-	Reciprocating internal combustion engine 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 firefighting delivery hose
IS-638	-	Sheet rubber jointing and rubber inserting jointing
IS-778	-	Gun metal gate, globe and check valves for general purpose
IS-780	-	Sluice valves for water works purposes (50 to 300mm)
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 identification of pipe lines
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 1200mm size)
IS-3582	-	Basket strainers for fire fighting purposes (Cylindrical type)
IS-3589	-	Electrically welded steel pipes for water, gas and sewage (150 to 2000mm 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 (Part 1)	-	Swing check type reflex (non-return valves)
IS 5306	-	Code of practice for fire extinguishing installation and equipment on premises
Part – I	-	Hydrant system, hose reels and foam inlets
Part-II	-	Sprinkler system
BS:5150	-	Specification for cast iron gate valves

PG Test Procedures

NFPA-13	-	Standard for the installation of sprinkler system
NFPA-15	-	Standard for water spray fixed system for the fire protection
NFPA-12A	-	Standard for Halong 1301 Fire Extinguishing System
NFPA-72E	-	Standard on Antomatic Fire Detectors
NFPA-12	-	Standard on Carbon dioxide extinguisher systems

Electrical generating and distributing stations code of practice

Steel structures

IS-228	-	Method of Chemical Analysis of Pig iron, cast iron and plain carbon and low alloy steels
IS-802(P1 to P3)	-	Code of practice for use of structural steel in overhead transmission line towers
IS-806	-	Code of practice for use for steel tubes in general building construction
IS-808	-	Dimensions for hot rolled steel beams, column channel and angle sections
IS-814	-	Covered electrodes for manual arc welding of carbon manganese steel
IS-816	-	Code of practice for use of metal arc welding for general construction in mild steel
IS-817	-	Code of practice for training and testing of metal arc welders Part 1: Manual metal arc welding

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 and nuts of products grade C
IS-1364	-	Hexagonal head bolts, screws and nuts of products 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 purpose
IS-2595	-	Code of practice for radiographic testing
IS-3063	-	Single coil rectangular section spring washer for bolts, nuts and screws
IS-3664	-	Code of practice of ultrasonic pulse echo testing by contact and immersion method
IS-7205	-	Safety code for erection of structural steel work
IS-9595	-	Recommendation of metal arc welding of carbon and carbon manganese steels
ANSI-B18.2.1	-	Inch series square and Hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
ANSI-G8.14	-	Round head bolts
ASTM-A6	-	Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use
ASTM-A36	-	Specifications of structural steel
ASTM-A47	-	Specification for malleable iron castings
ASTM-A143	-	Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for detaching embrilement
ASTM-A242	-	Specification for high strength low alloy structural steel
ASTM-A283	-	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	-	Specification for Galvanized steel transmission tower bolts and nuts
ASTM-441	-	Specification for High strength low alloy structural manganese vanadium steel.
ASTM-A572	-	Specification for High strength low alloy colombium-Vanadium steel of structural quality

AWS D1-0	-	Code for welding in building construction welding inspection
AWS D1-1	-	Structural welding code
AISC	-	American institute of steel construction
NEMA-CG1	-	Manufactured graphite electrodes
Piping and pressure vessels		
IS-1239 (Part 1 &2)	-	Mild Steel Tubes, tubular and other wrought steel fittings
IS-3589	-	Seamless Electrically welded steel pipes for water, gas and sewage
IS-6392	-	Steel Pipe Flanges
ASME	-	Boiler and pressure vessel code
ASTM-A120	-	Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use
ASTM-A53	-	Specification for pipe, steel, black, and hot-dipped, zinc coated welded and seamless
ASTM-A106	-	Seamless carbon steel pipe for high temperature service
ASTM-A284	-	Low and intermediate tensile strength carbon-silicon steel plates for machine parts and general construction.
ASTM-A234	-	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-S181	-	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	-	Forgings, carbon steel for piping components
ASTM-A307	-	Carbon steel externally threated standard fasteners
ASTM-A193	-	Alloy steel and stainless steel bolting materials for high temperature service
ASTM-A345	-	Flat rolled electrical steel for magnetic applications
ASTM-A197	-	Cupola malleable iron
ANSI-B2.1	-	Pipe threads (Except dry seal)
ANSI-B16.1	-	Cast iron pipe flangesand glanged fitting. Class 25, 125, 250 and 800
ANSI-B16.1	-	Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	-	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	-	Factory-made wrought steel butt welding fittings
ANSI-B16.11	-	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	-	Ferrous pipe plug, bushings and locknuts with piplethreads
ANSI-B16.25	-	Butt welding ends
ANSI-B18.1.1	-	Fire hose couplings screw thread.
ANSI-B18.2.1	-	Inch series square and hexagonal bolts and screws

ANSI-B18.2.2	-	Square and hexagonal nuts
NSI-B18.21.1	-	Lock washers
ANSI-B18.21.2	-	Plain washers
ANSI-B31.1	-	Power piping
ANSI-B36.10	-	Welded and seamless wrought steel pipe
ANSI-B36.9	-	Stainless steel pipe

ACSR MOOSE CONDUCTOR

IS-6745	-	Method for Determination of mass of Zinc coatings on Zinc coated Iron and Steel articles
IS-209	-	Zinc Ingot
IS-398 Part- V	-	Aluminium Conductors for Overhead Transmission
IS-1778	-	Reels and Drums for Bare Conductors
IS-2629	-	Recommended practice for Hot dip galvanizing on Iron and Steel
IS-2633	-	Methods for testing uniformity of coating of zinc coated articles
IS-4826	-	Hot dip Galvanized coatings on Round Steel WiresPurposes
BS:215(Part-II)	-	Aluminum Conductors galvanized steel reinforced extra high voltage (400 kV and above)

GALVANISED STEEL EARTHWIRE

IS-1521	-	Method for tensile testing of steel wire
IS-1778	-	Reels and Drums for Bare Conductors
IS-2629	-	Recommended practice for Hot dip galvanizing on Iron and Steel
IS-2633	-	Methods for testing uniformity of coating of zinc coated articles
IS-4826	-	Hot dip Galvanized coatings on Round Steel Wires
IS-6745	-	Method for Determination of mass of Zinc coatings on Zinc coated Iron and Steel articles
IS-209	-	Zinc Ingot
IS-398 (P1 to P5:1992)	-	Aluminium Conductors for overhead transmission purposes.

ANNEXURE - B

Sl No.	LIST OF DRAWINGS/DOCUMENTS
1	Single Line Diagram
2	Electrical Layout – Plan and Sections
3	Tower, Equipment & cable trench layout drawing
4	Earthing system design calculation & layout drawing
5	Lighting protection system design & drawings
6	Structure Layout (Plan & Section) drawing
7	Cantilever Strength calculations (if applicable)
8	Design calculation for Sag – Tension stringing chart
9	GTP and drawings for Bus-Post Insulator
10	Tension/suspension string insulator and Hardware Assembly GTP and drawing
11	Soil Investigation Report (if applicable)
12	**Circuit Breakers (220kV,132kV, 33 kV- As applicable)** - GA drawing, GTP, Type test Reports
13	**CTs & CVTs (220kV,132 kV, 33kV- As applicable)** - GA drawing, GTP, Type test Reports
14	**Surge Arrestors (216kV,120kV, 30kV- As applicable)** - GA drawing, GTP, Type test Reports
15	**Isolators (220kV,132kV, 33 kV- As applicable)** - GA drawing, GTP, Type test Reports
16	**Capacitor Bank 39.78MVAR,36kV** - GA drawing, GTP, Type Test Reports
17	**Control, Relay Panels and Substation Automation system** - GTP, technical literature, type test reports
18	**PLCC, LINE TRAP & Digital Protection Coupler** - GTP and technical literature
19	**Civil Works (as applicable)** **a)** Control Room cum Administrative Building structure design, Foundation Design & Drg., Plinth Beam Design & Drg. and column Design & Drg. upto G.F./F.F Level **b)** Auto transformer foundation design/drawings **c)** Reactor foundation design/drawings **d)** 220/132/33kV Tower, structure & foundation design/drawings. **e)** 220/132/33kV Equipment support structure & foundation design/drawing
20	Gas Insulated Sub Station Drawing

NOTE:

1. The above list of drawing/document is only illustrative and not exhaustive. The contractor shall submit drawings/documents as per requirement of Technical specification.

TECHNICAL SPECIFICATION
VOL-II, SEC-III
220kV GAS INSULATED SWITCHGEAR

GENERAL CHARACTERISTICS

1.1. The SF6 gas insulated metal enclosed switchgear shall be totally safe against inadvertent touch of any of it's constituent parts. It should be designed for indoor application with meteorological conditions at site as per Section Project.

1.2. All parts of the switchgear and the bus ducts (for both indoor and outdoor applications) shall be single phase/three phase enclosed for 220kV and three phase enclosed for 132 KV.

1.3. 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.

1.4. The required overall parameters of GIS are as follows:-

Sl. No	Technical particulars	220 kV System	132KV system
1.	Rated Voltage (RMS)	245 kV	145 kV
2.	Rated frequency	50 HZ	50 HZ
	Grounding	Effectively earthed	Effectively earthed
3.	Rated power frequency withstand Voltage (1 min) line to earth (rms)	460 kV	275 kV
4.	Impulse withstand BIL (1.2/50/mic. Sec) Line to earth	1050 kVp	650 kVp
5.	Switching impulse voltage (250/2500 mic.-sec)	-	-
6.	Rated short time withstand current (1 sec) (As applicable)	50/ 40 kA (rms)	31.5kA (rms)
7.	Rated peak withstand current (as applicable)	125/100 kA (peak)	78.75kA (peak)
8.	Rated current (at 50 degree C design ambient temperature)	As per Bid Price schedule	
9.	Seismic level	"High" (as per clause no 4.2 of IEC-62271-207)	

		for the area under the Zone-V as per IS-1893. "Medium" (as per clause no 4.2 of IEC-62271- 207) for the area under other than the Zone-V as per IS-1893

2. 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 as on date of bid opening:

IEC 62271-203	Gas Insulated metal-enclosed switchgear for rated voltages above 52 KV
IEC 62271-207	Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52 kV
IEC 60376	New sulphur hexafluoride
IEC 62271- 100	High voltage alternating current Circuit breakers
IEC 62271-1	Common clauses for high voltage Switchgear and control-gear standards
IEC 62271-102	Alternating current disconnectors(isolators) and earthing switches
IEC 61869-2	Current transformers
IEC 61869-3	Voltage transformers
IEC 60137	Bushings for alternating voltages above 1000 V
IEC 62271-209	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.
IEEE 80 (2000)	IEEE Guide for Safety in AC Substation grounding.
CIGRE-44	Earthing of GIS- an application guide. (Electra no.151,Dec'93).
IEC 61639	Direct connection between Power Transformers and gas insulated metal enclosed switchgear for rated voltage 72.5 kV and above.

The components and devices which are not covered by the above standards shall conform to, and comply with, the applicable standards, rules, codes and regulations of the internationally recognized standardizing bodies and professional societies as may be approved by the Employer and the manufacturer shall list all such applicable standards, codes etc.

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. 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 equipment.

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 Operation: 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 gas-tight volume.

4. GENERAL DESIGN AND SAFETY REQUIREMENT

4.1. The GIS shall be designed, manufactured and tested in accordance with the best international engineering practices under strict quality control to meet the requirement stipulated in the technical specification. Adequate safety margin with respect to thermal, mechanical, dielectric stress and insulation coordination etc. shall be maintained during

design, selection of raw material, manufacturing process etc. so that the GIS provides long life with least maintenance.

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

4.2. 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-energising 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 pressures developing within the enclosures under worst operating conditions, thus providing controlled pressure relief in the affected compartment.

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 free of any voids and free of partial discharge at a voltage which is at least 5% greater than the rated voltage. These shall be designed to have high structural and dielectric strength 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.

4.4. Gas barrier insulators shall be provided so as to divide the GIS into separate compartments. These 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 during maintenance, this compartment shall be designed so that it shall remain in service to perform its intended duty. The gas tight barriers shall be clearly marked on the outside of the enclosures.

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. The design of 220 kV GIS shall be such that in case a circuit breaker module of a feeder is removed for maintenance, both busbars shall remain in service. Further the design of 132kV GIS shall be such that that in case a circuit breaker module of a feeder is removed for maintenance, the bus bar shall remain in service. For achieving the above requirements,

adequate Mechanical support and number of intermediate gas tight compartments as required, shall be provided to ensure equipment and operating personnel's safety.

Typical drawings indicating gas tight compartments are enclosed at **Annexure-A**.

4.5. The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through for a period of 300 ms at rated short time withstand current. 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.

4.6. 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 Disconnectors and earth switches.

4.7. 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.

4.8. 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.

4.9. The maximum SF6 gas leakage shall not exceed 0.5% (half percent) per year for the whole equipment and for any individual gas compartment separately. The SF6 gas leakage should not exceed 0.5% per year and the leakage rate shall be guaranteed for at least 10 years. In case the leakage under the specified conditions is found to be greater than 0.5% after one year of commissioning, the manufacturer will have to supply free of cost, the total gas requirement for subsequent ten (10) years, based on actual leakage observed during the first year of operation after commissioning

4.10. 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 vapour which may penetrate into the enclosures as well as the by-products of SF6 during interruption. Each gas compartment shall be fitted with non-return valve connectors for evacuating & filling the gas and checking the gas pressure etc.

4.11. 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.

4.12. The thermal rating of all current carrying parts shall be minimum for one sec. for the rated symmetrical short-circuits current.

4.13. 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:

13.1) Bus bars
13.2) Intermediate compartment
13.3) Circuit breakers
13.4) Line Disconnectors
13.5) Voltage Transformers
13.6) Gas Insulated bus duct section between GIS and XLPE cable/Overhead Conductor.
13.7) Gas Insulated bus section between GIS & Oil filled Transformer/ Reactor (if applicable)

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. The layout of the substation equipment, bus bars and switchgear bays shall preferably be based on the principle of "phase grouping". Switchgear layout based on the "mixed phases" principle shall not be accepted without mutual agreement between supplier and employer. The arrangement of the equipment offered must provide adequate access for operation, testing and maintenance.

4.16. All the elements shall be accessible without removing support structures for routine inspections. 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. All interlocks that prevent potentially dangerous mal-operations shall be constructed such that they cannot be operated easily, i.e. the operator must use tools or brute force to over-ride them.

4.18. 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. 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.

4.19. The GIS shall be designed, so as to take care of the VFT over voltages generated as a result of pre-strikes and re-strikes during isolator operation. Maximum VFT over voltages peak shall not be higher than rated lightning impulse withstand voltage (LIWV) of the equipment. Necessary measures shall be under taken by GIS manufacture to restrict maximum VFT over voltages lower than the LIWV. Manufacturer shall submit the study report of VFTO generated for GIS installation.

4.20. 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.

4.21. 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.

4.22. 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.

4.23. The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electro-dynamic stresses even under short circuit conditions. The average intensity of electromagnetic field shall not be more than 50 micro-tesla on the surface of the enclosure. The contractor shall furnish all calculations and documents in support of the above during detailed engineering.

4.24. 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.

4.25. The ladders and walkways shall be provided wherever necessary for access to the equipment.

4.26. 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 heaters shall be so arranged and protected as to create no hazard to adjacent equipment from the heat produced.

4.27. The enclosure & support structure shall be designed that person of 1780 mm in height and 80 Kg in weight is able to climb on the equipment for maintenance.

4.28. The sealing provided between flanges of two modules / enclosures shall be such that long term tightness is achieved.

4.29. 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.

Gas Insulating System:

i) Loss of Gas Density.

ii) Loss of Heater power(if required)

iii) Any other alarm necessary to indicate deterioration of the gas insulating system.

Operating System:

i) Low operating pressure.

ii) Loss of Heater power.

iii) Loss of operating power.

iv) Loss of control supply.

v) Pole Discordance.

4.30. The equipment will be operated under the following ambient conditions(**or as defined in the section project**):

a) The ambient temperature varies between 0 degree-C and 50 degree-C. However, for design purposes, ambient temperature should be considered as 50 degree-C.

b) The humidity will be about 95% (indoors)

c) The elevation is less than 1000 metres

4.31. Optical beam fire detector shall be provided in line with TAC Guideline for 220kV GIS, if height of GIS hall is more than 10 m.

4.32. Temperature rise of current carrying parts shall be limited to the values stipulated in IEC-62271-1, under rated current and the climatic conditions at site. The temperature rise for accessible enclosure expected to be touched in normal operation shall not exceed 20 degree C above the ambient temperature of 50 degree C. In case of enclosures, which are accessible but need not be touched during normal operation, the temperature rise maybe permitted upto 30 degree C above the ambient of 50 degree C.

4.33. Bellows or Compensating Units:- Adequate provision shall be made to allow for the thermal expansion of the conductors & enclosures and of differential thermal expansion between the conductors and the enclosures. The bellows metallic(preferably stainless steel) with suitable provision for permitting the movement during expansion and contraction may be provided and shall be of following types:.

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 vibrations caused by the transformers and shunt reactors when connected to SF6 switchgear by oil- SF6 bushings.

The electrical connections across the bellows or compensating units shall be made by means of suitable connectors. For sliding type compensators, markers/pointers shall be provided to observe expansion or contraction during climatic conditions.

4.34. 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 from the floor or the platform in the vicinity of the equipment.

Inspection windows shall also be provided with all isolators and earth switches so that the switch contact positions can be verified by direct visual inspection.

4.35. Pressure relief device : Pressure relief devices shall be provided in the gas sections to protect the 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.

4.36. 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.)

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 type test on each type of enclosure.

Each enclosure has to be tested as a routine test at 1.5 times the design pressure for one minute.

4.37. Grounding:

4.36.1. 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.

4.36.2. The GIS supplier shall define clearly what constitutes the main grounding bus of the GIS. The contractor shall supply the entire material for grounding bus of GIS viz. conductor, clamps, joints, operating and safety platforms etc. The contractor is also required to supply all the earthing conductors and associated hardware material for connecting all GIS equipment, bus ducts, enclosures, control cabinets, supporting structure, GIS surge arrestor etc. to the ground bus of GIS.

4.36.3. 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, cable terminals, surge arrestors, earth switches and at

each end of the bus bars. The grounding continuity between each enclosure shall be effectively interconnected externally with Copper /Aluminum bonds of suitable size to bridge the flanges. Subassembly to subassembly bonding shall be provided to bridge the gap & safe voltage gradients between all intentionally grounded parts of the GIS assembly & between those parts and the main grounding bus of the GIS.

4.36.4. Each marshaling 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.

4.36.5. 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.

4.36.6. 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.

4.36.7. The contractor shall provide suitable measure to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrestor, phase to earth fault and discharges between contacts during switching operation. The grounding system shall ensure safe touch & step voltages in all the enclosures.

4.37. **UHF sensors for PD detection**: Contractor shall provide adequate number of UHF sensors in the offered GIS for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system and the number and location of these sensors shall be subject to approval of the employer. Further UHF sensors shall necessarily be provided in close proximity to VT compartments

However adequacy of number of sensors and their location shall be verified at site by the contractor as per recommendations of CIGRE task force TF 15/33.03.05 (**Task force on**

Partial discharge detection system for GIS: Sensitivity verification for the UHF method and the acoustic method). In case during site testing additional UHF sensors are required, the same shall also be supplied& installed to complete the technical requirement.

4.38. Gas Insulated Bus (GIB) layout:

GIB shall be designed based on the following criteria

(38.1) Maximum weight of gas in a gas tight section of GIB shall not exceed 250 Kg (for 220 kV & 132 kV).

(38.2) GIS bus ducts of each circuit shall be arranged in preferably horizontal formation and the clearance (outer to outer) between nearest bus ducts of two adjacent circuits shall be minimum one (1) meter.

(38.3) GIB shall be generally in only one horizontal layer. However in exceptional circumstance two horizontal GIB layers can be provided with the approval of PDD J&K and the vertical clearance between layers shall be minimum one

(38.3.1) meter in such case.

(38.4) The minimum outer to outer horizontal clearance between each GIS bus duct shall be 0.5 meter for 220 kV & 132 kV voltage level.

(38.5) The minimum vertical ground clearance of GIB at road crossing shall be 5.5 meters

(38.6) The horizontal clearance between GIB and GIS building /any other building wall shall be minimum three (3) meters.

(38.7) The GIB route inside the GIS Hall shall not obstruct easy access to GIS and control room buildings and shall not obstruct movement of crane, equipment including HV test equipment for maintenance works.

(38.8) The GIB height outside the GIS hall in switchyard area shall not obstruct easy access to GIB, movement of crane for maintenance work.

(38.9) Optimisation of outdoor GIB length using overhead AIS connection with Bus Post Insulator of respective voltage class is generally acceptable subject to meeting the electrical clearances as stipulated.

(38.10) For the maintenance of GIB of one circuit, only that circuit shall be isolated

4.39. A portable ladder with adjustable height shall be supplied to access the GIS equipment for O&M purpose.

4.40. Extension of GIS

4.40.1. The arrangement of gas sections or compartments shall be such as to facilitate future extension of any make 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.

4.40.2. As the GIS is likely to be extended in future, the contractor shall make available during detailed engineering stage, the complete design detail of interface module such as cross section, enclosure material, enclosure dimensions (inner & outer), Flange diameter (inner

& outer), conductor connection arrangement, bolt spacing & dimension, rated gas pressure etc. Further GIS manufacturer supplying GIS under present scope shall furnish all the required details in addition to mentioned above necessary for design and successful implementation of an interface module during later stage while extending GIS by any other GIS manufacturer, without any help of GIS manufacturer who has supplied the GIS equipment in present scope.

4.40.3. The Interface module shall be designed to provide Isolating link with access hole on enclosure. The Isolating link shall be provided in such a way so that HV test can be performed on either side of the interface module separately, keeping other side of GIS remain isolated.

4.40.4. Further the contractor who is extending the existing GIS installation shall optimally utilize the space inside the GIS hall (including the extension portion) for accommodating the interface module being supplied under the contract and the space (along the length of the hall) inside the GIS hall for interface module shall preferably be limited to 1 meter for 220/132kV

4.41. SF6 GAS

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.

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)

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.

The contractor 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.

The contractor 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.

The contractor shall also indicate the details and type of filters used in various gas sections, and should also submit the operating experience with such filters.

4.41.1. **SF6 gas monitoring devices and alarm circuits:** Dial type temperature compensated gas density monitoring devices with associated pressure gauge will be provided. The devices shall provide continuous & automatic monitoring of gas density & a separate device shall be provided for each gas compartment so that each compartment can be monitored simultaneously as follows:-

Sl. no	Compartment/ Compartments except CB	Circuit Breaker compartments
1	**"Gas Refill level:** This will be used to annunciate the need for the gas refilling. The contractor shall provide a contact for remote indication.	**'Gas Refill' level :** This will be used to annunciate the need for gas refilling. The contractor shall provide a contact for remote indication.
2	**"SF6 low level":** This will be used to annunciate the need for urgent gas filling. A contact shall be provided for remote indication	**"SF6 low level":** This will be used to annunciate the need for urgent gas filling. A contact shall be provided for remote indication

3	**'Zone Trip' level:**	**'Breaker Block' level:**
	This is the minimum level at which the Manufacturer will guarantee the insulation rating of the assembly.	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 and the closing & tripping circuit shall be blocked
4	**Not Applicable**	**'Zone Trip' level:** This is the Minimum level at which the manufacturer will guarantee the insulation rating of the assembly.

The density monitor/pressure switch contacts shall be in accordance with the above requirement.

4.41.2. The contractor 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.

4.41.3. **Gas Supply:** The contractor shall include the supply of all SF6 gas necessary for filling & putting into operation the complete switchgear installation being supplied. The empty gas cylinders shall be returnable to the contractor.

5. CIRCUIT BREAKERS

5.1. 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 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.

5.2. 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 effectively grounded system and perform make and break operations as per the stipulated duty cycles satisfactorily.

5.3. The circuit breaker shall be capable of:

1. Interrupting the steady and transient magnetizing current shall be as follows:

Voltage Level	Type of Transformer	Rating (in MVA)
220kV	**400/220kV**	**250 to 630**
	220/132kV	**50 to 200**
132kV	**220/132kV**	**50 to 200**
	132/33kV	**10 to 50**

2. Interrupting line/cable charging current as per IEC without re-strikes and without use of opening resistors. The breaker shall be able to interrupt the rated line charging current as

per IEC-62271-100 with test voltage immediately before opening equal to the product of $U/\sqrt{3}$ and 1.4

3. Clearing short line fault (Kilometric faults) with source impedance behind the bus equivalent to symmetrical fault current specified.

4. Breaking 25% the rated fault current at twice the rated voltage under phase opposition condition.

5. The breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energisation of shunt reactor and/or series capacitor compensated lines with trapped charges.

6. Withstanding all dielectric stresses imposed on it in open condition at lock out pressure continuously (i.e. shall be designed for 2 p.u. across the breaker continuously, for validation of which a power frequency withstand test conducted for a duration of at least **15** minutes is acceptable).

7. Circuit breakers shall be able to switch in and out the shunt reactor as detailed below:

Voltage Level	**Reactor Rating (in MVAR)**	**Max. rise of overvoltage (in p.u.)**
220kV	**25 to 50**	**2.3**

5.4. Total Break Time : The total break time shall not be exceeded under any of the following duties :

a) Test duties T10,T30,T60,T100 (with TRV as per IEC- 62271-100)

b) Short line fault L90, L75 (with TRV as per IEC-62271-100)

The Contractor 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%), pneumatic/hydraulic pressure and SF6 gas pressure etc. While furnishing the proof for the total break time of complete circuit breaker, the contractor 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.

5.5. Constructional features : The features and constructional details of breakers shall be in accordance with requirements stated hereunder:

5.6.1. **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.

5.6.2. 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.

5.6.3. 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.

5.6.4. 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 p.u. power frequency voltage across the breaker continuously)

5.6.5. 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.

5.6.6. Provisions shall be made for attaching an operational analyzer to record travel, speed and making measurement of operating timings etc. after installation at site. The contractor shall supply three set of transducer for each substation covered under the scope.

5.6.7. Circuit Breaker shall be supplied with auxiliary switch having additional 8 NO (normally open) and 8 NC (normally closed) contacts for future use over and above those required for switchgear interlocking and other control and protection function. These spare NO and NC contacts shall be wired up to the local control cubicle.

5.7. Operating mechanism

5.7.1. General Requirements:

7.1. a)Circuit breaker shall be operated by spring charged mechanism or electro 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.

7.1. 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.

7.1.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 anti-pumping and trip free (as per IEC definition) under every method of closing.

7.1.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.

7.1.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.

7.1.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.

7.1.g) The contractor shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker.

5.7.2. Control

7.2.a) The close and trip circuits shall be designed to permit use of momentary-contact switches and push buttons.

7.2.b) Each breaker pole shall be provided with two (2) independent tripping circuits and trip coils which may be connected to a different set of protective relays.

7.2.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 control cabinet.

7.2.d) The trip coil shall be suitable for trip circuit supervision during both open and close position of breaker.

7.2.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.

7.2.f) 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 shall be monitored for remote annunciations and operation lockout in case of dc failures.

7.2.g) The auxiliary switch of the breaker shall be positively driven by the breaker operating rod.

5.7.3. Spring operated Mechanism

7.3.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.

7.3.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.

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

7.3.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 90 seconds for full charging of the closing spring.

7.3.e) Closing action of circuit breaker shall compress the opening spring ready for tripping.

7.3.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 control cabinet & SAS.

7.3.g) Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition.

7.3.h) Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in the closed position.

7.3.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.

5.7.4. Hydraulically Operated Mechanism:

7.4.a) Hydraulically operated mechanism shall comprise of operating unit with power cylinder, control valves, high and low pressure reservoir, motor etc.

7.4.b) The hydraulic oil used shall be fully compatible for the temperature range to be encountered during operation.

7.4.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.

7.4.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.

7.4.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.

7.4.f) Trip lockout shall be provided to prevent operations of the circuit breaker below the minimum specified hydraulic pressure. Alarm contacts for loss of Nitrogen shall also be provided.

7.4.g) All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage.

5.8. The technical parameters of Circuit breakers are as per Annexure -1

5.9. Additional data to be furnished during detailed engineering:

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.

5.10. Tests:

5.10.1. **Type Tests**:

i. 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.

ii. The type test report of Electromagnetic Compatibility Test (EMC) of CSD shall be submitted for approval

5.10.2. 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.

i. 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 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 provided.

ii. Functional tests are to be carried out on circuit breaker along with Control Switching device (CSD).

iii. DCRM (Dynamic Contact Resistance Measurement) to be carried out for all CBs during routine test.

6. DISCONNECTORS (ISOLATORS)

6.1. Disconnectors shall be three-pole group operated or Single-pole individual operated (as per single line diagram of the substation) and shall be installed in the switchgear to provide electrical isolation. The disconnectors shall conform to IEC- 62271-102 and shall have the ratings as specified in BPS.

6.2. Construction & Design.

6.2.1. The disconnectors shall be operated by electric motor suitable for use on 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.

6.2.2. Disconnectors shall be suitable to switch the bus charging currents during their opening and closing and shall confirm to all three test duties viz. TD1, TD2 and TD3 as per Annexure –F of IEC: 62271- 102.They shall also be able to make and break rated bus transfer current at rated bus transfer voltage which appears during transfer between bus bars in accordance with Annexure –B of IEC: 62271-102. The contact shielding shall also be designed to

prevent restrikes and high local stresses caused by transient recovery voltages when these currents are interrupted.

6.2.3. 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.

6.2.4. 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.

6.2.5. 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.

6.2.6. 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 Local Control Cabinet (LCC) .

6.2.7. Remote control of the disconnectors from the control room/SAS shall be made by means of remote/ local transfer switch.

6.2.8. 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.

6.2.9. Each disconnector shall be supplied with auxiliary switch having additional 4 NO (Normally Open) and 4 NC (Normally Closed) contacts for future use over and above those required for switchgear interlocking and automation purposes. These spare NO and NC contacts shall be wired up to the local control cabinet.

6.2.10. 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.

6.2.11. 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.

6.2.12. The disconnectors and safety grounding switches shall have an 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, provision for mechanical padlock shall be made. Integrally mounted lock when provided shall be equipped with a unique key for such three phase group. Master key is not permitted.

6.2.13. The local control of the Isolator and high-speed grounding switches from the Local Control Cabinet (LCC) should be achieved from the individual control switches with the remote/local transfer switch set to local.

6.2.14. All electrical sequence interlocks will apply in both remote and local control modes.

6.2.15. Each disconnector shall have a clearly identifiable local, positively driven mechanical position indicator, together with position indicator on the local control cubicle (LCC) and provisions for taking the signals to the control room. The details of the inscriptions and colouring for the indicator are given as under :

INSCRIPTION		COLOUR
Open position	OPEN	GREEN
Closed position	CLOSED	RED

6.2.16. 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.

6.2.17. The disconnecting switches shall be provided with rating plates and shall be easily accessible.

6.2.18. The mechanical endurance class shall be M2 as per IEC for 220kV and it shall be M1 class for 132kV disconnectors.

6.2.19. Mechanical position indication shall be provided locally at each disconnector and Electrical indication at each Local Control Cabinet (LCC) / SAS.

6.3. The technical parameters of disconnectors are as per **Annexure-2**

7. SAFETY GROUNDING SWITCHES

7.1. Safety grounding switches shall be three-pole group operated or single-pole individual operated (as per single line diagram of the substation). It shall be operated by DC electric motor and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over-current and short circuit.

7.2. Each safety grounding switch shall be electrically interlocked with its associated disconnectors and circuit breaker such that it can only be closed if both the circuit breaker and disconnectors are in open position. Safety grounding switch shall also be mechanically key interlocked with its associated disconnectors.

7.3. Each safety grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the Local Control Cabinet (LCC) and provision for taking the signal to Control room.

7.4. The details of the inscription and colouring for the indicator are given as under :

	INSCRIPTION	COLOUR
Open position	OPEN	GREEN
Closed position	CLOSED	RED

7.5. Interlocks shall be provided so that manual operation of the switches or insertion of the manual operating device will disable the electrical control circuits.

7.6. Each ground switch shall be fitted with auxiliary switches having 4 NO (Normally Open) and 4 NC (Normally Closed) contacts for use by others over and above those required for local interlocking and position indication purposes.

7.7. Provision shall be made for padlocking / suitable locking arrangement for the ground switches in either the open or closed position.

7.8. 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 100 sq. mm.

7.9. The main grounding connections on each grounding switch shall be rated to carry the full short circuit current 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.

7.10. The safety grounding switches shall conform to the requirements of IEC- 62271- 102 and shall have electrical endurance class: E0 & shall have mechanical endurance M1 for 220/132 kV voltage level.

7.11. Combined Disconnectors & Safety grounding switch arrangement shall also be acceptable.

7.12. Mechanical position indication shall be provided locally at each switch and Electrical indication at each Local Control Cabinet (LCC) / SAS.

7.13. Continuous current rating of the grounding switches (not less than 100A) shall be specified by the manufacturer, which can be safely injected for Bay/ Bus equipment testing.

8. HIGH SPEED MAKE PROOF GROUNDING SWITCHES:

8.1. Grounding switches located at the beginning of the line feeder bay modules shall be of the high speed, make proof type and will be used to discharge the respective charging currents, trapped charge in addition to their safety grounding function. These grounding switches shall be capable of interrupting the inductive and capacitive currents and to withstand the associated TRV. These shall confirm to class B and electrical endurance class E1 as per annexure – C of IEC : 62271-102

8.2. High Speed Grounding switches shall be provided with individual/three pole operating mechanism suitable for operation from DC.

8.3. The switches shall be fitted with a stored energy closing system to provide fault making capacity.

8.4. The short circuit making current rating of each ground switch shall be at least equal to its peak withstand current rating as stated in clause 1.4 above. The switches shall have inductive / capacitive current switching capacity as per IEC-62271-102.

8.5. Each high speed make proof grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the Local Control Cabinet (LCC) and provision for taking the signal to Control Room/SAS.

8.6. The details of the inscription and colouring for the indicator shall be as under:-

	INSCRIPTION	COLOUR
Open position	OPEN	GREEN
Closed position	CLOSED	RED

8.7. High speed ground switch operation should be possible locally from Local Control Cabinet (LCC)

8.8. These high speed grounding switches shall be electrically interlocked with their associated circuit breakers and disconnectors so that the grounding switches cannot be closed if disconnectors are closed. Interlocks shall be provided so that the insertion of the manual operating devices will disable the electrical control circuits.

8.9. Each high speed ground switch shall be fitted with auxiliary switches having 4 NO (Normally Open) and 4 NC (Normally Closed) 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 Control Cabinet. Provision shall be made for padlocking the ground switches in their open or closed position.

8.10. 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 100 sq. mm.

8.11. 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.

8.12. The high speed make proof grounding switches shall confirm to the requirements of IEC-62271-102.

8.13. Continuous current rating of the High speed grounding switches (not less than 100A) shall be specified by the manufacturer, which can be safely injected for Bay/ Bus equipment testing.

9. INSTRUMENT TRANSFORMERS

9.1. Current Transformers

The current transformers and accessories shall conform to IEC: 60044-1 and other relevant standards except to the extent explicitly modified in the specification.

9.1.1. **Ratios and Characteristics: The** CT core distribution for various voltage levels shall be as per Table 3A, 3B, 3C & 3D. Further the numbers of cores, rating, ratios, accuracy class, etc. for the individual current transformers secondary cores shall be in accordance with above table.

Where multi-ratio current transformers are required the various ratios shall be obtained by changing the effective number of turns on the secondary winding.

9.1.2. **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 SF6 gas section shall be clearly marked by two plates fixed to the enclosure at each end of the current transformer.

9.1.3. Constructional Details:

1.3.a) The current transformers incorporated into the GIS will be used for protective relaying and metering purposes and shall be of metal- enclosed type.

1.3.b) Each current transformer shall be equipped with a secondary terminal 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.

1.3.c) Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

1.3.d) For 245/145 kV class CTs, the rated extended primary current shall be 120% (or 150% if applicable) on all cores of the CTs as specified in the Section – Project.

1.3.e) For 245/145 kV current transformer, characteristics shall be such as to provide satisfactory performance of burdens ranging from 25% to 100% of rated burden over a range of 5% to 120%(or specified rated extended current whichever is higher) of rated current in case of metering CTs and up to the accuracy limit factor/knee point voltage in case of relaying CTs.

1.3.f) The instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably built in construction of the CTs.

1.3.g) The wiring diagram, for the interconnections of the three single phase CTs shall be provided inside the Secondary terminal box.

1.3.h) The current transformers shall be suitable for high speed auto-reclosing.

1.3.i) Provisions shall be made for primary injection testing either within CT or outside.

1.3.j) All the current transformers shall have effective electromagnetic shields to protect against high frequency transients. Electromagnetic shields to be provided against high frequency transients typically 1-30 MHz.

9.2. VOLTAGE TRANSFORMERS

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.

9.2.1. **Ratios and Characteristics**: The rating, ratio, accuracy class, connection etc. for the voltage transformers shall be in accordance with annexure -4 & Table 4A and Table 4B

9.2.2. **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.

9.2.3. Secondary Terminals, Earthing

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.

9.2.4. The transformer shall be able to sustain full line to line voltage without saturation of transformer.

9.2.5. Constructional Details of Voltage Transformers:

2.5.a) The voltage transformers shall be located as a separate bay module and will be connected phase to ground and shall be used for protection, metering and synchronization.

2.5.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 supplier shall ensure that there is no risk of Ferro resonance due to the capacitance of the GIS.

2.5.c) The voltage transformers shall have three secondary windings.

2.5.d) Voltage transformers secondary shall be protected by Miniature Circuit breakers (MCBs) with monitoring contacts for all the windings. The secondary terminals of the VT's shall be terminated to preferably stud type non-disconnecting terminal blocks in the secondary boxes via the fuse.

2.5.e) The voltage transformer should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens.

2.5.f) The accuracy of 0.2 on secondary III should be maintained throughout the entire burden range up to 50 VA on all the three windings without any adjustments during operation.

2.5.g) The diagram for the interconnection of the VTs shall be provided inside secondary terminal box.

9.3. Tests:

Current and voltage transformers shall conform to type tests and shall be subjected to routine test in accordance with IEC.

10. SURGE ARRESTORS

10.1. The surge arrestors shall confirm in general to latest IEC –60099-4.

10.2. 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 is indicative only. If the contractor feels that at some more locations the surge arrestors are required to be provided the same should also be deemed included in the offer.

The contractor shall perform all necessary studies and 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 arrestor and shall demonstrate that the selected arrestor's protective and withstand levels, discharge and coordinating currents and arrestor 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.

10.3. Duty requirements of GIS Surge Arrestor

10.3.1. The surge arrester shall be of heavy duty station class and gapless (Metal oxide) type without any series or shunt gaps.

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

10.3.3. 245 & 145kV class arrester shall be capable of discharging energy equivalent to class 3 of IEC for 245 kV & 145 kV systems respectively on two successive operations.

10.3.4. The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

10.3.5. The surge arresters are being provided to protect the followings whose insulation levels are indicated in the table given below:-

Equipment to be protected	220KV system	132KV system
	Lightning impulse (kVp)	Lightning impulse (kVp)
Power Transformer	+ 950	+ 550
Instrument Transformer	+ 1050	+ 650
Reactor	-	-
CB/Isolator Phase to ground	+ 1050	+ 650
CB/Isolator Across open contacts	+ 1200	+ 750

10.3.6. Constructional Features

The nonlinear blocks shall be of sintered/infered 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 supplier and each arrestor shall be fitted with a Online continuous resistive leakage current monitoring system. The system shall be provided with an interface to integrate with the substation automation system.

The main grounding connection from the surge arrestor to the earth shall be provided by the contractor. The size of the connecting conductor shall be such that all the energy is dissipated to the ground without getting overheated.

10.4. Tests

10.4.1. 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.

10.4.2. Each metal oxide block shall be tested for the guaranteed specific energy capability in addition to the routine/acceptance test as per IEC-60099.

10.4.3. 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.

10.5. **Technical Parameters** : Technical parameters are as per annexure 5;

11. OUTDOOR BUSHINGS:

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 -60137.

11.1. 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 and in highly polluted area it shall not be less than 31mm/kV (as per section-Project).

11.2. **Bushing types and fitting**: The details of bushing shall be as follows

SF6 to air Bushing shall be of Polymer / composite type and shall be robust and designed for adequate cantilever strength to meet the requirement of seismic condition, substation layout. The electrical and mechanical characteristics of bushings shall be in accordance with IEC: 60137. All details of the bushing shall be submitted for approval and design review.

Polymer / composite insulator shall be seamless sheath of a silicone rubber compound. The housing & weather sheds should have silicon content of minimum 30% by weight. It should protect the bushing against environmental influences, external pollution and humidity. The hollow silicone composite insulators shall comply with the requirements of the IEC publications IEC 61462 and the relevant parts of IEC 62217. The design of the composite insulators shall be tested and verified according to IEC 61462 (Type & Routine test)

11.3. **Mechanical forces on bushing terminals:** Outdoor bushings must be capable of withstanding cantilever forces due to weight of bus duct (GIB) on one side & AIS conductor/Al tube on the other side and short circuit forces. Design calculations in support of the cantilever strength chosen shall be submitted for owners review and approval.

11.4. Type test reports as per applicable IEC including radio interference voltage (RIV) test shall be submitted in line with the requirement as specified in section GTR for approval.

11.5. The technical parameters of Bushing are as per Annexure -6

12. SF6 GIS TO XLPE CABLE TERMINATION

12.1. The underground cables shall be connected to GIS by the interfacing of XLPE cable sealing end to GIS Cable termination enclosure.

12.2. The SF6 GIS to XLPE cable termination shall conform to IEC-62271-209.

12.3. The rating of XLPE cables for different voltages are specified in the Section project.

12.4. Cable termination kit shall be in the scope of the contract. The ducts and the casing shall be suitable for the requirements for which it is designed. This interface section shall be designed in a manner which will allow ease of operation and maintenance.

12.5. 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 contractor 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.

12.6. All supporting structures for the SF6 bus-duct connections between the XLPE cable sealing ends and the GIS shall be the scope of the contract. The supplier may specify alternative connecting & supporting arrangements for approval of the purchaser.

12.7. 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 general arrangement drawing of interconnecting bus-duct from GIS bay module to XLPE cable termination end shall also be submitted.

12.8. Type test reports of radio interference voltage (RIV) level shall be submitted for approval

13. TRANSFORMER / REACTOR TERMINATION MODULE

13.1.1. The transformer / reactor termination module enables a direct transition from the SF6 gas insulation to the bushing of an oil-insulated transformer / reactor. For this purpose, the transformer/reactor bushing must be oil-tight, gas-tight and pressure resistant. Any temperature related movement and irregular setting of the switchgear's or transformer's/reactor's foundations are absorbed by the expansion fitting.

13.1.2. The oil filled transformers and reactors are as shown in the substation SLD. The oil to air bushings of the transformers and reactors shall be supplied by the respective supplier's and the same shall be connected to the SF6 ducts thru air to SF6 bushings to be provided under present scope.

13.1.3. Terminal connection arrangement to connect GIS duct to bushing and duct mounting arrangement details shall be submitted during detailed engineering for Employer's approval and for co-ordination with transformer and reactor supplier. Any modification suggested by autotransformer and reactor supplier shall have to be carried out by the supplier to facilitate proper connection with the bushings of the autotransformer and reactors.

13.1.4. In case of single phase transformers are being installed in the substation, HV &IV auxiliary bus for the transformer bank for connecting spare unit shall be formed inside the GIS hall as per the SLD furnished and as specified in Section project .

13.1.5. In case of single phase reactors are being installed in the substation auxiliary bus of rated voltage for the reactor bank for connecting spare unit shall be formed inside the GIS hall as per the SLD furnished and as specified in Section project.

14. LOCAL CONTROL CUBICLE (LCC)

14.1. Functions

14.1.1. Each circuit-breaker bay shall be provided with a local control cubicle containing local control switches and a mimic diagram for the operation and semaphore for status indication of the circuit-breaker and all associated isolators and earth switches together with selector switches to prevent local and remote and supervisory controls being in operation simultaneously

14.1.2. Status indications in the LCC shall be semaphore type or LED type.

14.1.3. Closing of the circuit- breaker from the local control unit shall only be available when the breaker is isolated for maintenance purposes. Circuit-breaker control position selector, operating control switch and electrical emergency trip push button shall be installed in the Local Control Cubicle. Circuit-breaker control from this position will be used under maintenance and emergency conditions only. The emergency trip push buttons shall be properly shrouded.

14.1.4. If Disconnector or earth switch is not in the fully open or closed position a "Control Circuit Faulty" alarm shall be initiated, and electrical operation shall be blocked.

14.1.5. 20% spare terminals shall be provided in each LCC apart from terminals provided for the termination and interconnection of all cabling associated with remote and supervisory control, alarms, indications, protection and main power supply etc.

14.1.6. Where plugs and sockets connect control cabling between the local control cubicle and the switchgear these shall not be interchanged.

14.1.7. Hydraulic/pneumatic and SF6 auxiliary equipment necessary for the correct functioning of the circuit breaker, isolators and earth switches shall be located in a separate cubicle compartment.

14.1.8. LCC shall be suitable for remote operation from substation automation system (SAS). Each gas tight compartment shall be monitored individually per phase basis through SAS

14.2. Constructional features

14.2.1. Local Control cubicle shall be either mounted on the GIS with front access or free standing, floor mounting type. It 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.

14.2.2. Access to all compartments shall be provided by doors. All fastenings shall be integral with the panel or door and provision made for locking. Cubicles shall be well ventilated through vermin-proof louvers having anti insect screen. All doors shall be gasketed all around with suitably profiled Neoprene/EPDM gaskets conforming with provision of IS 11149. However, XLPE gaskets can also be used for fixing protective glass doors.

14.2.3. Each LCC panel should have its own separate AC supply source feed from the ACDB. The DC supply shall be from respective relay & protection panel power, control, interlocking, signaling. Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with Fuses. All fuses shall be HRC cartridge type conforming to IS: 13703 mounted on plug-in type fuse bases. The short time fuse rating of Fuses shall be not less than 9 KA. Fuse carrier base shall have imprints of the fuse 'rating' and 'voltage'.

14.2.4. Each LCC Panel shall be provided with the following

2.4.1. **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.

2.4.2. **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.

2.4.3. **Space Heater**: Each panel shall be provided with a thermostatically connected 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

14.2.5. Operating mechanisms, auxiliary switches and associated relays, control switches, control cable terminations, and other ancillary equipment shall be accommodated in sheet steel vermin proof cubicles.

14.2.6. Local control cubicles shall be provided to be free standing and shall be equipped with anti-condensation heaters. A suitable humidity stat and thermostat shall be included in the heater circuit.

14.2.7. The interior of each cubicle shall be finished with a semi gloss white surface. An interior lamp suitable for the local LVAC supply, controlled by a door-operating switch, shall be fitted at the top of each panel.

14.2.8. The arrangement of equipment within cubicles shall be such that access for maintenance or removal of any item shall be possible with the minimum disturbance of associated apparatus. All the control switches shall be internal i.e. installed behind a lockable glass door.

14.2.9. An interlocking scheme shall be provided that takes into account the following basic requirements.

- To safeguard maintenance personnel who may be working on one section of the equipment with other sections live.
- prevent incorrect switching sequences that could lead to a hazardous situation to plant, equipment and personnel.

14.2.10. Electrical bolt interlocks shall be energized only when the operating handle of the mechanism is brought to the working position. Visible indication shall be provided to show whether the mechanism is locked or free. Means, normally padlocked, shall be provided whereby the bolt can be operated in the emergency of a failure of interlock supplies.

14.2.11. Where key interlocking is employed tripping of the circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism. Any local emergency-tripping device shall be kept separate and distinct from the key interlocking.

14.2.12. Disconnecting switches shall be so interlocked that they cannot be operated unless the associated circuit-breaker is open except that where double bus bar arrangements are specified, on-load transfer of feeder circuits from one bus bar to another shall be made possible by interlocks which ensure that the associated bus coupler and its isolators are closed.

14.2.13. Bus coupler circuit breaker shall be interlocked so that it shall not be possible to open a bus coupler circuit breaker while on load change over on that side of the breaker is in progress.

14.2.14. All isolating devices shall be interlocked with associated circuit-breakers and isolators in the same station so that it shall not be possible to make or break current on an isolating device unless a parallel circuit in that station is already closed.

15. GIS BUILDING

15.1 The buildings shall house each voltage class Gas Insulated Switchgear (GIS) separately and other associated equipment inside in each of the GIS buildings. GIS building(s) shall be constructed for the specified number of bays/diameters as per section project

15.2 Wherever GIS hall of proposed voltage is already existing, then the existing GIS hall of respective class shall be suitably extended (wherever applicable) to accommodate the number of bays/diameters as specified in the Section Project.

15.3 The contractor shall submit the design & construction proposal of the building along with necessary information, data, and drawings during the detailed engineering according to the complete requirements.

15.4 The area for GIS hall(s) is indicated in the enclosed General Arrangement drawing. The area given is for reference only and may vary according to requirement of the equipment to be installed inside. The contractor shall finalize the dimensions according to the equipment offered by them providing enough space & access for erection, operation and maintenance.

15.5. The contractor shall place their panels i.e. Bay level units, bay mimic, relay and protection panels, RTCC panels, PLCC panels etc. in a separate room in the GIS building.. The size of the room shall be such that all the panels for the future bays/ diameters as per clause 15.1 shall be accommodated in the above room. The panel room shall be air-conditioned. Further, the temperature of the room shall be monitored through substation automation system by providing necessary temperature transducers. The Switchyard panel room as detailed in section Sub-station Automation System is not required for GIS station.

16. ELECTRIC OVERHEAD CRANE:

16.1. One EOT Crane each for GIS hall 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 equipment.

16.2. The capacity of the crane shall be sized to lift the heaviest GIS switchgear component crane.

16.3. The Crane shall be used for the erection and maintenance of the GIS switchgear component and all plant installed in the GIS switchgear room .On completion of erection of the

switchgear, the Contractor shall completely service the crane before the Taking Over Certificate is issued.

16.4. Crane hook approaches shall be of the minimum possible dimensions to ensure maximum coverage of the plant area.

16.5. The crane(s) shall be capable of lifting and accurately positioning all loads ranging from full crane rated capacity to at least 10% rated capacity.

16.6. The crane shall have minimum speeds under full load of:

Speed

(a) Hoisting	2 meters/minute
(b)Cross Travel	10 meters/minute
(c) Long Travel	20 meters/minute

(d) Creep speed shall be of 25% of operating speed

16.7. The electric overhead cranes shall be provided with walkways, platforms. Guard hand rails shall be provided along the bridge rails and on the crab of EOT crane to facilitate cleaning/maintenance of the crane and to give access to the GIS room high bay lighting and ventilation duct and grilles.

16.8. The platform and walkways shall be designed to support any weight to be imposed upon them during crane overhaul.

16.9. An access platform shall be provided together with a guarded ladder on the crane to allow access to the bridge rails.

16.10. The crane shall be possible to be operated through the cable, through the pendant control and which shall be easily accessible from the floor of GIS building and through remote control device.

16.11. Contractor shall submit the capacity calculation of crane for GIS hall considering a factor of safety of 5.

a) The crane for 220kV GIS/132kV GIS shall have capacity of minimum 5T safe working load & minimum height of crane have shall be 8.0 meters or as per actual requirement whichever is higher.

16.12. In case the GIS hall is to be extended, the scope of work also involves extension of EOT crane girders to facilitate movement of EOT crane in the extended portion of GIS hall.

16.13. The following tests may be EOT Crane

1. The crane shall be tested at manufacturer work under full load and 25 percent overload of hoisting and cross transverse motions as a routine test.

2. Further the following tests may be done at site after installation of the crane at site

   a. Check althea accessories for proper function

   b. No load test

   c. Load test as per site conditions

17. VENTILATION SYSTEM FOR GIS HALL

17.1. 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.

17.2. 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. GIS hall shall be provided with motorized exhaust dampers with local control.

17.3 In case of extension of GIS hall is covered under the present contract, separate ventilation system shall be provided meeting the functional requirement as specified above and the same shall be integrated with existing ventilation system.

18. SEISMIC DESIGN CRITERIA:

18.1. 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 on concurrently. Seismic Qualification requirements shall be as per IEC 62271-207 for the design of equipment. The equipment 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. If the equipment has not been type tested earlier, Test Report/Analysis Report should be furnished.

18.2. 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 with-stand 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 employer's approval.

19. DESIGN REVIEW

19.1. Design reviews shall be conducted by Employer or an appointed consultant during the detailed Engineering of the GIS; however the entire responsibility of design shall be with the supplier.

19.2. Employer may also visit to the supplier's works to inspect design, manufacturing and test facilities.

19.3. The design review will commence after placement of award with the successful contractor and shall be finalised before commencement of manufacturing activity. These design reviews shall be carried out in detail to the specific design with reference of the GIS under the scope of this specification. Employer reserve the right to waive off the design review during detailed engineering.

19.4. The design review shall be conducted generally following the, "User Guide for the application of Gas Insulator Switchgear (GIS) rated voltage of 72.5kV and above" – CIGRE report No. 125 prepared by CIGRE Working Group 23.10.

19.5. The manufacturer will be required to demonstrate the use of adequate safety margins for thermal, mechanical, dielectric, insulation coordination and vibration etc. design to take into the account the uncertainties of his design and manufacturing processes.

19.6. The scope of such a design review shall at least include the following:

1. 2.	Dielectric Stress of Solid Insulation like Gas Barrier, support insulator etc. Dielectric stress of SF6 Gas Volume.
3.	Mechanical strength of enclosure, expansion joints etc.
4.	Criteria for providing expansion joint.
5.	Sealing system
6.	Insulation coordination
7. 8.	Thermal stress and resulting increase in gas pressure during short circuit condition. Earthing of enclosure w.r.t circulating current.
9.	Seismic design, as per IEC 62271-207
10.	Circuit Breaker .
11.	Isolator and Earth switch.
12.	Voltage transformer.
13.	Current Transformer.
14.	Surge Arrester.
15.	Bushing.
16.	Ducting.
17.	Corrosion protection .

18.	Electrical and physical Interfaces with substation .
19.	Testing capabilities.
20.	Inspection and test plan.
21.	Transport and storage.
22.	Maintainability.
23.	Site Test.

19.7. Further, the manufacturer shall furnish the following information

a) Details regarding the loosely distributed metallic particles within the GIS encapsulation and calculations of critical field strength for specific particles of defined mass and geometry.

b) Study report of VFTO generated for GIS installation.

c) The methodology and all the equipment for electrical partial discharge (PD) detection, including that mentioned in the specification else-where.

d) The calculations and documents in support of the average intensity of electromagnetic field on the surface of the enclosure above during detailed engineering.

e) The detailed criteria/ design regarding location of pressure relief devices/rupture diaphragms

f) Calculations to show that there is no Ferro resonance due to capacitance of GIS for the voltage transformers

g) Design calculation for simulated parameters for Seismic level as applicable

h) Insulation Coordination studies including studies to recommend for additional surge arrestor

i) Calculation in support of touch & step voltages in all enclosures and earthing of complete GIS installation.

j) Measures to mitigate transient enclosure voltage by high frequency currents.

k) Calculation for providing bus duct supports.

20. TYPE TESTS

The offered GIS equipment shall conform to the type tests as per IEC-62271-203. Contractor shall submit type test reports for the following type tests & additional type tests.

Sl.	Description of the Type Test for GIS
1	Tests to verify the insulation level of the equipment and dielectric test on

	auxiliary circuits
2	Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit
3	Tests to prove the ability of the main and earthing circuits to carry the rated peak and rated short time withstand current
4	Tests to verify the making and breaking capacity of the included switching devices
5	Tests to prove the satisfactory operation of the included switching devices
6	Tests to prove the strength of the enclosures
7	Gas tightness tests
8	Tests on partitions
9	Tests to prove the satisfactory operation at limit temperatures
10	Tests to assess the effects of arcing due to internal fault
11	Verification of the degree of protection of the enclosure
12	Tests to prove performance under thermal cycling and gas tightness tests on insulators
13	Additional tests on auxiliary and control circuits
14	Reactor current switching test
15	Test to demonstrate the Power frequency withstand capability of breaker in Open condition at lock out pressure.
16	Electromagnetic compatibility tests (if applicable)
17	Radio inference voltage tests (RIV) , if applicable

The test reports of the above type tests for GIS (including type test report on Circuit breaker, Disconnectors, Grounding switches, Current and Voltage transformers as per relevant IEC and type tests of SF6/Air & Oil bushing as per IEC 60137 shall be submitted for approval as per Section- GTR, Technical Specification.

21. GENERAL

21.1. Painting of enclosure: All enclosures shall be painted externally as per manufacturer's painting procedure. The painting procedures as followed shall be submitted during detailed engineering.

21.2. Heaters: Wherever required, heaters shall be provided to prevent moisture condensation.

Heaters are not allowed inside the main circuit**.**

21.3. Identification & rating plate

Each bay shall have a nameplate showing

a) A listing of the basic equipment (such as a breaker, Disconnectors grounding switches, current transformers, voltage transformers, and bushings etc).

b) A schematic diagram indicating their relative locations.

c) PDD J&K Contract Number.

d) 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.

22. TRANSPORT OF EQUIPMENT TO SITE

The contractor shall be responsible for the loading, transport, handling and offloading of all equipment and materials from the place of manufacture or supply to site. The contractor shall be responsible to select and verify the route, mode of transportation and make all necessary arrangement with the appropriate authorities as well as determining any transport restrictions and regulations imposed by the government and other local authorities. All transport packages containing critical units viz. Circuit breakers and Voltage transformers shall be provided with sufficient number of electronic impact recorders (on returnable basis) during transportation to measure the magnitude and duration of the impact in all three directions. The acceptance criteria and limits of impact in all three directions which can be withstood by the equipment during transportation and handling shall be submitted by the contractor during detailed engineering. The recording shall commence in the factory and must continue till the units reach site. The data of electronic impact recorders shall be downloaded at site and a soft copy of it shall be handed over to Executive Engineer – in –charge. Further, contractor shall communicate the interpretation of the data within three weeks.

23. PACKING, STORAGE AND UNPACKING

23.1. All the equipment shall be carefully packed for transport by sea, rail and road in such a manner that it is protected against the climatic conditions and the variations in such conditions that will be encountered enroute from the manufacturer's works to the site.

23.2. The SF6 metal clad equipment shall be shipped in the largest factory assembled units that the transport and loading limitations and handling facilities on site will allow to reduce the erection and installation work on site to a minimum.

23.3. Where possible all items of equipment or factory assembled units shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner. Should the units be considered too large for packing in crates, they shall be suitably lagged and protected to prevent damage to any part, particularly small projections, during transport and handling. Special lugs or protective supports shall be provided for lifting to prevent slings and other lifting equipment from causing damage. Each

crate, container or shipping unit shall be marked clearly on the outside to show where the weight is bearing and the correct position for the slings.

23.4. Each individual piece to be shipped, whether crate, container or large unit, shall be marked with a notation of the part or parts contained therein.

23.5. Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. This applies particularly to the metal clad equipment of which each gas section shall be sealed and pressurized prior to shipping. Either dry nitrogen/air or dry SF6 gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and the atmospheric pressure encountered during shipment to site and calculating the pressure to which the sections shall be filled to ensure positive pressure at all times during shipment. The type of gas, the maximum pressure to which sections will be filled prior to shipment and the minimum allowable pressure during shipment shall be advised prior to dispatch.

23.6. All blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site shall be provided as part of the contract and shall remain the property of PDD J&K. If considered necessary, blanking plates or other sealing devices shall be provided with facilities for measuring the gas pressure and recharging at any time during the transport period. Any seals, gaskets, 'O' rings, etc. that may be used as part of the arrangement for sealing off gas sections for shipment of site, shall not be used in the final installation of the equipment at site. Identification serial numbers shall be stamped into the blanking plates, etc., and on the switchgear equipment to which they are fitted so that they can easily be identified and refitted should it ever be necessary to ship sections of the switchgear back to the manufacturer's works for repair.

23.7. Valves and other gas couplings associated with the switchgear gas systems shall be adequately protected against damage from any bumps or physical blows. They shall also be capped to prevent ingress of dirt or moisture or damage to any coupling, pipes, threads or special fittings. Any explosion vents and other pressure relief devices shall be suitably sealed and protected to prevent accidental exposure of the sealed sections during shipment to site.

23.8. For bus ducts involving male and female joints of the current carrying conductor, the same shall be transported in disassembled condition to avoid any damage during transit. All bright parts liable to rust shall receive a coat of anti rusting composition and shall be suitably protected.

23.9. The contractor will be able to use the available storage areas at site. The contractor shall ensure that during the period between arrival at site and erection, all materials and parts of the contract works are suitably stored in such approved manner as to prevent damage by weather, corrosion, insects, vermin or fungal growth. The scope of providing the necessary protection, storing off the ground, as required etc. is included in the works to be performed by the contractor.

23.10. The equipment shall only be unpacked or removed from the containers immediately prior to being installed. They shall not be left lying unnecessarily in open crates or containers. Special precautions

shall be taken when gas sections which have been sealed and pressurized for shipping are opened up to reduce the ingress of dirt and atmospheric moisture to a minimum. Whenever possible this shall only be done immediately prior to installation and if any section is to be left outside for any length of time after being opened, it shall be resealed and pressurized with either dry nitrogen/air or SF6 gas until required.

24. INSTALLATION OF GIS

24.1. Civil works of GIS Hall shall be completed in all respects for taking up the installation and it shall be ensured that all dust and dirt in the hall are removed. All openings (including Bus Duct) except entry door should be closed and proper sealed

24.2. The installation area shall be secured against entry of unauthorized personnel. Only certified manufacturer's engineer and supervisor shall supervise critical & important erection works. The help of local technicians can be taken only for material handling and non-critical erection works. Engineers and supervisors of the manufacturer shall submit authorization and competency certificate to PDD J&K.

24.3 Assembly drawing for GIS erection for the section under progress shall be available and displayed in GIS hall at the time of work.

24.4 Proper power supply shall be ensured by installing DG Set of proper rating and frequency if required prior to commencement of erection work so that assembly work is not interrupted in the middle which is critical for GIS installation.

24.5 Working personnel shall clean their shoes or apply covers on shoes before entering the immediate working area. The working clothes of authorized personnel shall be made of non fluffy material.

24.6. GIS hall door shall have automatic close facility after entry of personnel to avoid dust and moisture entry. Walls and ceiling shall be in a condition so that neither dirt nor plaster might fall or rub off and formation of condensation water in ceiling shall be prevented under any circumstances.

24.7. Floor in the installation area shall have a firm surface and shall be kept dust free with a vacuum cleaner. Vacuum cleaning to be done at regular interval throughout the day with separate team of persons assigned for cleaning work only.

24.8. Only T&P and consumables required for GIS erection shall be kept in GIS during erection.

24.9. In case of outdoor installation of GIS or of GIS components open gas compartments shall be protected from dust and moisture ingress (by tarpaulin covers etc)

24.10. Bus duct exit in the GIS hall wall shall be kept covered by suitable means until permanent cover is provided after installation of bus ducts.

24.11. A separate room shall be identified in consultation with PDD J&K for carrying out repair works/ small part assembly and the room shall be weather protected and lockable. All excess material (not required for immediate installation works) test equipment and tools and tackles to be stored separately from GIS hall in the separate room for rework

24.12. All assembly work shall be done by qualified personnel only who are to be identified and list submitted to PDD J&K site before starting of erection work.

24.13. Erection agency shall submit method statement and make available formats for checking during each stage of hall preparation, assembly process and final checks to be approved by PDD J&K site before start of erection. Method statement shall include record of shock/ impact recorder at the time of unpacking. Shock recorder down loaded data and analysis shall be submitted before commencement of erection work. In case of violation of shock limits, expert form manufacturer shall visit and do the internal inspection before giving clearance for erection.

24.14. Cleaning is of utmost importance and hence before assembly, all the loose metal parts, subassemblies and all contact& sealing surfaces shall be cleaned before installation. Cleaning shall be e carried out with specified cleaning agents of the manufacturer in no condition water is to be used except for external surfaces. Further, Prior to opening, gas compartment shall be thoroughly cleaned and vacuum cleaning of the installation area shall also be done specially the immediate vicinity of the flanges to be connected. Dust disturbance in the area to be avoided

Also, before closing a flange connection clean the immediate vicinity and all accessible parts of the components shall be connected with a vacuum cleaner

24.15. Once the transport covers are removed installation of flanges shall be done without any interruptions, if interruptions cannot be avoided open flanges are to be covered with clean plastic foil. Transport covers, O-rings and other packing material shall be taken out of GIS after immediately after removal.

24.16. O Rings shall be properly stored and taken out only before installation. O Rings are also to be cleaned before use with manufacturer authorized cleaning agent.

24.17. At all points of time during installation authorized personnel shall use disposable gloves to avoid contamination.

24.18. Cable termination work shall commence only after completion of GIS equipment as during GIS installation period laying and termination of cables interferes with the GIS erection work and affects cleanliness.

24.19. Approved Field Quality Plan shall be followed strictly during site work.

25. ON SITE TESTING

After the switchgear has been completely installed on site and filled with SF6 gas, the complete assembly shall be subjected to the site tests as per IEC – 62271-203 and with the test voltages specified below :-

25.1. The adequacy of number of UHF sensors and their location shall be verified as per recommendations of CIGRE task force **TF 15/33.03.05** (Task force on **Partial discharge detection system for GIS: Sensitivity verification for the UHF method and the acoustic method**). In case during site testing additional UHF sensors are required, the same shall also be supplied and installed to complete the technical requirement.

25.2. Application of AC voltage equal to 1.2 times the service voltage in order to condition the GIS whilst at the same time permitting measurement of Partial discharge and detection of conductive particles by UHF method.

25.3. In case of a disruptive discharge in the gas as outlined in clause no: C.6.2.2 Procedure b) , annexure – C of IEC : 62271-203 , and a repeat test is performed due to failure during the AC voltage test , then the test shall be carried out at 1.2 times the service voltage .

The analysis of PD measured during High voltage test shall done very carefully and presence of PD measured by any sensor shall be attended and HV test shall be repeated after the rectification work. Calibration of PD sensors shall be completed before start of HV test to establish reference for detection of PD above 5 pc

25.4. Method statement/ procedure of on site high voltage testing and PD measurement shall be submitted by contractor in advance.

26. On site testing: Pre-commissioning test on GIS shall be done in line with requirement of PDD J&K.

27. TESTING & MAINTENACE EQUIPMENT

All testing & maintenance equipment shall be offered, if specified as per relevant schedule of BPS.

27.1. SF6 Gas leakage detector.

The detector shall be portable, battery operated with built in battery charger, hand held type and having a minimum SF6 gas leakage sensitivity of 5gm/year. The sensor shall be connected through a flexible wand for easy accessibility to joints, seals and couplings in GIS equipment and provided with a protection filter. The equipment shall have on/off switch & suitable indicating lamps/LEDs, variable pitch audible signal for leakage indication, and a head phone jack. The equipment shall have automatic zeroing of background signals suitable for detecting SF6 gas leakage in charged switchyard. The test kit shall be compatible for EMI/EMC environment as per IEC 1000.

27.2. Gas filling and evacuating plant :

26.2.1. The plant necessary for filling and evacuating the SF6 gas in the switchgear shall be supplied 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 from at least one phase of one complete bay (switchgear and associated equipment).

26.2.2. 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.

26.2.3. The minimum capacity of evacuation plant will be as under :

Vacuum Pump: 60 M^3/Hour (Nominal suction pressure)
Compressor : 15 M3/Hour (Delivery)

26.2.4. 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.

26.2.5. The gases compartments shall preferably be fitted with permanent non-return valves through which the gas is pumped into or evacuated form 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 furnished

26.3. SF6 gas analyzer:

The SF6 gas analyser should be of portable type and instruments shall have following features:

a. In-built calibration facility.

b. Sensitivity of the equipment shall not be affected by any atmospheric conditions like dust, humidity, heat, wind etc.

c. Equipment shall work on zero gas loss principle i.e. gas should be pumped back to the compartment after measurement without any exposure to the atmosphere.

d. Equipment shall be supplied with suitable regulator which can be used to connect SF6 cylinder if required.

e. Following acidic/impurities products should be detected as per IEC 60480 and IEC 60376

i) SF6 purity – Range: 0-100 % & Accuracy: +/- 0.5 %
ii) Dew point - Range : -60 to +20 deg C & Accuracy: +/- 0.5 deg C
iii) SO2 - Range : 0-150 ppm & Accuracy : +/- 2 %
iv) CF4 – Range : 0-60% vol & Accuracy : +/- 1 %
v) HF - Range : 0-200ppm & Accuracy : +/- 5 %

f. Instrument should work on AC source as well as on rechargeable battery

g. Input pressure: upto 10 bar

h. It should be housed in a robust IP67 case with wheels

26.4. Portable Partial Discharge (PD) monitoring system (Applicable for 220kV&132 kV)

26.4.1. 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.

26.4.2. It shall be capable for measuring PD in charged GIS environment as EHV which shall have bandwidth in order of 100 MHz–2GHz with possibility to select a wide range of intermediate bandwidths for best measurement results. The principle of operation shall be based on UHF principle of detection. The instrument should also be able to detect partial discharges in cable joints and terminations.

26.4.3. 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. Software for display and diagnosis of PD signals and an expert software system for accurate interpretation of cause of PD shall also be supplied and installed by the contractor.

26.4.4. The equipment shall meet the following requirements

4.4.1. Measurement shall be possible in noisy environment.

4.4.2. Stable reading shall be possible in presence of vibrations within complex GIS assemblies, which can produce signals similar to PD.

4.4.3. Equipment should have necessary synchronizing circuits to obtain PD correlation with power cycle and power frequency.

4.4.4. The equipment shall be battery operated with built-in-battery charger. It shall also be suitable for 230V AC/50 Hz input.

4.4.5. 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.

4.4.6. 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 and expert interpretation software, carrying case, rechargeable battery pack with charger suitable for 230V AC, 50Hz supply connecting cables (duly screened) to view in storage.

4.4.7. The function of software shall be covering the following:

4.4.7.a) Data recording, storage and retrieval in computer
4.4.7.b) Data base analysis
4.4.7.c) Template analysis for easy location of fault inside the GIS
4.4.7.d) Evaluation of PD measurement i.e, Amplitude, Phase Synchronization etc.
4.4.7.e) Evaluation of bouncing/loose particles with flight time and estimation on size of particle.
4.4.7.f) Expert software system for accurate interpretation of cause of PD.
4.4.7.g) Report generation.

4.4.8. To prove the suitability in charged switchyard condition, practical demonstration shall be conducted before acceptance.

4.4.9. Supplier shall have “Adequate after sales service” facility in India.

4.4.10. Necessary training may be accorded to personnel to make use of the kit for locating PD sources inside the GIS

4.4.11. Instrument shall be robust and conform to relevant standard.

26.4.5. **Calibration:** The UHF Couplers have to be first calibrated as per CIGRE procedure TF 15/330305 as part of factory acceptance tests to guarantee detection sensitivity of 5pC or better. The GIS of same design shall be used as test specimen during the coupler calibration. The pulse injection level determined through above factory calibration tests shall only be used as reference for site sensitivity checks during commissioning of PDM system. The data sheet/frequency response characteristics shall be submitted for reference.

26.4.6. Pulse generator for UHF sensor sensitivity test shall also be supplied as a standard accessory.

ANNEXURE-1

TECHNICAL PARAMETERS FOR CIRCUIT BREAKER

Sl no	Parameter	220kV system	132 kV system
1.	Rated voltage kV (rms)	245	145
2.	Rated frequency (Hz)	50	50
3.	No. of poles	3	3
4.	Type of circuit breaker	SF6 insulated.	SF6 insulated.
5.	Rated continuous current (A) at an ambient temperature of 50^0C	1600/3000 (as applicable)	1250/600 (for line/bus-coupler /Tr. Bay- breaker) (as applicable)
6.	Rated short circuit capacity with percentage of DC component as per IEC-62271-100 corresponding to minimum opening conditions as specified.	50/40 kA (As applicable)	31.5 kA (As applicable)
7.	Symmetrical interrupting capability kA (rms) (As applicable)	50/40	31.5
8.	Rated short circuit making current kAp (As applicable)	125/100	80
9.	Short time current carrying capability for one second kA (rms) (As applicable)	50/40	80
10.	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	As per IEC	As per IEC

11.	before opening equal to the product of U/Ö3 and 1.4 as per IEC-62271- 100 First pole to clear Factor	1.3	As pr IEC
12.	Rated break time as IEC (ms)	60	60
13.	Total break time (ms)	65	65
14.	Total closing time (ms)	Not more than 200	Not more than 200
15.	Rated operating duty cycle	O-0.3s-CO-3 min-CO	
16.	Reclosing	Single phase & Three phase auto reclosing.	Single phase &Three phase auto reclosing.
17.	Pre-insertion resistor requirement	NA	NA
	Rating (ohms)	NA	NA
	Minimum pre- insertion time (ms)	NA	NA
	Opening of PIR contacts	NA	NA
18.	**Rated insulation levels**		
	Full wave impulse withstand (1.2 /50 µs) between line terminals and ground:	1050 kVp	+ 650 kVp
	Full wave impulse withstand (1.2 /50 µs) Between terminals with circuit breaker open:	1050 kVp	+ 750kVp
	Rated switching impulse withstand voltage (250/2500 µs) Dry & wet.	NA	NA
	Rated switching impulse withstand voltage (250/2500µs) Dry & wet Between terminals with circuit breaker open:	NA	NA
	One minute power frequency withstand voltage between line terminals and ground	460 kV rms.	275 kV rms

	One minute power frequency withstand voltagebetween terminals with circuit breaker open	530 kV rms.	315 kV rms
19.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 266 kV (Micro volts)	1000 μV	500μV
20.	Max. difference in the instants of closing/opening of contacts (ms) between poles	As per IEC	As per IEC
21.	Trip coil and closing coil voltage with variation as specified in Sec. GTR	220 V DC	220 V DC
22.	Thermal rating of Auxiliary contacts.	10A at 220 V DC	10A at 220 V DC
23.	Breaking capacity of Aux. Contacts with circuit time constant not less than 20 ms.	2A at 220 V DC	2A at 220 V DC
24.	System neutral earthing	Solidly Grounded	

ANNEXURE-2

TECHNICAL PARAMETERS FOR DISCONNECTORS/ ISOLATORS

Sl. No	**Particulars**	**220 kV**	**132kV**
1.	Rated voltage (rms) Un	245 kV	145 kV
2.	Rated frequency	50 HZ	50 Hz
3.	System earthing	Effectively earthed	Effectively earthed
4.	Type	SF6 insulated	SF6 insulated
5.	Rated continuous current (A) at 50^0C ambient temp.(as applicable)	1600/3000 (as applicable)	1200/600 (for line /transformer /bus coupler)
6.	Rated short time withstand current of isolator and earth switch(as applicable)	50/40 kA for 1 Sec.	31.5 kA for 1 second
7.	Rated dynamic short circuit withstand current withstand current of isolator and earth switch(As applicable)	1125/00 kAp.(As applicable)	80 kAp
8.	Rated insulation level:		
	One minute power freq. Withstand voltage: To earth :	460 kV rms.	275 kV rms.
	One minute power freq. Withstand	530 kV rms.	315 kV rms.
	voltage: Across isolating distance		
	1.2/50 micro sec. Lighting impulse withstand voltage (+ve or –ve polarity) To earth:	±1050 kVp	±650 kVp
	1.2/50 micro sec. Lighting	1200 kVp	750 kVp

	impulse withstand voltage (+ve or –ve polarity) : Across Isolating distance		
	Rated switching impulse withstand voltage (250/2500 micro-sec.)Dry&wet :between line terminals and ground:	N.A	N.A
	Rated switching impulse withstand voltage (250/2500 micro-sec.) Dry&wet :Between terminals with Isolator open:	N.A	N.A
9.	Mechanical Endurance clause as per IEC	M2	M1
10.	No. of spare auxiliary contacts on each isolator	4 NO and 4 NC	4 NO and 4 NC
11.	No. of spare auxiliary contacts on each earthing switch	4 NO and 4 NC	4 NO and 4 NC

ANNEXURE-3

TECHNICAL PARAMETERS FOR CURRENT TRANSFORMERS

Sl no	Particular	220 kV	132kV
1.	Rated voltage Un	245 kV (rms)	145 KV (rms)
2.	Rated frequency	50 Hz	50 Hz
3.	System neutral earthing	Effectively earthed.	
4.	Rated shorttime thermal current for 1 second (as applicable)	40 kA	31.5 kA
5.	Rated dynamic current	100 kAp.	78.75kA
6.	Rated insulation levels		
i.	1.2/50 micro second impulse voltage	1050 kVp	650 kVp
ii.	one minute power frequency withstand voltage	460 kV (rms)	275 kV (rms)
7.	Maximum temperature rise over an ambient temperature of 40^0C	As per IEC 60044-1	As per IEC 60044-1
8.	Radio interference voltage at 1.1 Un/√3 and frequency range 0.5 to 2 MHz	1000 µV	500µV
9.	One minute power frequency withstand voltage between sec. Terminal & earth	3 kV (rms)	3 kV (rms
10.	Partial discharge level	5 pico coulombs	5 pico Coulombs

TABLE -3A

REQUIREMENTS FOR 220 kV CURRENT TRANSFORMER

TABLE-3D

REQUIREMENTS FOR 132 kV CURRENT TRANSFORMER

No. of cores	Core no.	Applic-ation	Current ratio	Output Burden (VA)	Accuracy Class as Per IEC: 44-1	Min. Knee pt. Voltage Vk	Max. CT Sec. Wdg. Resist-ance (ohm)	Max. Exci-tation cu-rrent at Vk (in mA)
5	1	BUS DIFF CHE-CK	800-400/1	-	-	800/400	8/4	25 on 800/1 50 on 400/1
	2	BUS DIFF MAIN	800-400/1	-	-	800/400	8/4	25 on 800/1 50 on 400/1
	3	METE RING	800-400/1	20	0.2S	-	-	-
	4	TRAN BACK UP/ LINE PRTN.	800-400/1	-	-	800/400	8/4	25 on 800/1 50 on 400/1
	5	DIFF/ LINE PRTN.	800-400/1	-	-	800/400	8/4	25 on 800/1 50 on 400/1

All relaying CTs shall be of accuracy class PS as per IS: 2705.

ANNEXURE-4

TECHNICAL PARAMETERS FOR VOLTAGE TRANSFORMERS

Sl. No.	Particular	220 kV	132kV
1	Rated system voltage (Un)	245 kV (rms)	145 KV (rms)
2	Rated frequency	50 Hz	50 Hz
3	System neutral earthing	Effectively earthed	Effectively earthed
4	System fault level	50/40 kAp.(As applicable)for 1 Second.	31.5 kA
5	Rated insulation levels		
i.	1.2/50 micro second impulse voltage	1050 kVp	650 kVp
ii.	one minute power frequency withstand voltage	460 kV (rms)	275 kV (rms)
iii.	250/2500microsecondswitching impulse voltage (dry & wet)	NA	NA
6	One minute power frequency withstand voltage for secondary winding	3 kV (rms)	3 kV(rms)
7	Radio interference voltage at 1.1 Un/√3 and frequency range 0.5 to 2 MHz	1000 μV	500μV
8	Rated total thermal burden	400 VA	
9	Partial discharge level	10 Pico coulombs.	10 pico coloumbs

TABLE -4A

REQUIREMENT OF VOLTAGE TRANSFORMERS

Sl. No	PARTICULARS	220 kV			132kV		
1	Rated primary voltage	220/√3 kV			132//√3 kV		
2	Type	Electromagnetic			Electromagnetic		
3	No. of secondaries	3			3		
4	Rated voltage factor	1.2 continuous			1.2 continuous		
		1.5 for 30 seconds			1.5 for 30 seconds		
5	Phase angle error	⍰10 minutes (for metering core)			⍰10 minutes (for metering core)		
		Sec I	Sec II	Sec III	Sec I	Sec II	Sec III
6.	Rated secondary voltage (V)	110/√3	110/√3	110/√3	110/√3	110/√3	110/√3
7.	Application	Protecti on	Protecti on	Metering	Prote ction	Prote ction	Mete ring
8.	Accuracy	3P	3P	0.2	3P	3P	0.2
9.	Output burden (VA) (minimum)	50	50	50	50	50	50

ANNEXURE-5

TECHNICAL PARAMETERS OF GIS SURGE ARRESTOR

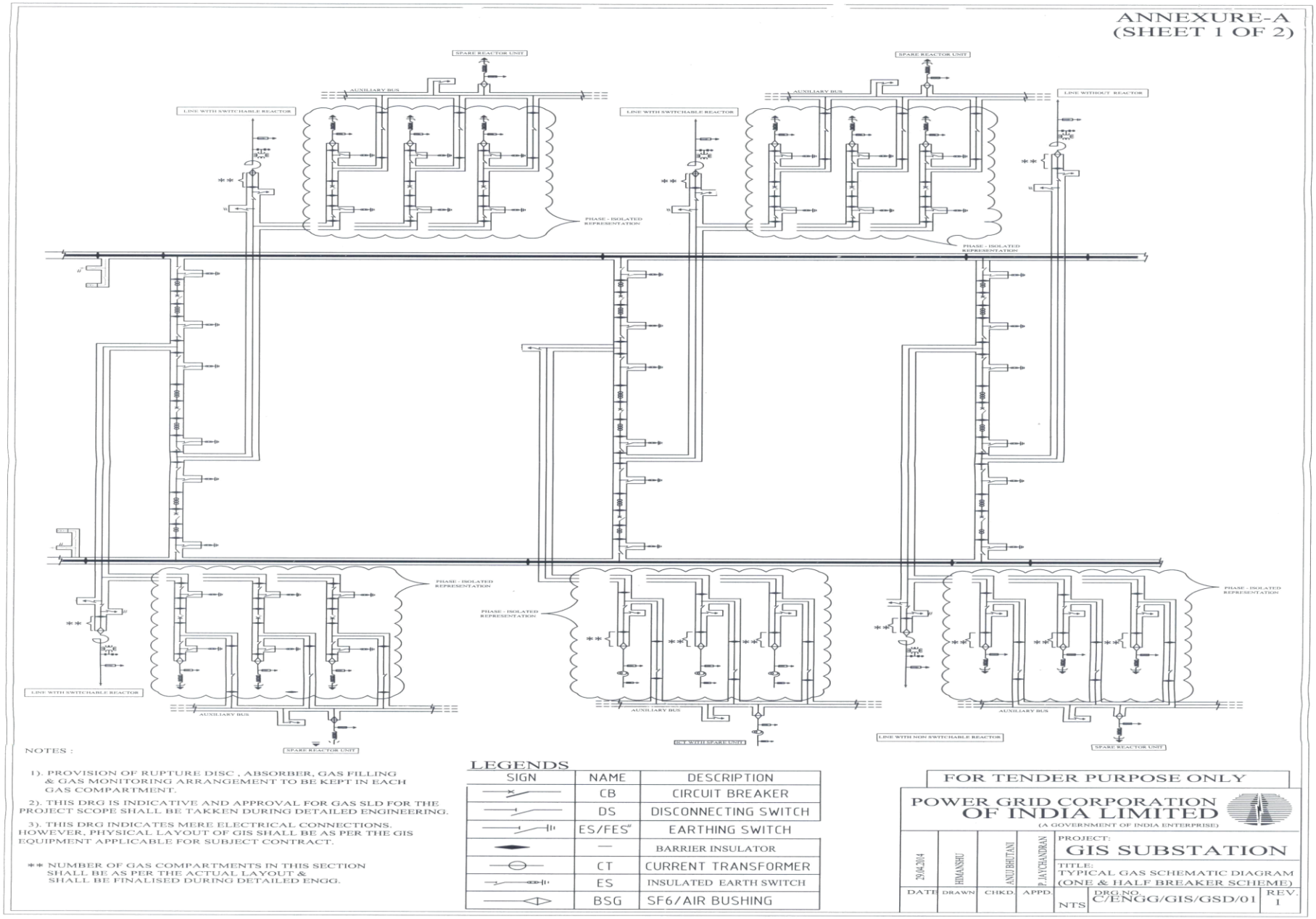
Sl. No.	**Particulars**	**220 kV**	**132 kV**
1	Rated system voltage	245 kV	132kV
2	System neutral earthing	Effectively earthed	Effectively earthed
3	Rated arrestor voltage	216 kV	120 kV
4	Nominal discharge current	10 kA of 8/20 µs wave	10 kA of 8/20 µs wave
5	Rated frequency	50 Hz	50 Hz
6	Minimum discharge capability voltage corresponding to minimum discharge characteristics	5 KJ/kV (referred to rated arrestor)	5 KJ/kV (referred torated arrestor)
7	Continuous operating voltage at 50^0C	168 kV	102 kV
8	Min. switching surge residual voltage	-	
	Max. surge switching voltage residual	500 kVp	280kVp
9	Max. residual voltage at 5 kA	560 kVp	310kVp
11	Max. residual voltage at 10 kA nominal discharge current	600 kVp	330 kVp

Sl. No.	Particulars	220 kV	132 kV
12	Max. residual voltage at 20 kA nominal discharge current	-	
13	Steep fronted wave residual voltage	650kVp 10kA	
14	Long duration discharge class	3	3
15	High current short duration test value (4/10 micro second wave)	100 kAp	100 kAp
16	Current for pressure relief test	50kA/50kA (as applicable)	31.5 kA
17	Prospective symmetrical fault current	40 kA rms for 0.2 Sec	As per IEC
18	Pressure relief class:	A	A
19	RIV at 1.1 $U_n/\sqrt{3}$ kV rms(micro volts)	Less than 500	Less than 500
20	Partial discharge at 1.05 COV (pC)	Not more than 5	Not more than 5
21	Reference ambient temp.	50 ^{0}C	50 ^{0}C

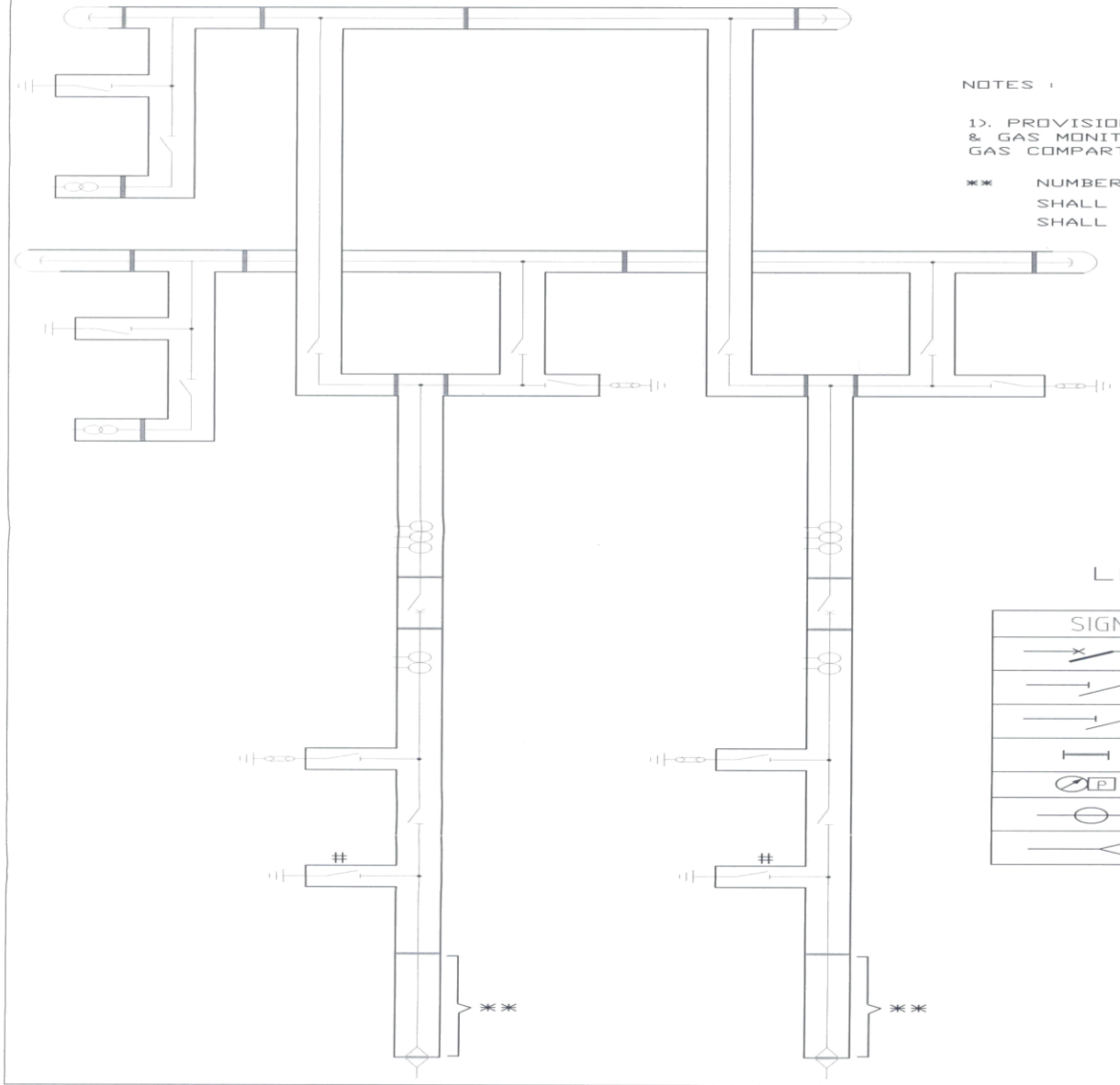
ANNEXURE-6

TECHNICAL PARAMETERS FOR SF6/AIR BUSHING

Sl. No.	**Particular**	**220 kV**	**132kV**
1	Rated Voltage (kV)	245 kV (rms)	145 kV (rms)
2	Rated Current (Amp)	1600	600
3	1.2/50 micro second impulse voltage (Lightning impulse withstand voltage)	1050 kVp	630 kVp
4	250/2500microsecond switching impulse voltage	-	
5	One minute power frequency withstand voltage		275 kV (rms)
6	Minimum total distance Creepage in mm	6125	3625
7	Minimum Cantilever strength (kN)	8	5


ANNEXURE-A
(SHEET 1 OF 2)
SPARE REACTOR UNIT
AUXILIARY BUS
LINE WITH SWITCHABLE REACTOR
PHASE - ISOLATED REPRESENTATION
LINE WITHOUT REACTOR
LINE WITH NON SWITCHABLE REACTOR
NOTES :
1). PROVISION OF RUPTURE DISC , ABSORBER, GAS FILLING & GAS MONITORING ARRANGEMENT TO BE KEPT IN EACH GAS COMPARTMENT.
2). THIS DRG IS INDICATIVE AND APPROVAL FOR GAS SLD FOR THE PROJECT SCOPE SHALL BE TAKKEN DURING DETAILED ENGINEERING.
3). THIS DRG INDICATES MERE ELECTRICAL CONNECTIONS. HOWEVER, PHYSICAL LAYOUT OF GIS SHALL BE AS PER THE GIS EQUIPMENT APPLICABLE FOR SUBJECT CONTRACT.
** NUMBER OF GAS COMPARTMENTS IN THIS SECTION SHALL BE AS PER THE ACTUAL LAYOUT & SHALL BE FINALISED DURING DETAILED ENGG.
LEGENDS
SIGN
NAME
DESCRIPTION
CB
CIRCUIT BREAKER
DS
DISCONNECTING SWITCH
ES/FES"
EARTHING SWITCH
—
BARRIER INSULATOR
CT
CURRENT TRANSFORMER
ES
INSULATED EARTH SWITCH
BSG
SF6/AIR BUSHING
FOR TENDER PURPOSE ONLY
POWER GRID CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)
PROJECT:
GIS SUBSTATION
TITLE:
TYPICAL GAS SCHEMATIC DIAGRAM
(ONE & HALF BREAKER SCHEME)
DATE
29.04.2014
DRAWN
HIMANSHU
CHKD.
ANUJ BHUTANI
APPD.
P.JAYCHANDRAN
NTS
DRG NO.
C/ENGG/GIS/GSD/01
REV.
1

ANNEXURE-A
(SHEET 2 OF 2)



NOTES :

1). PROVISION OF RUPTURE DISC,ABSORBER,GAS FILLING & GAS MONITORING ARRANGEMENT TO BE KEPT IN EACH GAS COMPARTMENT.

** NUMBER OF GAS COMPARTMENTS IN THIS SECTION SHALL BE AS PER THE ACTUAL LAYOUT & SHALL BE FINALISED DURING DETAILED ENGG.

LEGENDS

SIGN	NAME	DESCRIPTION
	CB	CIRCUIT BREAKER
	DS	DISCONNECTING SWITCH
	ES/FES#	EARTHING SWITCH
	---	BARRIER INSULATOR
P	---	SF6 GAS DENSITY MONITOR
	CT	CURRENT TRANSFORMER
	BSG	SF6/AIR BUSHING

FOR TENDER PURPOSE ONLY

TND CONSULTING SERVICES PVT. LTD.
REC TRANSMISSION PROJECTS PVT. LTD.

GIS SUBSTATION
(DOUBLE MAIN SCHEME)

DATE	DRAWN	CHKD	APPD		DRG.NO.	REV.
				NTS	C/ENGG/GIS/GSD/02	0

TECHNICAL SPECIFICATION
VOL-II, SEC-IV

33kV & 11kV Indoor Switchgear

SECTION-IV
TECHNICAL SPECIFICATION FOR

33kV & 11kV Indoor Switchgear (GIS Type)

1.00 GENERAL

This specification covers the design, manufacture, assembly, testing at manufacture's works before dispatch and delivery of metal clad partitioned, SF6 gas insulated, switchboard panel confirming to IEC-62271-200. The switchboard panels for line bays, transformer bays, bus coupler/Bus-section bays, etc. shall be fitted with Vaccume circuit breakers, three position disconnecting and earthing switches, voltage transformers, current transformer, metering instruments, protection relays, cable terminal ends for incoming & outgoing cable feeders etc. as per foregoing specification.

2.00 REFERENCE STANDARDS

2.01 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 relevant standards, specification and codes of practices, referred to herein & in Section GTR, and shall be the latest editions including all applicable official amendments and revisions as on the date of opening of bid. In case of conflict between this specification and those (IS Codes, Standards etc.), the former shall prevail. In addition to relevant standards specified in Section-GTR, following standards shall also be applicable:

IEC 62271-200	Gas insulated metal-enclosed switchgear for rated voltage above 1kV and up to and including 52 kV
IEC 62271-102	A.C. disconnectors (isolators) and Earthing switches for voltages above1000 V
IEC 62271-207	Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52 kV
IEC 60376	New Sulphur hexafluoride
IEC 62271- 200	High voltage metal enclosed switchgear & control gear Circuit breakers
IEC 60044-1	Current Transformers
IEC 60044-2	Voltage Transformers
IEC 62271-209	Cable connections for gas-insulated switchgear

2.02 The components and devices which are not covered by the above standards shall conform to, and comply with, the applicable standards, rules, codes and regulations of the internationally recognized standardizing bodies and professional societies as may be approved by the Employer and the manufacturer shall list all such applicable standards, codes etc.

2.03 Equipment conforming to any other internationally accepted standards, will also be considered if they ensure performance and constructional features equivalent or superior to the standards listed above.

3.00 EQUIPMENT SPECIFICATION

3.01 Switchgear Panel

a) Gas insulated Metal clad switchgear shall be complete with all the accessories for efficient and trouble free operation. The equipment offered shall be safe, reliable and compact to install. The workmanship shall be high order. The circuit breaker, switches and protective device etc shall be latest design so as to ensure rapid and efficient interruption of fault current low arc energy, small arching time and freedom from fire hazards.

b) The GIS shall be designed, manufactured and tested in accordance with the best international engineering practices under strict quality control to meet the requirement stipulated in the technical specification. Adequate safety margin with respect to thermal, mechanical, dielectric stress and insulation coordination etc. shall be maintained during design, selection of raw material, manufacturing process etc. so that the GIS provides long life with least maintenance.

c) 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.

d) The switchgear panel shall be free standing, floor mounted, fully compartmentalized, metal enclosed construction complying requirements of IEC 62271-200. Each circuit shall have a separate vertical panel with required compartments for circuit breaker, cable termination, main bus-bars and auxiliary control devices.

e) The SF6 gas insulated metal enclosed switchgear shall be totally safe against inadvertent touch of any of it's constituent live parts.

f) The design should be such that all parts subjected to wear and tear are easily accessible for maintenance purposes. The Service Class Continuity of Switchgears shall be LSC 2B-PM (as per IEC 622771-200).

g) All necessary equipment required for Gas handling at site (if any), shall be arranged by the supplier at their own cost.

h) All louvers (if provided), shall have very fine brass or GI mesh screen. Tight fitting gourmet / gaskets are to be provided at all openings in relay compartment. Relays shall be fully flush mounted on the switchgear panels at a suitable height from operator point of view.

i) Switchgear shall have an Internal Arc Classification of IAC-A-FLR 25 KA, 3 sec. The switchgear construction shall be such that the operating personnel are not

endangered by breaker operation and internal explosions, and the front of the panels shall be specially designed to withstand these. Gas Pressure relief device/Explosion Vent/Pressure relief duct shall be provided for each SF6 gas compartment, so that in case of a fault in a compartment, the gases produced are safely vented out, thereby minimizing the possibility of it's spreading to other compartments and panels. The pressure relief device/Explosion Vent/Pressure relief duct shall not however reduce the degree of protection of panels under normal working conditions.

j) The switchgear shall be cooled by natural air flow.

k) Total height of the switchgear panels shall be finalized during detail engineering in line with building design. The height of switches, pushbuttons and other hand operated devices shall not exceed 1800 mm and shall not be generally less than 700 mm.

l) Suitable interlock & Indications shall be provided to prevent opening of any HT compartment doors, in case the incoming HT supply is ON.

m) Suitable base frames made out of steel channels shall be supplied along with necessary anchor bolts and other hardware, for mounting of the switchgear panels. These shall be dispatched in advance so that they may be installed and leveled when the flooring is being done, welding of base frame to the insert plates shall be in Bidder's scope. The bidder may offer panels with built in base frame ready for dispatch and suitable for installation on indoor cable trenches.

n) The switch board shall have the facility for extension on both sides.

o) SF6 gas leakage rate should not exceed 0.5% per annum.

p) Thermostatically controlled space heater with common MCB shall be provided for various compartments.

3.02 **Circuit Breakers (VCB Type)**

a) The circuit breakers shall be of Vacuum type. It shall comprise of three single pole interrupting units or 3-pole interrupting unit, operated through a common shaft by a sturdy operating mechanism.

b) Circuit breaker shall be re-strike free, stored energy operated and trip free type. Motor wound closing spring charging shall only be acceptable. Anti-pumping features shall be provided for each breaker. An arrangement of two breakers in parallel to meet a specified current rating shall not be acceptable.

c) Circuit breaker shall be provided with two trip coils.

d) Suitable indicators shall be provided on the front of panel to indicate OPEN / CLOSED conditions of the circuit breaker, and CHARGED / DISCHARGED

conditions of the closing spring, SF6 gas density monitor for all gas compartments.

e) The rated control supply voltage shall be as mentioned elsewhere under Technical parameters. The closing coil and spring charging motor shall operate satisfactorily at all values of control supply voltage between 85-110% of the rated voltage. The trip coil shall operate satisfactorily under all operating conditions of the circuit breaker upto its rated short circuit breaking current at all values of control supply voltage between 70-110% of the rated voltage. The trip coil shall be so designed that it does not get energized when its healthiness is monitored by indicating lamps and trip coil supervision relay.

f) The time taken for charging of closing spring shall not exceed 60 seconds. The spring charging shall take place automatically preferably after a closing operation. Breaker operation shall be independent of the spring charging motor which shall only charge the closing spring. Opening spring shall get charged automatically during closing operation. As long as power supply is available to the charging motor, a continuous sequence of closing and opening operations shall be possible. Spring charging motors shall be capable of starting and charging the closing spring twice in quick succession without exceeding acceptable winding temperature when the control supply voltage is anywhere between 85-110% of rated voltage. The initial temperature shall be as prevalent in the switchgear panel during full load operation with 40 deg. C ambient air temperature. The motor shall be provided with Over load protection.

j) Motor windings shall be provided with class E insulation or better. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in a hot, humid and tropical climate.

3.03 **Disconnecting & Earthing Switches**

a) Each Switchgear panel shall be provided with three (3) position disconnecting-cum-earthing switch of required rating.

b) It shall be possible to control these switches from front of the panel & remotely from SAS through IED.

c) Necessary indication shall be provided on the front of the panel for Close/Open status of the three position switches.

3.04 **Control and Interlocks**

a) The circuit breaker shall normally be controlled remotely from SAS system through closing and trip coils. However, it shall also be designed to control locally from Indoor Switchgear panel. Suitable mimic on Panel shall be provided.

b) Facilities shall be provided for mechanical tripping of the breaker in an emergency. Facility shall also be provided for manual charging of the stored energy mechanism for a complete duty cycle.

c) Necessary mechanical & Electrical interlocks shall be provided between CB, Isolator & Earth switches for failsafe operation.

d) Each CB, Isolator & earth switch shall have 2 NO + 2 NC Auxiliary spare contacts for future use by owner.

3.05 **Busbars and Insulators**

a) Busbar shall be of Copper of adequate size and bus bar size calculation / supporting type test report shall be submitted for approval. They shall be adequately supported on insulators to withstand electrical and mechanical stresses due to specified short circuit currents.

b) Busbar shall be supported on the insulators such that the conductor expansion and contraction are allowed without straining the insulators.

c) Bus bar cross-section shall be uniform throughout the length of switchgear board. Bus bars shall be in SF6 gas insulated compartment.

d) Busbar insulators shall be of arc and track resistant, high strength, non-hygroscopic, non-combustible type and shall be suitable to withstand stresses due to over-voltages, and short circuit current. In case of organic insulator partial discharge shall be limited to 100pico coulomb at rated Voltage X 1.1/ $\sqrt{3}$.

e) All busbars shall have suitable phase identification. Bus switching scheme shall be as per Single Line diagram attached with bidding documents.

f) The temperature of the busbars and all other equipment, when carrying the rated current continuously shall be limited as per the stipulations of relevant Standards, duly considering the specified ambient temperature (40 deg. C).

3.06 **Earthing and Earthing Devices**

a) The grounding system for GIS 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.

b) A copper / galvanized steel earthing bus shall be provided at the bottom and shall extend throughout the length of each switch board. It shall be bolted/ welded to the framework of each panel and each breaker earthing contact bar. The earth bus shall have sufficient cross section to carry the momentary short-circuit and short time fault currents to earth without exceeding the allowable temperature rise.

c) Suitable arrangement shall be provided at each end of the earth bus for bolting to station earthing grid. All joint splices to the earth bus shall be made through at least two bolts and taps by proper lug and bolt connection.

d) All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical continuity of the whole switchgear enclosure frame work and the truck shall be maintained even after painting.

e) All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering shall not be acceptable. Looping of earth connections which would result in loss of earth connection to other devices, when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths of earth bus is acceptable.

f) 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 of one secondary circuit may be removed without disturbing the earthing of other circuits.

g) The panel shall have **Voltage Presence Indicator (VPI)** to warn the operator against earthing of live connections.

h) All hinged doors shall be earthed through flexible earthing braid.

3.07 Instrument Transformers

a) All current transformers shall preferably be ring type where as voltage transformers (PT) shall be cast resin insulated type.

b) Instrument transformers shall be suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated load and the outside ambient temperature is 40 deg. C. The class of insulation shall be E or better.

c) All instrument transformers shall withstand the power frequency and impulse test voltage specified for the switchgear assembly. The current transformer shall further have the dynamic and short time ratings at least equal to those specified for the associated switchgear and shall safely withstand the thermal and mechanical stress produced by maximum fault currents specified when mounted inside the switchgear for circuit breaker modules.

d) The parameters of instrument transformers specified in this specification are indicative and shall be finalized by the Employer during detailed engineering, considering the actual burden of various relays and other devices finally selected.

In case the Bidder finds that the specified ratings are not adequate for the relays and other devices offered by him, he shall offer instrument transformer of adequate ratings without any cost implication.

e) All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block.

f) All voltage transformer's secondary circuits shall have suitable HRC/MCB protective devices.

3.08 Numerical Protection Relays (IEDs)

3.08.01 Indoor switchgear panels shall have communicable numerical protection relays (IEDs) complying with IEC-61850 on all feeders which shall be networked on Ethernet to communicate with substation SAS system on IEC-61850. These IEDs shall also be used for control monitoring the switchgear from SAS. In addition to status of devices (CBs/Isolators/Earth Switches) and equipment alarms, Metering data shall also be made available to SAS station from protection IEDs. Further, multifunction meters with Modbus protocol are also envisaged, which will be connected in daisy-chain-link to communicate to station SAS. Modbus to IEC 61850 converter shall be provided for integration with SAS.

The Bidder's scope shall include the followings:

a) Communicable Numerical Protection Relays (with IEC 61850) in each of the feeders & Bus-section/Bus coupler

b) IED's / Numerical Relays shall have digital display, Single line diagram (SLD) display to facilitate settings, relay operations and to view measurement, event and alarm etc.

c) Relays shall have built in Local/Remote Selector Switch.

d) Cat5e Ethernet cable for connection of Numerical Relays (IEDs) to Ethernet switches and Optical cable between Ethernet switch (for indoor switch gear IEDs) and ring/ redundant network of Substation LAN switch shall be used.

e) Required number of Ethernet switches mounted in Indoor Switchgear panels for communication with IEDs on IEC 61850 protocol.

f) The SAS system has been envisaged as part of main substation. Bidder shall facilitate in successful Integration of Numerical Relays to the SAS system through Ethernet switches.

3.08.02 All Numerical relays shall be of proven design for the application satisfying requirements specified elsewhere and shall be subject to Employer's approval. Numerical Relays shall have appropriate setting ranges, accuracy, resetting ratio,

transient overreach and other characteristics to provide required sensitivity for the intended application.

3.08.03 All numerical relays shall be rated for control supply voltage as mentioned elsewhere under system parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Heavy duty binary output contacts of IEDs to be used for breaker close and trip commands shall be so rated as to be used directly used in the closing and tripping circuits of breaker without the need of any interposing / master trip relays.

3.08.04 Threshold voltage for binary inputs shall be suitably selected to ensure avoidance of mal-operation due to stray voltages and typically shall be more than 70% of the rated control supply voltage.

3.08.05 All IEDs shall have freely programmable optically isolated binary inputs (BI) and potential free binary output (BO) contacts as per approved scheme. These I/O points shall be used for wiring of status of devices (CB/Isolator/Earth switch) and equipment alarms etc.

3.08.06 Failure of a control supply and de-energization of a relay shall not initiate any circuit breaker operation.

3.08.07 Relays shall have event recording feature with time stamping. Event records & alarms shall be stored in Non-volatile memory and failure of control supply shall not result in deletion of any of these data.

3.08.08 All Numerical relays shall have features for electrical measurements including voltage, current, power (active & reactive), frequency, power factor etc.

3.08.09 All numerical relays shall have provision of both current (CT) and voltage (VT) inputs as required for protection & measurement purposes using protection cores.

3.08.10 All numerical relays shall have built-in key pad / keys to allow relay setting from relay front.

Resetting of relay shall be possible from remote SCADA.

3.08.11 Relays shall have suitable output contact for circuit breaker failure protection (LBB) logic.

3.08.12 Relays shall have self diagnostic feature with continuous self check for power failure, program routines, memory and main CPU failures and a separate output contact for indication of any failure.

3.08.13 Contractor shall submit applicable Type Test reports for Numerical relays as per IEC including report for IEC 61850 protocol from accredited lab.

3.09 **Control & Protection System**

All numerical relays shall communicate to station SAS on IEC-61850 communication protocol. It is envisaged that these protection IEDs shall be used for CB control & monitoring of bay equipments.

3.09.01 **Numerical Transformer Protection Relay**

a) The relay shall have instantaneous as well as time delayed three over current (50) and one earth fault (50N) protection elements.

b) The over current element should have the minimum setting adjustable between 20-200% of CT secondary rated current and high set setting 500-2000%.

c) The earth fault element of relay shall be suitable for detection of earth fault currents in the range of 5% to 80% of the CT rated current (IDMT) and high set 100-1000%.

d) The relay shall have selectable directional & non-directional feature

e) For transformers of rating 5MVA and above, definite time delayed Stand by earth fault protection shall be provided having a pick up setting range of 10% to 40% with a timer delay of 0.3 sec to 3 sec.

f) The relay shall allow higher setting during transformer charging (inrush) and lower setting during normal operating condition.

g) Transformer troubles like Buchholz, Winding temperature, Oil temperature & Pressure Relief Device trips etc. (as applicable) shall be wired independently to separate binary inputs of the relay and shall be configured to issue trip command to the breaker. Similarly alarm points shall be wired separately to binary inputs of the relay.

h) Trip circuit supervision shall be provided to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions.

3.09.02 **Numerical Line Protection Relay**

a) The relay shall have instantaneous as well as time delayed three over current (50) and one earth fault (50N) protection elements.

b) The over current element should have the minimum setting adjustable between **20**-200% of CT secondary rated current.

c) The earth fault element of relay shall be suitable for detection of earth fault currents in the range of 5% to 80% of the CT rated current.

d) The relay shall have selectable directional & non-directional feature

e) Trip circuit supervision shall be provided to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions.

3.09.03 **Numerical Bus Coupler/Bus-Section Protection Relay**

a) The relay shall have instantaneous as well as time delayed three over current (50) and one earth fault (50N) protection elements.

b) The over current element should have the minimum setting adjustable between **20**-200% of CT secondary rated current.

c) The earth fault element of relay shall be suitable for detection of earth fault currents in the range of 5% to 80% of the CT rated current.

d) No bus volt signal shall be configured in the relay for use in control logics and other Protections and Control functions in the Relays.

e) Trip circuit supervision shall be provided to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions.

3.09.04 Other Control and Protections features

a) Control of breakers, three position Isolators & Earth switches shall be carried out from the station HMI of SAS system through the LAN and the numerical relays.

b) The station HMI shall have a graphical dynamic Plant Key Single Line Diagram to view the complete system status. This shall include the status of the switchgears, measurement values, operation counters, graphical alarm representation, etc. Spontaneous changes of a state, typically opening of a circuit breaker from a protection, shall have a specific colour code. All the Breakers with the status shall be clearly displayed along with values of currents, voltages, frequency, active and reactive powers etc.

c) Schematics requiring auxiliary relays / timers for protection function shall be part of numerical relay. Timer functions shall be configurable for on & off delays as per requirement.

d) The numerical relay shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery backup for real time clock in the event of power supply failure shall be provided.

e) At least 100 time tagged events / records shall be stored with time stamping. Details of at least 5 previous faults including the type of protection operated, operating time, all currents & voltages and time of fault.

f) Automatic testing, power on diagnostics with continuous monitoring shall be provided in the IED to ensure high degree of reliability. Test features such as examination of input quantities, status of digital inputs and relay outputs shall be shall be available on the user interface

g) The alarm/status of each individual protection function and trip operation including measurement values shall be communicated to the SAS system.

h) Sequence of events shall have 1ms resolution at device level.

i) Measurement accuracy shall be 1%.

j) It shall be possible to carryout open / close operation of breakers from a laptop by interfacing from the relay front port during initial commissioning.

3.10 **Painting**

Painting of panels shall be as specified in Section-GTR.

4.00 ETHERNET SWITCH

a) Ethernet switches shall be 'substation hardened', and shall comply with IEC61850 for communications with IEDs. The Ethernet switches shall be of managed type with two (2) No. of Fiber optic cable ports and at least Sixteen (16) Copper ports to achieve the LAN configuration. More no. of switches or higher ports switch can also be supplied to meet all IEDs & Multi-function meters requirements for the LAN. The Ethernet switches shall have features to support the redundant rings. These switches shall be mounted in the switchgear Panels. The FO ports shall be Single-mode 1000Mbps ports. Copper ports shall be 10/100Mbps ports.

b) Necessary software for configuration and real-time network monitoring shall be provided along with the Ethernet switches.

5.00 POWER CABLE TERMINATION

a) Cable termination compartment shall receive the stranded Aluminium conductor, XLPE insulated, shielded, armored, PVC jacketed, single core / three core, unearthed / earthed grade HT power cable(s) as specified in Section -Project.

b) Adequate clearance shall be kept between the cable lug bottom ends and gland plates for stress cone formation for XLPE cables. Inter-phase clearance in the cable termination compartment shall be adequate to meet electrical and mechanical requirement besides facilitating easy connections and disconnection of cables. Dimensional drawing of cable connection compartment showing the location of lug, glands, gland plates etc. and the electrical clearances available shall be submitted during detail engineering.

c) Cable termination compartment shall have provision for termination of power cables of sizes indicated in the bidding documents. Cable entry shall generally be from the bottom; however, this shall be finalized during detail engineering.

d) Necessary cable termination plugs shall be part of Indoor switchgear panel supplier for all panels. Scope also includes Panel terminal ends jointing/connection with HT cables.

6.00 GENERAL REQUIREMENTS FOR ERECTION

6.01 Contractor shall move all equipment into the respective rooms through the regular door or openings specifically provided for this purpose. No parts of structure shall be utilized to lift or erect any equipment without prior permission of Engineer-in-charge.

6.02 Switchgear shall be installed on finished surfaces, concrete or steel sills. Contractor shall be required to install and align any channel sills which form part of foundations. Minor modifications to foundations shall be carried out by the Contractor. Contractor shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments and relays are supplied loose along with switchgear, they shall be mounted only after the associated switchgear panels have been erected and aligned. The blocking materials, employed for safe transit of instrument and relays shall be removed after ensuring that panels have been completely installed and no further movement of the same would be necessary. Any damage shall be immediately reported to Engineer.

6.03 Contractor shall include all special tools required for regular operation & routine maintenance of switchgear.

7.00 CONFIGURATION OF INDOOR SWITCHGEAR PANELS (GIS TYPE)

Sl. No.	Equipment	Unit	IP1 I/C	IP2 O/G	IP3 LT TR	IP4 B/S
1.	CB, Three position Isolator & Earth Switch (3- Ph)	Set	1	1	1	1
2.	CB Spring charge indicator	No.	1	1	1	1
3.	ON/OFF indicators for CB	Set	1	1	1	1
4.	ON/OFF Indicators for three position GIS Isolator & Earth Switch	Set	1	1	1	2
5.	ON/OFF indicators for AIS Line Isolator & Line Earth Switch	Set	-	1	-	-
6.	CT (1-Phase)	Nos.	3	3	3	3
7.	VT (1-Phase)	Nos.	-	-	-	6
8.	Multi Function Meter	No.	1	1	1	1
9.	Control switch for Circuit Breaker	No.	1	1	1	1
10.	Control Switches for Three position GIS Isolator & Earth switch (Electrical)	Set	1	1	1	2
11.	DC healthy lamp (white)		1	1	1	1

12.	Trip circuit healthy lamp		1	1	1	1
13.	SF6 Gas Density indicator for each compartment (set)	Set	1	1	1	1
14.	Capacitive Voltage Detection system (CVD)	Set	1	1	1	-
15.	Mimic to represent SLD	Set	1	1	1	1
16.	Voltmeter with selector switch	Set	-	-	-	2
17.	Numerical protection relay (IED)	No.	1	1	1	1
18.	LAN Switches and LAN/FO Cables	Set	AS per requirement			
19.	Cable Termination arrangement including cable end Plugs	Set	AS per requirement			

Notes:

1. IP1 (I/C): Panel for Transformer Incomer feeder
2. IP2 (O/G): Panel for outgoing Line Feeder
3. IP3 (LT TR): Panel for LT Transformer feeder
4. IP4 (B/S): Panel for Bus Sectionaliser
5. Location of VT (I/C or B/S Panel) shall be decided during detail engineering.
6. Numerical protection relay (IED) for all type of panels shall preferably be interchangeable to optimize mandatory spares.

8.00 TESTS

8.01 Type Tests

The contractor shall submit the reports for the following type tests on the equipment to be supplied under the contract:

A. Switchgear Panel (with Circuit Breaker installed)
   a. Short circuit duty test
   b. Short time and peak withstand current test
   c. Power frequency withstand test
   d. Lightning impulse withstand test
   e. Temperature rise test
   f. Internal Arc Test as per IEC 62271-200 (for 1 second)
   g. Measurement of resistance of main circuit
   h. Test to verify pressure relief operation of the panel **(During internal arc test)**
   i. Cable charging test
   j. Short circuit withstand test of earthing device

B. Circuit Breaker

   a. Mechanical Endurance Test

C. Current Transformer

a. Short time current test

b. Temperature rise test

c. Lighting Impulse voltage withstand test

D. Potential Transformer

a. Temperature rise test

b. Lighting Impulse voltage withstand test

E. Switchgear Panel

a. IP 4X test

8.02 **Routine Tests**

All acceptance and routine tests as per the specification and relevant standards IEC 62271-200 & IEC 62271-100 shall be carried out. Charges for these shall be deemed to be included in the equipment price.

The manufacturer shall furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

8.03 **Commissioning Checks / Tests**

After installation of panels, power and Control wiring and connections, Contractor shall perform commissioning checks as listed below to verify proper operation of switchgear / panels and correctness of all equipment in all respects. In addition, the Contractor shall carry out all other checks and tests recommended by the manufacturers.

8.03.01 General

a. Check name plate details according to specification.
b. Check for physical damage
c. Check tightness of all bolts, clamps and connecting terminals
d. Check earth connections
e. Check cleanliness of equipment
f. Check heaters are provided
g. H.V. test on complete switchboard with CT & breaker in position.
h. Check all moving parts are properly lubricated.
i. Check for alignment of busbars
j. Check continuity and IR value of space heater.
k. Check earth continuity for the complete switchgear board.

8.03.02 Circuit Breaker

a. Check alignment
b. Check correct operation
c. Check control wiring for correctness of connections, continuity and IR values.
d. Manual operation of breakers completely assembled.
e. Power closing / opening operation, manually and electrically
f. Closing and tripping time.
g. Trip free and anti-pumping operation.
h. IR values, resistance and minimum pick up voltage of coils.
i. Simultaneous closing of all the three phases.
j. Check electrical and mechanical interlocks provided.
k. Checks on spring charging motor, correct operation of limit switches and time of charging
l. All functional checks.

8.03.03 Current Transformers

a. Megger between windings and winding terminals to body.
b. Polarity tests.
c. Ratio identification checking of all ratios on all cores by primary injection of current.
d. Magnetization characteristics & secondary winding resistance.
e. Spare CT cores, if any to be shorted and earthed.

8.03.04 Voltage Transformers

a. Insulation resistance test.
b. Ratio test on all cores.
c. Polarity test.
d. Line connections as per connection diagram.

8.03.05 Cubicle Wiring

a. Check all switch developments.
b. It should be made sure that the wiring is as per relevant drawings. All interconnections between panels shall similarly be checked.
c. All the wires shall be meggered to earth.
d. Functional checking of all control circuit e.g. closing, tripping interlock, supervision and alarm circuit including proper functioning of component / equipment.
e. Check terminations and connections.
f. Wire ducting.
g. Gap sealing and cable bunching.

8.03.06 Relays

a. Check internal wiring.

b. IR of all terminal body.
c. IR of AC to DC terminals
d. Check operating characteristics by secondary injection.
e. Check operation of electrical/ mechanical targets.
f. Relay settings.

9.00 SYSTEM PARAMETERS:

1	Nominal System voltage	33 kV	11 kV
2	Highest System voltage	36 kV	12 kV
3	Rated Frequency	50 Hz	50 Hz
4	Number of phases/ poles	Three	Three
5	System neutral earthing	As per Vector Group of Transformers	As per Vector Group of Transformers
6	One minute power frequency withstand voltage	70	28
7	1.2/50 microsecond Impulse withstand voltage	170 kV (peak)	75 kV (peak)
8	Short time rating for bus bars, CB, CT and switchgear Assembly..	25 kA (rms) for one (1) sec.	25 kA (rms) for one (1) sec.
9	Dynamic withstand rating	62.5 kA (peak)	62.5 kA (peak)
10	IAC Rating	25 KA ,1.0 sec	25kA, 1.0 Sec
11	Control supply voltage:		
a)	Trip and closing coils	As per Station DC Supply	As per Station DC Supply
b)	Spring charging motor	As per Station DC Supply	As per Station DC Supply
12	Maximum ambient air temperature	40 deg. C	40 deg. C
13	Degree of Protection:		
a)	HV-live parts	IP65	IP65
b)	Low voltage compartments	IP4X	IP4X

a)	**CIRCUIT BREAKERS**		
1.	Rated Voltage	33 kV	11 kV
2.	CB rated Current		
a)	Incomer Breaker	1600A	1250A
b)	Outgoing feeder Breaker	1250A	1250A
3.	Short circuit breaker Current:		
a)	A.C. component	25 kA	25kA
b)	D.C. component	As per IS: 13118 or IEC-62271	As per IS: 13118 or IEC-62271
4.	Short Circuit making current	62.5 kA (peak)	62.5 kA(peak)
5.	Out of phase breaking Current capacity	As per IEC	As per IEC
6.	Rated line/cable charging Interrupting current at 90° Leading power factor angle	As per IEC	As per IEC
7.	Maximum allowable switching Over voltage under any switching Condition	As per IEC	As per IEC
8.	Rated small inductive current Switching capability with over Voltage less than 2.3 pu	As per IEC	As per IEC
9.	First pole to clear factor	1.5	1.5
10	Operating Duty	**O-0.3 Sec-CO-3 Min-CO**	**O-0.3 Sec-CO-3 Min-CO**
11	Total break time	Not more than 4 cycles	Not more than 4 cycles
12	Total make time	Not more than 5 cycles	Not more than 5 cycles
13	Reclosing	3 phase auto reclosing	3 phase auto reclosing
14	Max. difference in the instants of closing/opening contacts between poles at rated control Voltage and rated operating and quenching media pressures	As per IEC	As per IEC
15	Auxiliary contacts	2NO+2NC for Employers future use besides scheme requirement	2NO+2NC for Employers future use besides scheme requirement

16	Operating Mechanism	Motor wound spring charged stored energy type as per IEC-62271	Motor wound spring charged stored energy type as per IEC-62271
b) CURRENT TRANSFORMER(Incomer/Bus coupler-Bus Sectionalizer Feeder)			
1.	Rated primary voltage	**33kV**	**11kV**
2.	Rated primary current	1000A	800A
3.	Type of CT	1-Phase	1-Phase
4.	Max temp rise	As per IEC:60044-1	As per IEC:60044-1
5.	Class of Insulation	Class E or better	Class E or better
6.	One minute power frequency withstand voltage between secondary terminal & earth	2kV	2kV
7.	No. of Secondary cores	3	3
c) CURRENT TRANSFORMER (Line Feeder)			
1.	Rated primary voltage	**33kV**	**11kV**
2.	Rated primary current	300A	300A
3.	Max temp rise	As per IEC:60044-1	As per IEC:60044-1
4.	Class of Insulation	Class E or better	Class E or better
5.	One minute power frequency withstand voltage between secondary terminal & earth	2kV	2kV
6.	Nos. of Secondary cores	2	2
d) CURRENT TRANSFORMER (LT Transformer feeder)			
1.	Rated primary Voltage	**33kV**	**11kV**
2.	Rated primary current	40A	40A
3.	Max temp rise	As per IEC:60044-1	As per IEC:60044-1
4.	Class of Insulation	Class E or better	Class E or better
5.	One minute power frequency withstand voltage between secondary terminal & earth	2kV	2kV
6.	Nos. of Secondary cores	2	2

e)	**VOLTAGE TRANSFORMERS**				
1.	Rated primary Voltage	33kV		11kV	
2.	Type	1-phase		1-Phase	
3.	Voltage ratio (kV)	(33/√3)/(0.11/√3)		(11/√3)/(0.11/√3)	
4.	Rated Voltage Factor	1.2 continuous and 1.5 for 30 seconds		1.2 continuous and 1.5 for 30 seconds	
5.	Nos. of Secondary cores	2		2	
6.	Accuracy of Secondary core	Metering	Protn.	Metering	Protn.
		0.5	3P	0.5	3P
7.	Class of insulation	Class E or better		Class E or better	
8.	Rated output burden (Minimum)	5VA		5VA	
f	**Bus-Bar/ Bus-Section/Bus Coupler rating**				
	Current rating of Bus bars	2500A		1250A	
	Current rating of Bus-Section/ Bus Coupler CB & Isolator	2500A		1250A	

REQUIREMENT FOR 33KV CURRENT TRANSFORMERS

INCOMER / BUS COUPLER FEEDER

	Metering	**O/C & E/F Protn.**	**Diff. Protn.**
Current ratio	1000-500/1	1000-500/1	1000-500/1
Accuracy class	0.2S class	5P20	PS
Knee point voltage (at minimum ratio)	-	-	400V
Rated burden	7.5VA	-	-

LINE FEEDER

	Metering	**O/C & E/F Protn.**
Current ratio	300-150/1	300-150/1
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	7.5VA	-

LT TRANSFORMER FEEDER

	Metering	O/C & E/F Protn.
Current ratio	40-20/1	40-20/1
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	7.5VA	-

Notes: The ratings indicated for instrument transformers are tentative only and may be changed to meet the functional requirements.

REQUIREMENT FOR 11KV CURRENT TRANSFORMERS

INCOMER / BUS COUPLER FEEDER

	Metering	O/C & E/F Protn.	Diff. Protn.
Current ratio	800-400/1	800-400/1	800-400/1
Accuracy class	0.2S class	5P20	PS
Knee point voltage (at minimum ratio)	-	-	400V
Rated burden	7.5VA	-	-

LINE FEEDER

	Metering	O/C & E/F Protn.
Current ratio	300-150/1	300-150/1
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	7.5VA	-

REQUIREMENT FOR 11KV CURRENT TRANSFORMERS (LT TRANSFORMER FEEDER)

	Metering	O/C & E/F Protn.
Current ratio	40-20/1	40-20/1
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	7.5VA	-

Notes: The ratings indicated for instrument transformers are tentative only and may be changed to meet the functional requirements.

10.00 INPUT SIGNAL TO SAS SYSTEM

The following digital input of 33kV & 11kV Indoor switchgear bays shall be provided through IEDs in the SAS system:

i) Status of CB, Isolator, Earth switch
ii) CB trouble
iii) CB operation/closing lockout
iv) Trip circuit faulty
v) Bus VT FUSE Fail
vi) Back-up overcurrent & earth fault protection Operated
vii) DC source fail

11.00 MULTIFUNCTION METER

The Multifunction meter shall have feature to measure KV, I, MW, MVAR, PF, MWhr, MVARhr with accuracy class of 0.5. Further, multifunction meter shall have bi-directional feature to register/record MWhr values.

12.00 MANDATORY SPARES

Sl.N	Equipment	Unit	Quantity	
			33kV	11kV
1.	CB Spring charge indicator	No.	1	1
2.	ON/OFF indicator for CB (Mechanical)	No.	1	1
3.	ON/OFF indicator for GIS Isolator/Earth Switch (Mechanical)	No.	1	1
4.	CT (1-Phase)	No.	1 No. of Each type	1 No. of Each type
5.	VT (1-Phase)	No.	1 No. of Each type	1 No. of Each type
6.	Multi Function Meter	No.	1	1
7.	Control switch for Breaker	Nos.	2	2
8.	Control switch for GIS Isolator	Nos.	2	2
9.	Control switch for GIS Earth Switch	Nos.	2	2
10.	DC healthy lamp (white)	Nos.	5	5
11.	Trip circuit healthy lamp	Nos.	5	5
12.	Voltmeter with selector switch	No.	1	1
13.	Numerical protection relay (IED)	No.	1 No. of Each type	1 No. of Each type
14.	Indicator for Line Isolator & Earth Switch	Nos.	5	5
15.	LAN Switch	No.	1	1
16.	Trip coil assembly	Now.	2	2
17.	Closing coil assembly	Nos.	2	2
18.	SF6 gas density indicator	Nos.	2	2

TECHNICAL SPECIFICATION

VOL-II, SEC-V

SWITCHGEAR ISOLATORS

SECTION-V
SWITCHGEAR ISOLATORS

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SECTION-V
SWITCHGEAR ISOLATORS

1.0 GENERAL:

1.1 The Isolators and accessories shall conform in general to IEC: 62271-102, IS: 9921 except to the extent explicitly modified in specification and shall be in accordance with requirement of Section -GTR.

1.2 Isolators shall be outdoor, off-load type. Earth switches shall be provided on isolators wherever called for, with possibility of being mounted on any side of the isolator. 220 kV & below rated isolators shall be double break type, unless specified otherwise.

1.3 Complete isolator with all the necessary items for successful operation shall be supplied including but not limited to the following:

1.3.1 Isolator assembled with complete Support Insulators, operating rod insulator, base frame, linkages, operating mechanism, control cabinet, interlocks etc.

1.3.2 All necessary parts to provide a complete and operable isolator installation, control parts and other devices whether specifically called for herein or not.

1.3.3 The isolator shall be designed for use in the geographic and meteorological conditions as given in Section -GTR.

2.0 DUTY REQUIREMENTS:

a) Isolators and earth switches shall be capable of withstanding the dynamic and thermal effects of the maximum possible short circuit current of the systems in their closed position. They shall be constructed such that they do not open under influence of short circuit current.

b) The earth switches, wherever provided, shall be constructionally interlocked so that the earth switches can be operated only when the isolator is open and vice versa. The constructional interlocks shall be built in construction of isolator and shall be in addition to the electrical interlocks. Suitable mechanical arrangement shall also be provided for delinking electrical drive for manual operation.

c) In addition to the constructional interlock, isolator and earth switches shall have provision to prevent their electrical and manual operation unless the associated and other interlocking conditions are met. All these interlocks shall be of fail-safe type. Suitable individual interlocking coil arrangements shall be provided. The

interlocking coil shall be suitable for continuous operation from DC supply and within a variation range as stipulated in Section-GTR.

d) The earthing switches shall be capable of discharging trapped charges of the associated lines.

e) The isolator shall be capable of making/breaking normal currents when no significant change in voltage occurs across the terminals of each pole of isolator on account of make/break operation.

f) Isolator rated for above 72.5 kV shall be of extended mechanical endurance class - M2 as per IEC-62271-102. Isolator rated for 72.5 kV and below shall be of extended mechanical endurance class - M1 as per IEC-62271-102. All earth switches shall be of M0 duty**.**

3.0 CONSTRUCTIONAL FEATURES:

The features and constructional details of Double Break Isolators, earth switches and accessories shall be in accordance with requirements stated hereunder:

3.1 **Contacts:**

a) The contacts shall be self-aligning and self-cleaning and so designed that binding cannot occur after remaining closed for prolonged periods of time in a heavily polluted atmosphere.

b) No undue wear or scuffing shall be evident during the mechanical endurance tests. Contacts and spring shall be designed so that readjustments in contact pressure shall not be necessary throughout the life of the isolator or earthing switch. Each contact or pair of contacts shall be independently sprung so that full pressure is maintained on all contacts at all time.

c) Contact springs shall not carry any current and shall not loose their characteristics due to heating effects.

d) The moving contact of double break isolator shall have turn-and -twist type or other suitable type of locking arrangement to ensure adequate contact pressure.

3.2 **Base :**

Each single pole of the isolator shall be provided with a complete galvanised steel base provided with holes and designed for mounting on a supporting structure.

3.3 **Blades :**

a) All metal parts shall be of non-rusting and non-corroding material. All current carrying parts shall be made from high conductivity electrolytic copper/aluminum. Bolts, screws and pins shall be provided with lock washers. Keys or equivalent locking facilities if provided on current carrying parts shall be made of copper silicon alloy or stainless steel or equivalent. The bolts or pins used in current carrying parts shall be made of non-corroding material. Ferrous parts, other than stainless steel shall not be used in close proximity of main current path. All ferrous castings, if used elsewhere shall be made of malleable cast iron or cast-steel. No grey iron shall be used in the manufacture of any part of the isolator.

b) The live parts shall be designed to eliminate sharp joints, edges and other corona producing surfaces, where this is impracticable adequate corona rings shall be provided. **Corona shields are not acceptable.** Corona rings shall be made up of aluminum/aluminum alloy.

c) Isolators and earthing switches including their operating parts shall be such that they cannot be dislodged from their open or closed positions by short circuit forces, gravity, wind pressure, vibrations, shocks, or accidental touching of the connecting rods of the operating mechanism.

d) The switch shall be designed such that no lubrication of any part is required except at very infrequent intervals. i.e. after every 1000 operations or after 5 years whichever is earlier.

3.4 **Insulator :**

a) The insulator shall conform to or IEC-60168. The porcelain of the insulator shall conform to the requirements stipulated under Section-GTR and shall have a minimum cantilever strength of **1000**/600 Kgs. for **245**/145 kV insulators respectively.

b) Pressure due to the contact shall not be transferred to the insulators after the main blades are fully closed.

c) The parameters of the insulators shall meet the requirements specified under Section -GTR.

d) Insulator shall be type and routine tested as per IEC-60168**.**

e) For 245 kV Insulator: (For Isolator)

Top PCD	=	127 mm
No. of holes	=	4 x M16
Bottom PCD	=	**275 mm**
No. of holes	=	8 x 18 dia

f) For 145 kV Insulator: (For Isolator)

Top PCD	=	127 mm
No. of holes	=	4 x M16
Bottom PCD	=	254 mm
No. of holes	=	8 x 18 dia

3.5 **Name Plate :**

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

4.0 EARTHING SWITCHES :

a) Where earthing switches are specified these shall include the complete operating mechanism and auxiliary contacts.

b) The earthing switches shall form an integral part of the isolator and shall be mounted on the base frame of the isolator.

c) Earthing switches shall be only locally operated.

d) The earthing switches shall be constructionally interlocked with the isolator so that the earthing switches can be operated only when the isolator is open and vice versa. The constructional interlocks shall be built in construction of isolator and shall be in addition to the electrical interlocks. Suitable mechanical arrangement shall be provided for de-linking electrical drive for manual operation.

e) Each earth switch shall be provided with flexible copper/aluminum braids for connection to earth terminal. These braids shall have the same short time current carrying capacity as the earth blade. The transfer of fault current through swivel connection will not be accepted.

f) The plane of movement and final position of the earth blades shall be such that adequate electrical clearances are obtained from adjacent live parts in the course of its movement between ON and OFF position.

g) The frame of each isolator and earthing switches shall be provided with two reliable earth terminals for connection to the earth mat.

h) Isolator design shall be such as to permit addition of earth switches at a future date. It should be possible to interchange position of earth switch to either side.

i) The earth switch should be able to carry the same fault current as the main blades of the Isolators and shall withstand dynamic stresses.

5.0 OPERATING MECHANISM :

a) The bidder shall offer motor operated Isolators and earth switches. Isolators of 36 kV and below and earth switches of 72.5 kV and below rating shall be manual operated.

b) Control cabinet/operating mechanism box shall conform to the requirement stipulated in Section-GTR and shall be made of cast aluminum/aluminum sheet of adequate thickness (minimum 3 mm).

c) A "Local/Remote" selector switch and a set of open/ close push buttons shall be provided on the control cabinet of the isolator to permit its operation through local or remote push buttons.

d) Provision shall be made in the control cabinet to disconnect power supply to prevent local/remote power operation.

e) Motor shall be an AC motor and conform to the requirements of Section 2-GTR.

f) Suitable reduction gearing shall be provided between the motor and the drive shaft of the isolator. The mechanism shall stop immediately when motor supply is switched off. If necessary a quick electromechanical brake shall be fitted on the higher speed shaft to effect rapid braking.

g) Manual operation facility (with handle) should be provided with necessary interlock to disconnect motor.

h) Gear should be of forged material suitably chosen to avoid bending/jamming on operation after a prolonged period of non-operation. Also all gear and connected material should be so chosen/surface treated to avoid rusting.

i) The test report for blocked rotor test of motor shall be submitted as per the requirement of clause 23.0 of Section GTR of Technical Specification.

j) Only stranded conductor shall be used for wiring. Minimum size of the conductor for control circuit wiring shall be 1.5 sq.mm. (Copper).

k) The operating mechanism shall be located such that it can be directly mounted on any one of the support structure.

6.0 OPERATION :

a) The main Isolator and earth switches shall be gang operated in case of **245**/145 kV & **36**kV. The operating mechanism of the three poles shall be well synchronized and interlocked.

b) The design shall be such as to provide maximum reliability under all service conditions. All operating linkages carrying mechanical loads shall be designed for negligible deflection. The length of inter insulator and interpole operating rods shall be capable of adjustments, by means of screw thread which can be locked with a lock nut after an adjustment has been made. The isolator and earth switches shall be provided with "over center" device in the operating mechanism to prevent accidental opening by wind, vibration, short circuit forces or movement of the support structures.

c) Each isolator/pole of isolator and earthswitch shall be provided with a manual operating handle enabling one man to open or close the isolator with ease in one movement while standing at ground level. Non-detachable type manual operating handle shall have provision for padlocking. For detachable type manual operating handles, suitable provision shall be made inside the operating mechanism box for parking the detached handles. The provision of manual operation shall be located at a convenient operating height from the base of isolator support structure.

d) The isolator shall be provided with positive continuous control throughout the entire cycle of operation. The operating pipes and rods shall be sufficiently rigid to maintain positive control under the most adverse conditions and when operated in tension or compression for isolator closing. They shall also be capable of withstanding all torsional and bending stresses due to operation of the isolator. Wherever supported the operating rods shall be provided with bearings on either

ends. The operating rods/ pipes shall be provided with suitable universal couplings to account for any angular misalignment.

e) All rotating parts shall be provided with grease packed roller or ball bearings in sealed housings designed to prevent the ingress of moisture, dirt or other foreign matter. Bearings pressure shall be kept low to ensure long life and ease of operation. Locking pins wherever used shall be rustproof.

f) Signaling of closed position shall not take place unless it is certain that the movable contacts, have reached a position in which rated normal current, peak withstand current and short time withstand current can be carried safely. Signaling of open position shall not take place unless movable contacts have reached a position such that clearance between contacts is at least 80% of the isolating distance.

g) The position of movable contact system (main blades) of each of the Isolators and earthing switches shall be indicated by a mechanical indicator at the lower end of the vertical rod of shaft for the Isolators and earthing switch. The indicator shall be of metal and shall be visible from operating level.

h) The contractor shall furnish the following details along with quality norms, during detailed engineering stage.

   (i) Current transfer arrangement from main blades of isolator along with millivolt drop immediately across transfer point.

   (ii) Details to demonstrate smooth transfer of rotary motion from motor shaft to the insulator along with stoppers to prevent over travel.

7.0 TERMINAL CONNECTOR STUD/PAD:

The isolator terminal pads/studs shall be made of high quality copper or aluminium and shall be conforming to Australian standard AS-2935 for rated current. The terminal pad shall have protective covers which shall be removed before interconnections.

8.0 SUPPORT STRUCTURE:

245/145/**36** kV Isolators shall be suitable for mounting on support structures to be supplied in accordance with stipulations of section-GTR.

9.0 TESTS:

9.1 In continuation to the requirements stipulated under Section-GTR the isolator alongwith its earthing switch and operating mechanism should have been type tested as per IEC and shall be subjected to routine tests in accordance with IEC-62271-102. Minimum 1000 Nos. mechanical operations in line with mechanical endurance test, M0 duty, shall be carried out on 1 (one) isolator out of every lot of Isolators, assembled completely with all accessories, as acceptance test for the lot. The travel characteristics measured at a suitable location in the base of insulator along with motor current/power drawn, during the entire travel duration are to be recorded at the start and completion and shall not vary by more than (+/-) 10% after completion of 1000 cycles of operation. After completion of test, mechanical interlock operation to be checked**.**

9.2 The test reports of the type tests and the following additional type tests (additional type tests are required for isolators rated above 72.5 kV only) shall also be submitted for the Purchaser's review.

(i) Radio interference voltage test.

(ii) Seismic withstand test on isolator mounted on Support structure. The test shall be performed in the following position :

Isolator open	E/S Closed
Isolator open	E/S Open
Isolator Closed	E/S Open

10.0 SPARE PARTS AND MAINTENANCE EQUIPMENT:

Bidder shall include in his proposal mandatory spare parts in accordance with the requirements stipulated in Section- PSR.

11.0 TECHNICAL PARAMETERS:
(In addition to those specified under Section-GTR)

II. 245/145 **kV ISOLATORS:**

B11.1	Type	Outdoor
B11.2	Rated current at 50^{O}C ambient temperature	1600 A

B11.3	Rated short time withstand current of isolator and earth switch	**40**/31.5 kA for 1 Sec.
B11.4	Rated dynamic short circuit withstand current of isolator and earth switch	80 kAp
B11.5	Temperature rise over design ambient temperature	As per table V of IEC-694.
B11.6	Rated mechanical terminal load.	As per table III of IEC-62271-102 or as per value calculated in Section-GTR whichever is higher.
B11.7	Operating mechanism of isolator/earth switch	A.C. Motor operated
C11.8	No. of auxiliary contacts on each isolator	Besides requirement of this spec., 5 NO + 5 NC to contacts, wired to terminal block exclusively for Purchaser's use in future.
B11.9	No. of auxiliary contacts on each earthing switch	Besides requirement of this spec., the bidder shall wire up 3 NO + 3 NC to TBs (Reversible) for Purchaser's future use.
B11.10	Operating time	15 sec. or less
B11.11	Number of terminal in control cabinet (Interpole cabling shall be supplied by Contractor)	All contacts & control circuits are to be wired upto control cabinet plus 24 spare terminals evenly distributed.

III. 33kV ISOLATOR

C11.1	Type	Outdoor (Double Break)
C11.2	Temperature rise over design ambient temperature	As per table V of IEC 62271-1
C11.3	Rated mechanical terminal load	As per table-III of IEC 62271-102 IEC 129(1984) or as per value calculated in Section- GTR whichever is higher
C11.4	Number of terminals in control cabinet (Interpole cabling shall be Supplied by contractor)	All contacts and control circuits are to be wired upto control cabinet plus 24 terminals exclusively for Owner's use.
C11.5	Rated current at design ambient temperature	**2500/1600/1250**/800Amps(as appli.)
C11.6	Rated short time withstand current of isolator and earthswitch	25 kA for 1 Sec
C11.7	Rated dynamic short circuit withstand current of isolator and earth switch	As per IEC
C11.8	Operating mechanism for Isolator and Earth switch	Manual
C11.9	No. of auxiliary contacts on each isolator	5 NO + 5 NC contacts, wired to terminal block exclusively for Owner's use in future.
C11.10	No. of auxiliary contacts on each earthing switch	3 NO + 3 NC contacts wired to terminal block exclusively for Owner's use in future.

C.I The porcelain of the 36 kV insulators shall have minimum cantilever strength of 450 KGS

C.II 33 kV Isolator shall be gang operated for main blades and earth switches.

12.0 PRE-COMMISSIONING TESTS

12.1 An indicative list of tests on isolator and earthswitch 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 Supplier or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

(a) Insulation resistance of each pole.

(b) Manual and electrical operation and interlocks.

(c) Insulation resistance of control circuits and motors.

(d) Ground connections.

(e) Contact resistance.

(f) Proper alignment so as to minimize vibration during operation.

(g) Measurement of operating Torque for isolator and Earth switch.

(h) Resistance of operating and interlocks coils.

(i) Functional check of the control schematic and electrical & mechanical interlocks.

(j) 50 operations test on isolator and earth switch.

12. 2 The contractor shall ensure that erection, testing and commissioning of Isolators above 72.5 kV class shall be carried out under the supervision of the Isolator manufacturer's representative. The commissioning report shall be signed by the manufacturer's representative.

TECHNICAL SPECIFICATION

VOL-II, SEC-VI

SWITCHGEAR SURGE ARRESTERS

SECTION-VI
SWITCHGEAR SURGE ARRESTERS

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SECTION-VI
SWITCHGEAR SURGE ARRESTERS

1.0 GENERAL:

1.1 The Surge arresters shall conform to IEC: 60099-4 except to the extent modified in the specification and shall also be in accordance with requirements under Section -GTR.

1.2 Arresters shall be of hermetically sealed units, self-supporting construction, suitable for mounting on tubular support structures to be supplied by the Contractor.

1.3 The Surge Arrestors shall be designed for use in the geographic and meteorological conditions as given in the Section -GTR.

2.0 DUTY REQUIREMENTS:

a. The surge arresters shall be of heavy duty station class and gapless 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. 245/145/36 kV class arrester shall be capable for discharging energy equivalent to class 3 of IEC for 245/145/36 kV system on two successive operations.

d. The surge arresters shall be suitable for withstanding forces as defined in Section-GTR.

e. The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

f. The surge arresters are being provided to protect the following equipment whose insulation levels are indicated in the table given below:-

Equipment to be protected	Lightning impulse(kVp) for 245 kV system	Lightning Surge for 145 kV system
Power transformer	± 950	± 550
Instrument Transformer	± 1050	± 650
Reactor	--	--
CB/Isolator Phase to ground	± 1050	± 650
CB/Isolator Across open contacts	± 1050(for CB) ± 1200(for Isolator	± 750

g. The duty cycle of CB installed in 245/145 kV System of the Purchaser shall be O-0.3 sec-CO-3 min-CO. The Surge Arrester shall be suitable for such circuit breaker duties in the system.

3.0 CONSTRUCTIONAL FEATURES:

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

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

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

c) The arresters shall not fail due to arrester porcelain contamination.

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

e) Outer insulator shall be porcelain/polymer conforming to requirements stipulated in Section-GTR. Terminal connectors shall conform to requirements stipulated under Section-GTR.

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

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

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

h) The heat treatment cycle details along with necessary quality checks used for individual blocks along with insulation layer formed across each block are to be furnished. Metalizing coating thickness for reduced resistance between adjacent discs is to be furnished with additional information schedule of bid proposal sheets along with procedure for checking the same. Details of thermal stability test for uniform distribution of current on individual disc is to be furnished.

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

j) The sealing arrangement of the Surge Arrester stacks shall be done incorporating grooved flanges with the O-rings/elliptical cross-section gaskets of Neoprene or Butyl rubber.

k) The Surge arrester with porcelain housing shall have a cantilever strength of not less than 350 kg for 216/120kV surge arresters or as per the value obtained vide Section-GTR, whichever is higher. For Surge arrester with polymer housing, the cantilever strength shall not be less than 150kg.

4.0 FITTINGS AND ACCESSORIES:

a) 216/120/30 kV Arresters shall be complete with insulating base and Surge monitor having provision for bolting to flat surface of structure.

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

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

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

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

5.0 TESTS:

5.1 **In accordance with the requirements stipulated under Section-GTR, the surge arresters should have been type tested as per IEC and shall be subjected to routine and acceptance tests in accordance with IEC document For contamination test, procedures outlined in 60099-3 shall be followed.**

The test reports of the type tests and the following additional type tests(additional type tests are required for Surge Arresters above 72.5 kV class only) shall also be submitted for the Purchaser's review.

i) Radio interference voltage test as per IEC 60099-4.
ii) Seismic withstand test.
iii) Contamination test.
iv) Test to verify the Power frequency versus time characteristics. Temporary over voltage profile for arresters are to be mutually agreed.

Each metal oxide block of surge arresters shall be tested for the guaranteed specific energy capability in addition to the routine/acceptance test as per IEC: 60099-4.

5.2 (a) **Acceptance Tests:**

1. Measurement of power frequency reference voltage of the arrester units.
2. Lightning Impulse Residual voltage on arrester units. (IEC clause 6.3.2).
3. Internal Ionisation or partial Discharge test.

(b) **Special Acceptance Test:**

1. Thermal stability test on three sections. (IEC Clause 7.2.2).
2. Aging & Energy Capability test on blocks (procedure to be mutually agreed).
3. Wattloss test.

(c) **Routine Tests:**

1. Sealing test: Water dip test at 1.5m depth from top of Surge Arrestor for 30 minutes shall be performed during assembly of Surge Arrester stacks (followed by other routine tests, i.e. P.D. Measurement, Reference Voltage, Residual Voltage & IR measurement).
2. Measurement of reference voltage.
3. Residual voltage test of arrester unit.
4. Internal Ionisation test or partial discharge test.
5. Verticality check on completely assembled Surge arresters as a sample test on each lot.

(d) **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 10kA current impulse (8/20 micro sec.) shall also be performed on the Surge monitor.

Surge monitors shall be routinely tested for water dip test at 1.5m for 30 minutes. No water vapors shall be visible on the monitor glass.

(e) **Test on insulators**

All routine tests shall be conducted on the hollow column insulators as per IEC 62155. Polymer housing shall be tested in accordance to IEC-61462.

6.0 SPARE PARTS AND MAINTENANCE EQUIPMENT:

Bidder shall include in his proposal spare parts and maintenance equipment, as mentioned in Section-PSR.

7.0	**TECHNICAL PARAMETERS:**	
A.	**245 kV CLASS SURGE ARRESTER**	
A 7.0(a)	Rated arrester voltage	216 kV
A 7.0(b)	Nominal discharge Current	10 kA of 8/20 microsecond wave
A7.0(c)	Minimum discharge capability	5kJ/kV (referred to rated arrester voltage corresponding to minimum discharge characteristics.
A 7.0(d)	Continuous operating voltage at 50 deg.C	168 kV rms
A 7.0(e)	Max. switching surge residual voltage (1kA)	500 kVp
A 7.0(f)	Max. residual voltage at	
	i) 5 kA	560 kVp
	ii) 10 kA nominal discharge current	600 kVp
A 7.0(g)	Max. steep current impulse residual voltage at 10 kA.	650 kVp
A 7.0(h)	Long duration discharge class	3
A 7.0(i)	High current short duration test value (4/10 micro second wave)	100 kAp
A 7.0(j)	Current for pressure relief test	40 kA rms / 50 kA rms (as applicable)
A 7.0(k)	Low current long duration test value (2400 micro sec)	As per IEC.
A 7.0(l)	Pressure relief class	40 kA / 50 kA (as applicable)
B.	**145 kV CLASS SURGE ARRESTER**	
B7.0(a)	Rated arrester voltage	120 kV
B7.0(b)	Nominal discharge current	10 kA of 8/20 microsecond wave
B7.0(c)	Minimum discharge capability	5kJ/kV (referred to rated arrester voltage corresponding to minimum discharge characteristics.
B7.0(d)	Continuous operating voltage at 50 deg.C	102 kV rms
B7.0(e)	Max. switching surge residual voltage (1kA)	280 kVp

B7.0(f)	Max. residual voltage at	
	i) 5 kA	310 kVp
	ii) 10 kA nominal discharge current	330 kVp
B7.0(g)	Long duration discharge class	3
B7.0(h)	High current short duration test value (4/10 micro second wave)	100 kAp
B7.0(i)	Current for pressure relief test	40 kA rms
B7.0(j)	Low current long duration test value (2400 micro sec)	As per IEC.
B7.0(k)	Pressure relief class	31.5 kA

C 33kV Surge Arresters

C7.0(a)	Rated arrester voltage	30 kV
C7.0(b)	Nominal discharge capability	10 kA of 8/20 microsecond wave
C7.0(c)	Minimum discharge capability	5kJ/kV (referred to rated arrester voltage corresponding to minimum discharge characteristics).
C7.0(d)	Continuous operating voltage at 50 deg.C	24 kV rms
c7.0(e)	Max. switching surge residual voltage (0.5kA)	63 kVp
C7.0(f)	Max. residual voltage	
	(i) 5 kA	80 kVp
	(ii) 10 kA nominal discharge current	85 kVp
C7.0(g)	Long duration discharge class	2
C7.0(h)	High current short duration test value (4/10 micro second wave)	100 kAp

C7.0(i)	Current for Pressure Relief test	40kA rms
C7.0(j)	Low current long duration test value (2000 micro sec)	As per IEC.
C7.0(k)	Pressure relief class as per IEC-60099-1	A

8.0 PRE-COMMISSIONING TESTS

8.1 An indicative list of tests is given below.

(a) Operation check of LA counter.
(b) Insulation resistance measurement
(c) Capacitance and Tan delta measurement of individual stacks.
(d) Third harmonic resistive current measurement (to be conducted after energisation.)

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

TECHNICAL SPECIFICATION

VOL-II, SEC-VII

LT SWITCHGEAR

SECTION-VII
LT SWITCHGEAR

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SECTION-VII
LT SWITCHGEAR

1.1. CONSTRUCTIONAL DETAILS OF SWITCHBOARDS AND DISTRIBUTION BOARDS

1.1.1.1. All boards shall be of metal enclosed, indoor floor mounted, compartmentalised double front construction and freestanding type.

1.1.1.2. 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 1.6 mm. 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. Gland plate shall be cold rolled sheet steel having thickness not less than 3 mm in all cases. However, in case of termination of single core power cables, gland plate shall be of non-magnetic material of at least 4mm thickness.

1.1.2. All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.

1.1.3. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cut-outs shall be true in shape and devoid of sharp edges.

1.1.4. All boards shall be of dust and vermin proof construction and shall be provided with a degree of protection of IP: 52, for category I enclosure as per IS: 13947 (Part-I) / IEC 60947 (Part-1). However, the busbar chambers having a degree of protection of IP: 42, in accordance with IS:13947 (Part-I) / IEC 60947 (Part-1), are also acceptable where continuous busbar rating exceeds 1000 Amp. Provision shall be made in all draw out Air Circuit Breaker compartments for providing IP: 52 degree of protection, when Circuit breaker trolley, has been removed. Panels with lighting transformers shall have IP 31 degree of protection in accordance with IS: 13947 (Part-I) / IEC 60947 (Part-1). Door frame of panels, meters, relays, Breaker cut-outs shall be provided with neoprene rubber gaskets generally conforming to Type – II, Class 2A as per IS: 11149 IEC / International Standards.

1.1.4.1. 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. Panels with lighting transformers in lighting distribution boards shall have louvers.

1.1.5. All boards shall be of uniform height not exceeding 2450 mm.

1.1.6. Boards shall be easily extendible on both sides, by the addition of the vertical sections after removing the end covers of bus bar chambers.

1.1.7. 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.

1.1.8. a) All boards shall be of double front construction and shall have ÷

(i) A completely enclosed busbar compartment for running horizontal busbars and vertical busbars. Busbar chambers shall be completely enclosed with metallic portions. Bolted covers shall be provided for access to horizontal and Vertical busbars for repair and maintenance, which shall be feasible without disturbing feeder compartment. Vertical bus bar chambers shall be accessible from front as well as back side of the panel and shall be of at least 350 mm width. One set of vertical busbars shall be used in between two adjacent sections for switchgear connections. In case of ACB feeders, the panel shall have single front without any vertical busbar chamber, however vertical busbars associated with ACBs shall be located in rear side and shall be additionally covered with metallic perforated/ transparent acrylic or polyvinyl bolted sheets to avoid direct access after opening rear door of chamber.

(ii) Completely enclosed switchgear compartment(s) one for each circuit for housing circuit breaker or MCCB or motor starter.

(iii) A distinct compartment or alley for power and control cables on each side of panel. Cable alley compartment shall have a through metallic partition for segregating cables on both sides. Cable alley door shall preferably be hinged. Cable alley shall have no exposed live parts. Any live terminals shall be fully shrouded/insulated from safety aspects. However, it shall be of atleast 350mm width.

(iv) A compartment for relays and other control devices associated with a circuit breaker.

b) Lighting transformers shall be supplied in separate and distinct panel completely assembled for incoming cable connection from bottom and outgoing connection through busbar with adjacent associated lighting distribution board. Lighting transformers shall have provision of base channel with rollers for taking in and out from the panel in case of maintenance after disconnecting incoming and outgoing connections. Provision of single phase fans at least two (2) numbers of suitable ratings shall be made in the panel for ventilation. These fans shall run in sequential mode at suitable time interval to be controlled by thermostat and timer. The offered design of panel should be such that in no case, temperature rise of lighting transformers shall exceed the permissible limits for the class of insulation of lighting transformer.

1.1.9. 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.

1.1.10. All equipment's 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.

1.1.11. After isolation of power and control circuit connections it shall be possible to safely carryout 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.

1.1.12. The minimum clearance in air between phases and between phase and earth for the entire run of horizontal and vertical busbars, shall be 25 mm. For all other components, the clearance between "two live parts", " A live part and an earthed part" and isolating distance shall be atleast 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 25 mm should be maintained even if they are sleeved.

1.1.13. 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.

1.1.14. All busbar chambers shall be provided with removable bolted covers. The covers shall be provided with danger labels.

1.1.15. All identical circuit breakers and module chassis of same test size shall be fully interchangeable without having to carryout modifications.

1.1.16. 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.

1.1.17. 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.

1.1.18. 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 replaceable.

1.1.19. All AC & DC boards shall be of double Front type.

1.1.20. All module shall be fixed type except air circuit breaker module, which shall be drawout type.

1.1.21. The connections from bus bars 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 of such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination.

1.1.22. 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 EMPLOYER approval. Bidder shall submit dimensional drawings showing complete internal details of bus bars and module components, for each type and rating for approval.

1.1.23. The tentative power and control cable entries shall be from bottom. However, Employer reserves the right to alter the cable entries, if required, during detailed engineering, without any additional commercial implication.

1.1.24. Adopter panels and dummy panels required to meet the various busbar arrangements and layouts required shall be included in Bidder's scope of work.

1.2. DERATING OF EQUIPMENTS

1.2.1. The current ratings of all equipments as specified in the Single Line Diagram For AC & DC System are the minimum standards current ratings at a reference ambient temperature as per relevant Indian Standards.

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 bars and the DC Distribution Boards shall be provided with two busbars.

1.3.2. All busbars and jumper connections shall be of high conductivity aluminium/copper of adequate size.

1.3.3. The Cross-Section of the busbars shall be uniform throughout 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 adequate numbers of high strength type Polyester fibre glass Moulded Insulators to withstand short circuit withstand capability of panel. Separate supports shall be provided for each phase and neutral busbar. If a common 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/spring 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: 11353-1985 (Guide for Uniform System of Marking and Identification of Conductors and apparatus Terminals / IEC: 60446.

1.3.7. The Bidder shall furnish calculations, 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 galvanised 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 breaker earthing contact bar vertical bus shall be provided in each vertical section which shall in turn be bolted / welded to main horizontal ground bus.

1.4.2. The earth bus shall have sufficient cross-section to carry the momentary short circuit and short time fault currents to earth without exceeding the allowable temperature rise.

1.4.3. Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Employer'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 throughout the intermediate travel.

1.4.6. Air Circuit Breaker (ACB) 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 equipment's shall be connected to earth by independent stranded copper wires of size not less than 2.5 mm^2. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering is not acceptable. Looping of earth Connection 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 of 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 draw out 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 it operating mechanism on a wheeled carriage. 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 the 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 potentially free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be provided in both `SERVICE' & `TEST' position of the breaker. All contacts shall be rated for making continuously carrying and breaking 10 Amps at 230V AC and 1 Amp (Inductive) at 220V 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 in 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 in 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 stationary 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 free feature, even if mechanical anti-pumping 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 110 kW 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 rotor currents of Induction Motors for rated 100 kW to 220 kW.

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 it 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: 13947 (Part – II) / IEC: 60947 Part-2. All MCCB offered shall have Ics = 100% Icu rating.

1.6.2. MCCB shall be flush mounted on the AC/DC distribution boards and shall have extended handle.

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 80% 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 IS: 8828/ IEC: 60898.

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 draw out construction for easy replacement from the front. They shall either have built-in 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-draw out cases.

1.7.2 All AC relays shall be suitable for operation, at 50 Hz with 110 volts VT 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 contacts. 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 reset operation indicators (Flags) for analysing the cause 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 contactor-controlled motors shall have single 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 of air break, electromagnetic type rated for uninterrupted duty as per IS: 13947 (Part - 4) / IEC: 60947 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 of utilisation category AC2. These contactors

shall be as per IS: 13947 (Part - 4) / IEC: 60947 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 230V 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 switchboard 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 MCBs 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 instruments 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 adjustment 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 shall 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 put 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 secondary's.

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 230V AC	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: 13947 Part-3 / IEC: 60947 Part-3.

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 230V 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 reset.

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 of 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 invariable 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 400 AC, and for DC circuits Class 1 type 4 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 EMPLOYER.

1.16 TERMINAL BLOCKS

1.16.1 Terminal blocks shall be of 750 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. Marking on terminal strip shall correspond to the terminal numbering on wiring on diagrams. It shall be similar to `ELEMEX' 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 with short 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 2.5 mm 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 back ground. Inscriptions and lettering sizes shall be subject to EMPLOYER 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 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 230V 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 upto the terminal blocks ready to receive Employer'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 1100 V grade, single core, 1.5 square mm or larger stranded copper wires having colour coded, PVC insulation. CT circuits shall be wired with 2.5 square mm copper wires. Voltage grade 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 stranded aluminium conductor, armoured XLPE/PVC insulated and sheathed, single core/three core, 1100 V 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 the successful bidder, to suit the final cable sizes which would be advised later.

1.20.3 The gland plate shall be of removable type and shall cover the entire cable alley. Bidder shall also ensure that sufficient space is provided for all cable glands. For all single core cables, gland plates shall be of non-magnetic Material.

1.21 TYPE TESTS

1.21.1 Type tests reports on Panels (Switchgear and Control gear assemblies) as per IS: 8263 Part – I / IEC: 60439 Part-1 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 – 2 / IEC: 60947 Part 2.
2. Protective Relays as per IEC: 60255.
3. Lighting transformers as per IS: 2026 / IEC:60076

For above equipment's, 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 Employer. No equipment shall be permanently bolted down to foundations until the alignment has been checked and found acceptable by the Employer.

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 Employer'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 room through the regular door or openings specifically provided for this purpose. No part of the structure shall be utilised to lift or erect any equipment without prior permission of Employer.

1.22.6 All boards shall be installed in accordance with relevant code of practices and at Employer'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 completed. 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 Employer.

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 switch-

boards/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 connection.

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 Megger 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 Megger all terminals to body.

1.23.6.3 Megger 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 particular 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 equipment's offered.

1.24.2 The list of these special tools and tackles shall be given in the bid proposal sheets alongwith 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 in accordance with this specification.

1.25.2 Standard scheme of interconnection of switchboards and distribution boards alongwith tentative feeder disposition for each board is indicated in Standard SLD of AC & DC system enclosed alongwith 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.

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 an 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 stabilising resistor.

(viii) One(1) set Current and Voltage transducers.
(ix) One(1) set High speed tripping relays.

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 metering.

(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 110 kW - 200 kW. 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 relay 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. Theearth fault relay shall be provided with a stabilising resistor.

(x) One (1) set Current and Voltage transducers.

(xi) One(1) set High speed tripping relay.

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) $\frac{415}{\sqrt{3}} / \frac{110}{\sqrt{3}}$ volts single phase voltage transformer star/star connect with star point solidly earthed mounted on common draw out chassis. Accuracy Class 0.5 for protection and metering with 50VA Burden.

(ii) Six (6) 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/Voltmeter 0-75V DC for 50V DCDB

(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 of relay should not be more than 1.25. The relay shall be provided with a series resistor and a push button across if 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/230V AC Auxiliary supply.

1.25.11 Module Type X

(i) One (1) Double pole 250 V MCB/ MCCB suitable for 20kA for 1 sec. Fault level

1.25.12 Module Type-DC (Incomer from Battery & Chargers)

(i) One (1) Double pole 250V DC MCCB for incomer from Battery.

(ii) One (1) DC ammeter with shunt and range of 90-0-400 Amps. For 220V DC DB and 90-0-200 Amp for 50V 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.

(v) One(1) set Voltage and Current Transducers

1.25.13 Module Type DG-1 (Electrically Controlled Circuit Breaker for Incomer from DG Set)

a) One (1) Four 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 transformers 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 transformers 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 of high impedance type, with necessary stabilizing resistors.

o) Two (2) Push buttons for Remote starting & stopping of DG Set (Red, Green).

p) One (1) set Current and Voltage transducers.

q) One(1) set High speed tripping relays.

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 ± 2.5%

c) Combined variation ± 105% 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	4 kA
	c) System Voltage	48 V ± 10%
	d) Fault Level	--

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 for Vertical panels.	As specified in Standard SLD For AC & DC system.
b)	Short time (1 sec. kA (rms)	20 kA
c)	Momentary (kA) PEAK	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	Smoke Grey shade No.692
b)	Exterior	Smoke Grey shade No.692

1.26.4 Circuit Breaker

a)	Type	Air Break
b)	No. of poles	3
c)	Voltage & Frequency	415 Volts, ± 10%, 50 HZ + 2.5%
d)	Rated Operating Duty	As per IEC
e)	Rated service short-circuit Breaking capacity (Ics)	20 kA (RMS)
f)	Short Circuit making current	45 kA (Peak)
g)	Short time withstand current for 1 sec. duration.	20 kA (RMS) for 1 sec.
h)	Operating Mechanism current for 1 sec. duration.	20 kA (RMS) for 1 sec.
i)	No. of auxiliary contacts	4 NO & 4 NC contacts for Employer's use on fixed portion of the cubicle
j)	Short Circuit breaking current	
	I. AC Component	20 kA (RMS)
	II. DC Component	As per IEC: 60947 (Part 2)

1.26.5 MOULDED CASE CIRCUIT BREAKER

		AC System	DC System
a)	No. of poles	4	2
b)	Voltage & Frequency	415 Volts, ± 10% 50 HZ ± 2.5%	250V
c)	Rated Operating Duty	As per IEC	
d)	Rated service short-circuit	20 kA (RMS)	4 kA

	Breaking capacity (Ics)		
e)	Short Circuit making current	45 kA (Peak)	-
f)	No. of auxiliary Contacts (only for incomer And bus-coupler MCCBs)	1 NO &1 NC	1 NO &1 NC
g)	Rated Ultimate Short Circuit breaking capacity		
	I. AC Component	20 kA (RMS)	As per IEC
	II. DC Component	As per IS:13947 IEC 60947	

1.26.6 Meters

a)	Accuracy class	2.5
b)	One minute power frequency withstand test voltage in KV	2.0

1.26.7 Current Transformers

a)	Type	Cast resin, Bar primary
b)	Voltage class and frequency	650V, 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	5 P 15, VA adequate for application, but not less than 7.5 VA.
f)	Accuracy class differential protection	PS, KPV = 300V
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/√3 V
	Secondary	110/√3 V
c)	Method of connection	
	Primary	Star
	Secondary	Star
d)	Rated voltage factor	1.1 continuous, 1.5 for 3 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 20VA

1.26.9 Relay

a)	One minute power Frequency withstand test	2 kV (rms)

1.26.10	**Transducers (1 phase)**	**Current**	**Voltage**
	a) Operating Voltage	220 V DC	220V DC

b) I/P	1A.	110V AC
c) O/P	4-20 mA	4-20 mA
d) Type	Analogue	Analogue

1.26.11 Lighting Transformers

Lighting transformers shall be of 100 KVA rating, 400/4400 V, 3 phase, 50 Hz Dry type natural air cooled type. The technical parameters of these lighting transformers are as follows:

Technical Parameters of Lighting Transformer

Type of transformer	:	Dry type natural air cooled
Rating	:	100 KVA
Voltage ratio	:	415/415 volts
No. of phases	:	Three
Frequency	:	50 Hz
Winding connection	:	Dyn-1
Class of insulation	:	'B' class
Impedance	:	4% ± 10%
No. of taps & steps	:	5, ± 5% in steps of 2.5%
Ref. standard	:	IEC: 60076

1.27 AUTOMATIC CONTROL OF OUTDOOR LIGHTING

1.27.1 EL-type module of 400V 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, Incomer 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 requirement 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 400 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.
On 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 initiated after a time delay, after the conditions warranting such change has been detected.

1.29 ANALOGUE INPUTS

LT System shall have provision of following analogue inputs for owner's substation automation purpose. These analogue inputs shall be generated by distinct transducers to be provided in respective modules. These inputs shall be wired up to respective terminal blocks.

ANALOGUE INPUTS:

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) Current from LT transformer-I
iv) Current from LT transformer-II
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) Voltage of 48V DCDB-I
x) Voltage of 48V DCDB-II
xi) Current from 48V Battery set-I
xii) Current from 48V Battery set-II

1.30 DIGITAL (Potential Free) INPUTS:

LT System shall have provision of following digital inputs for owner's substation automation purpose. These digital inputs shall be made available in the form of potential free contacts to be provided in respective modules. These potential free contacts shall be wired up to respective terminal blocks.

i) Main (MSB) Incomer-I breaker On/Off
ii) Main (MSB) Incomer-II breaker On/Off
iii) Main(MSB) 400V Bus-I/II U/V
iv) Main (MSB) bus coupler breaker on/off
v) DG set breaker on/off
vi) LT transformer-I Bunchholz Alarm & trip
vii) LT transformer-II Buchloz Alarm & trip

viii) LT transformer-I WTI Alarm & trip
ix) LT transformer-II WTI Alarm & trip
x) LT transformer-I OTI Alarm & trip
xi) LT transformer-II OTI Alarm & trip
xii) 220 V DC-I earth fault
xiii) 220V DC-II earth fault

TECHNICAL SPECIFICATION

VOL-II, SEC-VIII

BATTERY & BATTERY CHARGER

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SECTION-VII
BATTERY & BATTERY CHARGER

1.1. GENERAL TECHNICAL REQUIREMENTS

1.1.1.1. All materials/components used in battery chargers and batteries shall be free from flaws and defects and shall conform to the relevant Indian/IEC standards and good engineering practice.

1.1.1.2. DC System shall consist of two (2) float-cum-boost chargers and two (2) battery sets for each of 220V/110V and 48 V systems respectively. The standard scheme drawing is enclosed with this specification.

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

System Voltage	Maximum Voltage during Float operation	Minimum voltage available when no charger working and battery fully discharged upto 1.85V per cell.	Minimum Nos of cell
220 Volt	242 Volt	198 Volt	107
110 Volt	121 Volt	99 Volt	54
48 Volt	52.8 Volt	43.2 Volt	23

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:

	Load	**Duration**	**Type Of Loads**
220V/ 110V DC System	Continuous Load	3 hours	Relays, IEDs, Station HMIs, spring charging, Isolator interlocking load, Miscellaneous permanently connected loads etc.
	Emergency Load	1 hour	Substation emergency lighting loads.
	Momentary Load	1 minute	Breaker closing, Tripping loads (taking simultaneous occurrence as per system)
48V DC System	Continuous Load	3 hours	Continuous load associated with PLCs.(when speech is not working)
	Momentary Load	15 minute	Loads associated with PLCs (when speech is working)

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 shall be suitable for a long life under continuous float operations and occasional discharges. Air-conditioning shall be provided in Battery room the requirement of which has been specified elsewhere in the Technical Specification. The 220/110 V DC system is unearth and 48 V DC system is + ve earth system.

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 arrestor 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 27ºCelcius) 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 Celcius 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 with least count of 0.01Volt.

1.2.14. **Type Test of Battery**

1.2.14.1. Contractor shall submit type test reports of following tests as per IEC 60896-21 & IEC 60896-22, 2004. The type test reports shall be submitted in accordance with

the requirements stipulated in clause no. 9.2 of Technical Specification, Section-GTR except that the requirement of tests having been conducted within last five years as mentioned therein shall not be applicable.

S.No.	Description of test
1.	Gas emission
2.	High current tolerance
3.	Short circuit current and d.c. internal resistance
4.	Protection against internal ignition from external spark sources
5.	Protection against ground short propensity
6.	Content & durability of required markings
7.	Material identification
8.	Valve operation
9.	Flammability rating of materials
10.	Intercell connector performance
11.	Discharge Capacity
12.	Charge retention during storage
13.	Float service with daily discharges for reliable mains power
14.	Recharge behaviour
15.	Service life at an operating temperature of 40^0 C for brief duration exposure time.
16.	Impact of a stress temperature of 60^0 C for brief duration exposure time with 3 h rate discharge test.
17.	Abusive over-discharge
18.	Thermal runaway sensitivity
19.	Low temperature sensitivity
20.	Dimensional sensitivity at elevated internal pressure and temperature
21.	Stability against mechanical abuse of units during installation

Tests shall be conducted in accordance with IEC 60896-21 & IEC 60896-22, 2004

1.2.14.2. List of Factory & Site Tests for Battery

Sl. No.	Test	Factory Tests	Site Tests
	Physical Verification		√
	C/10 Capacity test on the cell	√	
	8 Hrs. Charge and 15 minutes discharge test at full rated load		√

1.2.15. **Installation and commissioning**

1.2.15.1. Manufacturer of Battery shall supervise the installation and commissioning and

perform commissioning tests as recommended in O&M manual / or relevant standards. All necessary instruments, material, tools and tackles required for installation, testing at site and commissioning are to be arranged by Battery manufacturer/ Contractor

1.2.16. Contractor shall be submitted following documents for approval:

a) Data sheet as per Annexure-I
b) GA of cell and layout drawing
c) Discharge Data for 10 Hour, 8 Hour, 3 Hour, 2 Hour, 1 Hour, 15 Minutes and One Minute indicating capacity factors for end cell voltage of 1.75 V & 1.85 V.
d) Temperature correction factors
e) Installation and commissioning Instructions
f) O & M Manual

1.3. Battery Charger

The DC system for 220/110 V DC is unearthed and for 48 V DC is +ve earthed. 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 Lead-Acid Batteries at 2.13 to 2.27 Volts per cell while supplying the DC load. The chargers shall also be capable of Boost charging the associated DC Battery at 2.28 to 2.32 volts per cell at the desired rate.
Charger shall regulate the float/boost voltage in case of prescribed temperature rise of battery as per manufacturer's 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.

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 $\pm$1% of the set value, for AC input voltage variation of $\pm$10%, frequency variation of $\pm$2.5%, a combined voltage and frequency variation of $\pm$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 anywhere 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 along with 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 220/110 V 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.

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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 bolts 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 IEC:- 60947 Part 1.

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 up to 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 IEC/International Standards. 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 be in accordance with IEC/International Standards. Welding shall not be done after phosphating. The phosphating 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 of shade-692 (smoke grey) 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 staved. 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 International 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 IEC: 60146 and short circuit test as per IEC:60076. 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.
ix) Temperature compensation feature demonstration

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 despatch 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.

Annexure-I

BATTERY SYSTEM DATA SHEETS

S.No.	Description of Data	Unit	220 V/ 110 V	48 V
1	General Data			
a)	Battery Type:			
	Grid alloy: Pure lead(Pb), lead calcium (Pb-Ca), lead antimony (Pb-Sb), or lead selenium (Pb-Se) or other pl. specify			
	Cell type: Absorbed glass mat or gel cell or other please specify			
	Seller's type number			
	Number of positive plates per cell			
b)	Does each battery and battery [rack]/ [cabinet] meet the seismic requirements	[Yes] [No]		
c)	Manufacturer's Designed Life of Battery	Yrs.		
d)	Recommended Battery Charger Data:			
	Floating voltage range	V		
	Boost charge	V		
	Current rating	Amps.		
	Recharge time	hr		
e)	Heat Released During:			
	Discharge duty cycle	Watt		
	Float charge	Watt		
	Boost Charge	Watt		
f)	Maximum Amount of Hydrogen Gas Evolved			
	During Battery-Boost Charge (2.33 V per cell) at Maximum Battery Temperature	(Litre /h)		
	Hydrogen Gas Evolution at Float	(Litre /h)		
g)	Time Battery may be Stored Without a Freshening Charge	months		
h)	Temperature Compensation Provided and its Details			

S.No.	Description of Data	Unit	220 V/ 110 V		48 V	
2.	Physical Description.					
a)	Battery Cell:					
	Size (L x W x H)	mm				
	Weight	Kg				
	Volume of electrolyte gal	L				
	Jar cover material					
	Jar container material					
	Separator material					
	Retainer material					
	Limiting-oxygen index (LOI)					
b)	Battery [Rack] [Cabinet]:					
	Outline or catalog number					
	Quantity of [racks][cabinets] for the battery					
	Description (tier or step type)					
c)	Total Net Weight of Battery Including [Racks] [Cabinets]	kg				
d)	Total Shipping Weight of Each Battery Jar and Associated Equipment	kg				
e)	Connectors:					
	Intercell:					
	Type					
	Material					
	No. per connection					
	Inter-[Tier] [Step]:					
	Type					
	Material					
	No. per connection					
	Terminal Detail:					
	Type					
	Material					
f)	Terminal Lugs for Power Cable:					
g)	Torque Data:		**Initial Torque Value**	**Re-torque Value**	**Initial Torque Value**	**Re-torque Value**
	Intercell Connectors					
	Inter-[Tier] [Step]:					

S.No.	Description of Data	Unit	220 V/ 110 V	48 V
3.	Performance Data.			

	Battery String Designation No. [1] [ ]			
	Float Voltage Without Boost	V/cell		
	Float Voltage With Boost	V/cell		
	Boost Charge Voltage	V/cell		
	Recommended Frequency of Boost Charge			
	Recommended Duration of Boost Charge			
	Open-Circuit Voltage	V/cell		
	Short-Circuit Current at Battery Terminals at Float Voltage at (27°C):			
	Battery Discharge Characteristics	A or A /positive plate		
	Guaranteed Amp-Hour Capacity (at the 10-hr rate) to Specified Final Voltage	AH		
	One-minute	A/cell		
	Fifteen-minute	A/cell		
	One-hour	A/cell		
	Two-hour	A/cell		
	Three-hour	A/cell		
	Eight-hour	A/cell		
	Ten-hour	A/cell		
4.	Required operating environment.			
	Battery Room Ambient Temperature Range	(°C to °C)		
	Battery Room Ambient Design Temperature	°C		
	Battery Room Minimum/Maximum Design Temperature	(°C to °C)		
	Maximum temperature at which battery can be stored	°C		

TECHNICAL SPECIFICATION

VOL-II, SEC-IX

LIGHTING SYSTEM

SECTION-IX
LIGHTING SYSTEM
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1.0 LIGHTING SYSTEM

1.1 LIGHTING SYSTEM FOR SUBSTATION

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 and pantry & accessories, lighting panels, lighting poles complete with distribution boxes, galvanized rigid steel /rigid PVC conduits, lighting wires, G.I. Earthwire, receptacles, tag block & telephone socket, switchboards, switches, junction boxes, pull out boxes complete with accessories, for control room cum administrative building, switchyard panel room if applicable, Fire Fighting pump house, Substation, security room, Main Gate and street lighting.

The entire indoor illumination i.e. control room building, GIS building, firefighting pump house, Security room and other buildings. Lighting shall be done by LED based low power consumption luminaries to achieve desired lux level specified. The bidder shall quote on lump sum basis on the basis of design criteria specified for each control room building, GIS building, Security room, firefighting pump house etc.

1.1.1 SYSTEM DESCRIPTION

The lighting system shall comprise of the following:

1.1.2 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.

1.1.3 AC Emergency Lighting

This system will be available in control room building, GIS building, Firefighting pump house , & switchyard area including DG set and LT Transformer area. 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. 25% of lighting fixtures shall be connected on AC emergency lighting.

1.1.4 **D.C. Emergency lighting**

A few DC 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 Firefighting pump house 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.

1.1.5 **Exit Lightings**

All Exit lightings in the buildings shall be fed by DC lighting panels. All necessary wiring and its termination shall be in the contractor's scope.

1.1.6 The lighting layout, conduit layout and electrical distribution diagram for and around Control Room Cum Administrative Office Building & Fire fighting Pump House indicating the type & BOQ for items shall be prepared and submitted by the contractor for Employer's approval during detailed engineering.
The lux levels to be maintained in the switchyard shall be as per following:

Sl No	Area	Average Lux Level
1.	Control Room Building, Firefighting pump house, Security room	**SN. Area Average Lux level at floor level** i) Control Room & Conference room - 350 Lux ii) Battery room, Passage, Pantry, Toilets, Corridors etc. - 100 Lux iii) All other rooms - 200 Lux
2.	Switchyard	-50 lux on main Equipments (i.e,Transformer, Reactor ISO, CB, CT, CVT, SA, Capacitor Bank) at first level (Equipment connections level.) -20 lux on balance area of switchyard and street / Road at ground level. --10 lux (Area between fence and peripheral roads around the switchyard). The lighting between the fence and the peripheral road around switchyard shall be done by providing the lighting fixtures on lighting pole of suitable height, if required.

The minimum lux level to average lux level ratio should not be less than 0.6 (i.e Emin/Eav>0.6). The maintenance factor for indoor illumination design shall be considered as 0.8. The surface reflectance for ceiling/wall/floor shall be 50/30/10
For achieving the specified lux levels in the switchyard, the contractor can provide luminaries of 1x400 W/1x250 W and 2x400 W/ 2x250 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 switch yard and street lighting by measurement.

In addition to the normal lighting provided in the switchyard area to maintain the desired lux levels, high beam fixtures(Type SF4- 8 nos) on swivel support shall be provided in strategic locations near equipment's for new substations which shall be kept normally OFF and these shall be switched ON in case of maintenance work.

1.1.7 Ceiling fans (1400 mm sweep, AC 230 volts) shall be provided in , fire fighting pump house and non AC rooms in the control room building and all the rooms in Security building as per the requirements. Wall mounted fans shall be provided in the conference room, control room, shift manager and substation incharge rooms in control room building. Exhaust fans shall be provided in toilets and pantry.

1.1.8 One no. of aluminum ladder of each size shall be supplied by the contractor for maintenance purpose.

1.1.9 The following specific areas are included in the scope of lighting:

(i) Switchyard Area.
(ii) Switchyard Control Room cum Administrative Office Building
(iii) Firefighting pump house
(iv) Street lighting (peripheral) inside switchyard fencing (Street lighting shall be done using street lighting poles)
v) DG area lighting
vi) LT Transformer area
vii) Security Room
viii) Residential quarters, if applicable
ix) GIS building(including panel rooms), if applicable

1.1.10 **For Outdoor Illumination**

The switchyard and street lighting design including lux level calculations, surface illuminance diagram at varying equipment surface levels , detailed drawings showing the lighting layout and Electrical distribution diagram and BOQ for items shall be prepared by the Contractor and submitted for approval. The above layout drawings will include disposition and location of lighting fixtures, receptacles, etc.

1.1.11 **For Indoor Illumination**

The conduit layout drawing for substation buildings, Electrical distribution diagram for substation buildings, & 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 Control Room cum Administrative Office Building and Fire Fighting pump house. In case where false ceiling surface conducting is permissible, all down run conduits will be concealed in wall below the false ceiling.

1.1.12 Each cable run shall be tagged with number that appear in the cable schedules. Cables shall be tagged at their entrance and/or exit from any piece of equipment, junction or pull box, floor opening etc.

1.1.13 The tag shall be made up of aluminum with the number punched on it and securely attached to the cable 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.

1.1.14 Location of cables laid directly under ground shall be indicated clearly by cable marker made of galvanised iron plate embedded in concrete block.

1.1.15 The location of underground cable joints if any, shall be clearly indicated with cable marker with an additional inscription "cable joint".

1.1.16 The marker, which is a concrete block, shall project 150 mm 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**

2.1 ***DESCRIPTION OF ITEMS FOR SUBSTATION LIGHTING***

The Contractor shall supply and install the following equipment and accessories in accordance with the specification.

2.1.1 **LIGHTING PANELS**

2.1.1.1 OUTDOOR

AC lighting panel with 400V, 63A, 3 phase 4 wire bus and one no. 63A, TPN, MCB with neutral unit as incomer and 20A, SP MCB as outgoing feeders, the details are as follows.

Type Of Panel	Description	Detail Of Outgoing Feeders
ACP 2	Outdoor	6 nos- 230 volts, 20 A single pole MCB and 3 No. 32 A Triple pole MCB with Neutral and suitable timer and contactor for automatic switching and 1 no. 5/15A Switch with Socket.
ACP 3	Outdoor Street lighting Panel	3 nos.- 32A Triple pole MCB with Neutral with suitable timer and contactor for automatic switching and 1 no. 5/15A Switch with Socket

Note: The number of outgoing feeders indicated above are the minimum.

2.1.1.2 **INDOOR**

415 V indoor AC lighting panel ,63 A 3 phase 4 wire bus and one number 63 amp FP MCB with 300ma 63 A FP RCCB. Flush mounted with per phase isolation and LED indication lamps. The DB will be flush mounted and double door type.

Type Of Panel	Description	Detail Of Outgoing Feeders
ACP 1	Indoor	18 nos. outgoing, 16 Amps SP MCB and 1 no. 5/15A Switch with Socket

220V DC indoor type change over board and 220V DC, 32A two wire bus and one 32A contractor 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.

Type Of Panel	Description	Detail Of Outgoing Feeders
DCP	Indoor	6 nos outgoing ,16 Amps DP MCB

2.1.1.3 **Sub-Lighting Panels**

Type Of Panel	Description	Detail Of Outgoing Feeders
SLP	Outdoor	4 pole 32A Isolator suitable for 400V, 50 cycles AC supply, with LILO facility using 8 nos terminal blocks suitable for

		cable upto 16 mm sq. cable Enclosure shall be suitable for outdoor use with IP-55 degree of protection as per IEC:60529.

2.1.2 **Lighting Fixtures**

Please Refer Annexure-1

2.1.3 **RECEPTACLES**

Type Of Receptacle	Description	Detail Of Outgoing Feeders
RO	Outdoor	15A, 230V, Receptacle 2 pole, 3- pin type
RP	Outdoor	63A, 400V, Interlocked switch socket, receptacle
RI	Indoor	5/15A, 230V, Receptacle 3-pin type (Modular)

2.1.4 (a) **SWITCH BOARDS**

Modular type switches, 5/15 Amp. Receptacles.

2.1.4 (b) **CONDUITS AND ACCESSORIES**

Galvanised Rigid steel or Rigid PVC conduits of 20/25 /32 mm for Lighting and Telephone wiring

2.1.5 **JUNCTION BOXES -** with 5 Nos.of terminal blocks

2.1.6 **LIGHTING POLES -** (Type A1 poles & Type E1 poles)

2.1.7 **FANS-**1400 mm Sweep with Electronic regulator and 450 mm Wall Mounted fans

2.1.8 **MAINTENANCE EQUIPMENT**

i) A type Aluminium ladder of 3 mtr. vertical height.

ii) Cartwheel mounted aluminium ladder Vertical Extendable from 5.1m to 11m.

2.1.9. **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, 230V, 2 pole, 3 pin type with third pin grounded, metal clad 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 Gl 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 35/3.5Cx70 sq.mm. aluminium 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.

2.1.10. **LIGHTING PANELS (L.P.)**

2.1.10.1 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 IEC: 60439.

2.1.10.2 **Constructional Features**

a) Panels shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be of thickness not less than 2.00 mm (cold rolled) smoothly finished, levelled and free from flaws. Stiffners shall be provided wherever necessary. The indoor lighting panels will be ready made DB of minimum 1.6 mm sheet thickness.

b) The panels shall be of single front construction, front hinged and front connected, suitable for either floor mounting on channels, sills or on walls/columns by suitable M.S. brackets. Indoor panels in control room shall be flush mounted.

c) 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.

d) All out door panels, removable covers, doors and plates shall be gasket all around with neoprene gaskets.

e) The outdoor panels shall be suitable for cable/conduit entry from the top and bottom. Suitable removable cable gland-plate shall be provided on the top and bottom of panels. Necessary number of double compression cable gland shall be supplied, fitted on to this gland plate. The glands shall be screwed on top and made of tinned brass.

f) The panels shall be so constructed as to permit free access to connection of terminals and easy replacement of parts.

g) Each panel shall have a caution notice fixed on it.

h) Each panel will be provided with directory holder in which printed and laminated as built circuit directory would be kept inside a document holder/pasted at site.

i) Each Outdoor lighting panel shall be provided with one no. 'ON' indicating lamp for each phase alongwith fuses. For indoor lighting panels din mounted phase indication lamps will be provided, mounted alongside of the MCB

j) **Main Bus Bars**

Bus bars shall be of aluminium alloy conforming to IEC: 60114/60105 and shall have adequate cross-section to carry the rated continuous and withstand short circuit currents. Maximum operating temperature of the bus bars shall not exceed 85 deg. C. The bus bars shall be able to withstand a fault level of 9 kA for 1 sec. for AC panels and 4 KA for 1 sec. for DC panels. The Indoor lighting panels shall have copper bus bar

2.1.10.3 **JUNCTION BOXES**

a) The junction boxes shall be concealed type for indoor lighting and suitable for mounting on columns, lighting poles, structures etc., for outdoor lighting.

b) Junction boxes shall be of square/rectangular type of 1.6 mm sheet steel with minimum 6 mm thick pressure diecast aluminium material LM-6 and shall have

bolted cover with good quality gasket lining.

c) The junction box and cover of sheet steel construction shall be hot dip galvanised.

d) The junction boxes shall be complete with conduit knockouts/threaded nuts and provided with terminal strips .The junction boxes shall be suitable for termination of Cable glands of dia. 20 mm, 25 mm, 32 mm, 40 mm on all sides. The junction boxes shall be provided with 4 way terminals suitable for two numbers 10 sq. mm. wire & for street lighting/switchyard lighting suitable for 2 numbers 4C x 16 Sq.mm Al. cable.

e) 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 400 volt junction box.

f) The junction boxes shall be weather proof type with gaskets conforming to IP 55 as per IEC: 60529.

2.1.10.4 **Occupancy Sensors:**

Sufficient number of occupancy sensors shall be provided in the stairs area and corridors of control room cum administrative building, local control room in GIS building. 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.

2.2 DESCRIPTION OF FCOMMON ITEMS FOR LIGHTING

2.2.1 LIGHTING FIXTURES AND ACCESSORIES

2.2.1.1 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.

2.2.1.2 Temperature Rise

All lighting fixtures and accessories shall be designed to have a low temperature rise according to the relevant International standard. The design ambient temperature shall be taken as 50 deg.C.

2.2.1.3 Supply Voltage

Lighting fixtures and accessories meant for 230V A.C. operation shall be suitable for operation on 230V A.C. 50Hz, supply voltage variation of ± 10%, frequency variation of ± 2.5% and combined voltage and frequency variation of ± 10%.

Lighting fixture and accessories meant for 220/110V DC operation shall be suitable for operation on 220/110V DC with variation between 190 to 230 Volts for 220V and 95 to 115 for 110V.

2.2.1.4 **Lighting Fixtures**

a) The lighting fixtures shall be Philips or equivalent International make except for fixtures type 'DSM' & 'HL' for which make has been specified elsewhere in this section. The different types of lighting fixtures are also indicated elsewhere in this Section.

b) 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.

c) All lighting fixtures shall be complete with LED /mercury vapour/sodium vapour lamps as specified and shall be suitably wired up.

d) All flourescent lamp fixture shall be complete with all accessories like ballasts, power factor improvement capacitors, lamps, starters, holders etc.

e) 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.

f) Each lighting fixture shall be provided with an earthing terminal suitable for connection to 16 SWG GI earthing conductors.

g) All light reflecting surfaces shall have optimum light reflecting co-efficient such as to ensure the overall light output as specified by the manufacturer.

h) 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.

2.2.1.5 **ACCESSORIES**

2.2.1.5.1 **Lamp holders and Starter Holders**

(a) Lamp holders/starter holders for fluorescent tubes shall be of the spring loaded, low contact resistance, bi-pin rotor type, resistant to wear and suitable for operation at the specified temperature, without deterioration in

insulation value, contact resistance or retention of the lamp/starter. They shall hold the lamp/starter in position under normal condition of shock and vibration.

(b) Lamp holders/starter for incandescent lamps and HPMV/HPSV lamps shall be of screwed type, manufactured in accordance with relevant standard and designed to give long and satisfactory service.

2.2.1.5.2 **Ballasts**

a) All HPSV/HPMV/Metal halide lamp fixtures shall be provided with wire wound ballasts. All fluorescent fixtures shall be provided with high frequency electronic ballasts. 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 wire-wound ballasts shall be of the inductive, heavy duty type, filled with thermosetting 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 tapping's 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.

e) High frequency electronic ballasts shall be capable of satisfactory performance in adverse environment like that of EHV substation. Ballasts shall consist of AC/DC converter, high frequency power oscillator and low pass filter. The ballasts shall be suitable for use of nominal voltage of 230V +/- 10%, 50 Hz supply. The filter circuit shall suppress the feedback of high frequency signals to the mains. The ballast shall be rated for 36/40W fluorescent fixtures. The ballasts shall confirm to IEC 68-2-6FC, IEC 60929 for performance, IEC 60928 for safety and EN 55015, EN 55022A for RFI and EN 61003.

2.2.1.5.3 **Capacitors**

a) The capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits.

b) Power factor of fluorescent lamp fixtures with HF electronic ballast shall not be less than 0.90 and that of High pressure Sodium Vapour, Mercury Vapour and Metal Halide lamp fixtures shall not be less than 0.85. 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.

2.2.1.5.4 **Lamps**

a) General Lighting Services (GLS) lamps shall be provided with screwed caps and shall be of 'clear' type unless otherwise specified.

b) The Bidder shall furnish typical wiring diagram for Fluorescent, HPMV & HPSV fitting including all accessories. The diagram shall include technical details of accessories i.e. starters, chokes, capacitors etc.

c) Flexible conduits if required, for any fixture shall be deemed to be included in Contractor's scope.

2.2.1.5.5 **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.

(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 luminaires, controlled by one no 6 amp switch would 4 nos. For DC fixtures there will be no switch and the same shall be directly controlled from DC LP

(e) The luminaires shall be wired in such a fashion that luminaires on each phase are evenly distributed all over the room.

2.2.1.5.6. **CONDUITS & CONDUIT ACCESSORIES**

a) The conduits shall conform to IEC: 61386 or IEC: 61035 or IEC: 60614 as applicable. All steel conduits shall be seemed by welding, shall be of heavy gauge and shall be hot dip galvanised.

b) Flexible conduits wherever required shall be made with bright, cold rolled annealed and electro-galvanised mild steel strips or PVC/Plastic.

c) All conduits accessories shall conform to relevant IEC and shall be hot dip galvanized or High quality virgin PVC.

2.2.1.5.7 **TERMINAL BLOCKS**

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. Terminal strips provided in street - lighting poles shall be suitable for terminating upto 2 nos. 4C x 16 sq. mm aluminium cables.

2.2.1.5.8 **PULL OUT BOXES**

a) 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.

b) The pull out boxes shall be circular of cast iron or 16 SWG sheet steel and shall have cover with good quality gasket lining.

c) The pull out boxes and cover shall be hot dip galvanised.

d) The pull out boxes shall be completed with conduit knock outs/threaded hubs and provided at approximately 3 meters intervals in a conduit run.

2.2.1.5.9 **Residual Current Circuit Breakers (RCCB)**

For indoor panels 63A 4pole 300 ma RCCB conforming IEC 13947 will be provided along with incomer.

2.2.1.5.10 **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. MCB of Type C tripping characteristics as per IEC: 60898 will be used for Switchyard lighting.

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 backup 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 IEC: 60898.

2.2.1.5.11 **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. Contactor 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 closed. The Contactor 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 load.

2.2.1.5.12 **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.

2.2.1.5.13 **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.

2.2.1.5.14 **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.

2.2.1.5.15 Type test reports for following tests on all lighting panels shall be submitted for approval as per clause 9.2 of Section GTR.

(i) Wiring continuity test
(ii) High voltage (2.5 KV for 1 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 IEC: 60947 (part 1)
(v) Heat run test

2.2.1.5.16. **LIGHTING POLES**

a) The Contractor shall supply, store and install the following types of steel tubular lighting poles required for street lighting.

i) Type A1 Street Lighting Pole - for one fixture

ii) Type E1 Post top lantern pole - for one fixture

b) Street/flood light poles shall conform to the enclosed drawings. In front of control room building , and Fire Fighting Buildings, decorative post top lantern (Type E1) poles and Bollards shall be installed.

c) Lighting poles shall be complete with fixing brackets and junction boxes. Junction boxes should be mounted one meter above ground level.

d) 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).

e) The galvanised sheet steel junction box for the street lighting poles shall be completely weather proof conforming to IP-55 and provided with a lockable door and HRC fuse mounted on a fuse carrier and fuse base assembly. The fuses & junction box shall be as specified in the specification. However, terminals shall be stud type and suitable for 2 nos. 16 sq.mm. cable.

f) 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.

g) Distance of centre of pole from street edge should be approximately 1000 to 1200 mm.

h) 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.

2.2.1.5.17 **CEILING & WALL MOUNTED FANS AND REGULATORS**

a) 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

b) The contractor shall supply and install the switch, electronic regulator and board for mounting switch and electronic regulator for celling fans. The regulator will be housed in common switchboard for lighting and shall be of similar make and model as that of modular switches.

c) Winding of the fans and regulators shall be insulated with Class-E insulating material. Winding shall be of copper wire.

d) Electronic regulator with stepped control shall be provided.

2.2.1.5.18 **LIGHTING WIRES**

a) The wiring used for lighting shall be standard products of reputed manufacturers.

b) The wires shall be of 1100 V grade, PVC insulated product of reputed manufacturers.

c) The conductor sizes for wires used for point wiring beyond lighting panels shall be 2.5 sq.mm, 4 sq.mm, 6 sq.mm and 1.5 sq.mm stranded copper wire.

d) The wires used for connection of a lighting fixture from a nearest junction box or for

loop-in loop-out connection between two fluorescent fixtures shall be single core copper stranded conductor, 1100V grade flexible PVC insulated cords, unsheathed, conforming to IEC:60502 with nominal conductor cross sectional areas of 2.5 sq. mm.

e) 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)

2.2.1.5.19 **LIGHTING SYSTEM INSTALLATION WORKS**

2.2.1.5.19.1 **General**

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.

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.

2.3.1.5.19.2 **Conduit System**

a) 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, checknuts, 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 20 mm PVC conduit and accessories for telephone wiring.

b) All unarmoured cables/wires shall run within the conduits from lighting panels to lighting fixtures, receptacles, etc.

c) Size of conduit shall be suitably selected by the Contractor.

d) Conduit support shall be provided at an interval of 750 mm for horizontal runs and 1000 mm for vertical runs.

e) 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 masonary or concrete for conduit support is not acceptable.

f) Where conduits are along with cable trays they shall be clamped to supporting steel at an interval of 600 mm.

g) 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.

h) For long conduit run, pull boxes shall be provided at suitable intervals to facilitate wiring.

i) Conduit shall be securely fastened to junction boxes or cabinets, each with a lock nut inside and outside the box.

j) 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.

k) The entire metallic/PVC 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.

l) 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.

2.2.1.5.19.3 **Wiring**

a) 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.

b) 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.

c) Wiring shall be spliced only at junction boxes with approved type terminal strip.

d) 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.

e) For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/junction box.

f) Maximum two wires can be terminated to each way of terminal connections.

g) Separate neutral wires are to be provided for each circuit.

h) AC and DC wiring should not run through the same conduit.

2.2.1.5.19.4 **Lighting Panels**

a) The lighting panels shall be erected at the locations to be finalised during detailed engineering.

b) Suitable foundations/supporting structures for all outdoor type lighting panels shall be provided by the Contractor.

2.2.1.5.19.5 **Foundation & civil works**

a) Foundation for street lighting poles, panel foundation and transformer foundation shall be done by the Contractor.

b) All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grouting of anchor bolts, sills, inserts and flastening devices shall be carried out by the Contractor including minor modification of civil works as may be required for erection.

c) 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.

ANNEXURE-1

Sl. No.	Type of Lighting Fixture	Description	Philips Catalogue No
1	F1	2x28W T5 type fluorescent lamps in industrial reflector type fixture, complete with accessories and suitable for pendent /surface mounting.	TMS 122/228 HF
2	FF	2x28 T5 energy efficient fluorescent lamps with low glare, mirror optics suitable for recess mounting type lighting fixture.	TBS 088/228 C5 HF
3	FL	2x28W T5 energy efficient fluorescent lamps with low glare mirror optics suitable for pendent/surface mounting with all accessories	TCS 398/228 D6 HF
4	TL	Sleek and Functional electronic decobatten suitable for use with 1x'TLD'36W fluorescent lamp with dual tone end caps. Pre-phosphated & powder coated CRCA steel channel complete with all electrical accessories like electronic ballast, lamp holders all prewired up to a terminal block	TMS500/136 HF
5	IB	60/100w GLS lamp in Bulkhead fixtures with Cast Aluminium alloy body, suitable for column, wall,and ceiling mounting finished stove enameled silver grey outside	NXC101
6	BL	Aesthetic wall/ceiling mounted luminaire suitable for 1x PL-C 13W OR 11W CFL. Low loss O.C. Copper ballast. Built in high gloss anodized reflector. Twin finish UV stabilised SAN diffuser for protection & elimination of lamp glare.	FMC21/113
7	SL	Aesthetic ceiling mounted luminaire for Ecotone crystal/Décor CFL of 2x9W or 1x18W. ABS housing pre-wired with porcelain lamp holder. Pre-phospated plated CRCA gear tray.	FL343/118
8	BH	Bulkhead luminaire suitable for use with PL-S 9W CFL. Single piece pressure die-cast aluminium & cover retaining Frame. Opal acrylic cover along with a gasket made of E.P.R..	FXC 101/109
9	BLD	2X9 Or 1x18 watt CFL bollard light for landscape lighting having FRP/LLDPE housing	FGC202 /118
10	DLR	2x18 watt CFL Downlighter with HF ballast suitable for recess mounting	FBH145/218L HF
11	DSM	1X13 WATT surface mounted CFL	FCS100/113

12	IF	Incandescent GLS lamp down light	DN622
13	SF1	1 X 400W HPSV lamps in high flood lighting fixture with integral control gear	SWF 330/1X400
14	SF2	2 X 400W HP sodium Vapour lamps in high flood lighting, non-integral control gear:	RVP302/2x400W
15	SF3	1 X 250W HPSV lamps in high flood lighting fixture with integral control gear:	SWF 330/1X250
16	SF4	150W HP Metal halide MHN-TD lamp in flood lighting fixture with integral control gear.	SWF230/150 MHN-TD
17	SF5	125 HP MV Lamp in weather proof post top lantern for mounting on pole top	HPC-101/125 HPF
18	SC	150W SON-T Tubular Sodium Vapour lamp in street lighting	SRX-51/150

NOTE: LED Lighting fixtures details for various indoor area shall be furnished by Contractor based on their design and drawings for approval of Employer

TECHNICAL SPECIFICATION

VOL-II, SEC-X

LT TRANSFORMER

SECTION-X
LT TRANSFORMER

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SECTION-X
LT TRANSFORMER

1.0 **INTENT**

This specification is intended to cover outdoor type oil filled 33/0.433KV, 315 & **250 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 equipment's 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 up to 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 220/110 V DC Control supply. All alarm and trip Contacts shall also be suitable for connection in 220/110V DC Circuits.

3.2 Bidders may specifically note that transformers offered shall conform to dynamic short circuit test and dielectric test as per IEC: 60076. Test report for the same shall be submitted during detail engineering for approval.

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 IEC: 60296 while tested at oil Contractor's premises, No inhibitors shall be used in oil. Ten percent 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: 13947 / IEC: 60947 Part-1.

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 Purchaser.

b) The Contractor shall carryout all routine tests on all the transformers as per relevant standards. Type test report shall be submitted for approval during detail engineering.

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, magnestisation 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 / IEC: 60076 shall be carried out on each transformer.

7.2 The transformer shall conform to all the type tests in accordance with latest issues of IS:2026 / IEC: 60076. The manufacturer shall submit type tests & additional test reports as listed above as already carried out on transformers of identical design for owner's acceptance. In such a case validity of type test reports shall be in line with clause 9.2 of Section-GTR of technical specifications. Following parameters in general shall be ensured for establishment of identical design as per IEC 60076, Part-V.

a) Same Voltage ratio, KVA rating, vector group & impedance.
b) Same conceptual design of core and winding.

c) Same arrangement and geometrical sequence of the main windings.
d) Same type of winding conductors.
e) Same type of main windings.
f) Absorbed power at short circuit (i.e. rated power/per unit short circuit impedance) between 30% and 130% of that relating to the reference transformer.
g) Axial forces and winding stresses occurring at short circuit not exceeding 120% of those relating to the reference transformer.
h) Same manufacturing process.
i) Same Clamping and winding support arrangement..

7.3 In addition to all type and routine tests, transformer shall also conform to following additional type tests as per IS:2026 / IEC: 60076.

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 as per IS 60296

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:
i) Routine Tests: As per IEC: 60076 Part-1 including
ii) Vacuum Tests: As per IEC: 60076 Part-1
iii) Pressure Test: As per IEC: 60076 Part-1

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 upto 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- PSR

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 Specification

S No	Description	Unit	Parameters	
1	Rated Capacity	kVA	250	315
2	Rated Voltage			
a)	HV	kV	33	33
b)	LV	kV	0.433	0.433
3	Type of Winding		Two Winding	
4	Service		Outdoor	
5	No of Phases	No.	Three	
6	Frequency	Hz	50	
7	Type of Cooling		ONAN	ONAN
8	Impedance at 75 Deg C	%	5	5
9	Tolerance on Impedance	%	±10	±10
10	Duty		Continuous	Continuous
11	Overload		IEC:60076-7	IEC:60076-7
12	Max. Temp. Rise over an ambient of 50 Deg C			
a)	Oil (Temperature rise measurement by thermometer)	^{0}C	50	
b)	Winding Temperature rise measurement by resistance method)	^{0}C	55	
13	Windings			
a)	System Apparent Short circuit level (kA)		As per IEC: 60076-Part 1	
b)	Winding Connection			
(i)	HV		Delta	Delta

S No	Description	Unit	Parameters	
(ii)	LV		Star	Star
14	Vector Group		Dyn1	
15	Insulation		Uniform	
16	Insulation Level	kVrms		
a)	Power Frequency Test Level			
(i)	HV	kVrms	95	95
(ii)	LV	kVrms	2	
17	Basic Impulse Level			
(i)	HV	kVp	250	250
(ii)	LV	kVp	-	-
18	Highest voltage (kV) for each winding	kV	52	52
19	Method of earthing		Solidly earthed	
20	Tap changer			
a)	(i) Tap Change		+5% to -10% in step of 2.5% on HV side	
b)	(ii) Tap control		Off Circuit Tap Change Switch	
21	HV Bushing			
a)	Rated Voltage	kV	52	52
b)	Rated current	A	100	100
c)	Basic Impulse Level (kVp)	kVp	250	250
d)	Wet & Dry Power frequency Withstand Voltage	kVrms	95	95
e)	Min. Total Creepage Distance	mm	1300	1300
f)	Mounting		Tank / Transformer Body	
22	LV & Neutral Bushing			
a)	Rated Voltage	kV	1.1	1.1
b)	Rated current	A	1000	1000
c)	Basic Impulse Level (kVp)	kVp	-	-

S No	Description	Unit	Parameters	
d)	Wet & Dry Power frequency Withstand Voltage	kVrms	2	2
e)	Mounting		Tank / Transformer Body	
23	Terminal Details			
a)	HV		**Suitable for 33kV Cable** or Over Head Conductor	Suitable for 33kV Cable or Over Head Conductor
b)	LV & Neutral		Cable Box	
24	Min. Clearance in Air	mm		
a)	Ph-Ph (HV/LV)	mm	530/25	530/25
b)	Ph-Earth (HV/LV)	mm	480/25	480/25

TECHNICAL SPECIFICATION

VOL-II, SEC-XI

FIRE PROTECTION

SECTION-XI
FIRE PROTECTION

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TECHNICAL SPECIFICATION FOR

FIRE PROTECTION SYSTEM

1.00.00 **INTENT OF SPECIFICATION**

This section covers the design and performance requirements of the following types of fire protection systems;

a. Hydrant System

b. High Velocity Water (H.V.W) Spray System

c. Fire Detection and alarm System

d. Portable Fire Extinguishers

e. Wheel/ Trolley mounted Fire Extinguishers

1.00.01 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 NFPA norms.

1.00.02 The scope of work includes complete earthwork (i.e. excavation, backfilling etc.) for the entire buried piping for the system, valve pits and pipe supports for buried, entrenched and overground piping.

1.00.03 The equipment offered shall comply with the relevant latest International Standards **unless specified otherwise**. The Deluge valves, HVW spray nozzles & quartzoid bulb detectors shall have the approval of any of the following agencies;

a. UL of USA.
b. F M of USA
c. LPCB of UK or
d. VDS of Germany,

1.00.04 Ambient temperature for design of all equipment shall be considered as 50°C.

1.00.05 The piping and instruments diagram for Hydrant and HVW spray system for 400kV switchyard is enclosed at Appendix-I. respectively. The successful bidder shall prepare detailed layout and piping drawing based on this drawing and other drawings such as road, drainage, cable trench, switch yard layout, etc. as

furnished by the Employer during detailed engineering.

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2.00.00 **DESIGN AND CONSTRUCTION**

2.01.00 **Hydrant System**

Hydrant system of fire protection essentially consists of a large network of pipe, both underground and over ground which feeds pressurised water to a number of hydrant valves, indoor (if applicable) as well as outdoor. These hydrant valves are located at strategic locations near buildings, Transformers and Reactors. Hose pipes of suitable length and fitted with standard accessories like branch pipes, nozzles etc., are kept in Hose boxes. In case of emergency, these hoses are coupled to the respective hydrant valves through instantaneous couplings and jet of water is directed on the equipment on fire. Hydrant protection shall be provided for the following in all substations of voltage levels 132kV and above (This is not applicable for extension of existing 220kV and 132kV substations where Hydrant system is not available). At least one hydrant post shall be provided for every 60m of external wall measurement of buildings.

a) Control room building

b) L.T. Transformer area.

c) Fire Fighting pump House.

d) Stores

e) Transformers

f) Shunt Reactors/ Bus Reactors.

2.01.01 A warning plate shall be placed near the hydrant points for the transformers and reactors substations to clearly indicate that water shall be sprayed only after ensuring that the power to the transformer/ reactor which is on fire is switched off and there are no live parts within 20metres of distance from the personnel using the hydrant.

2.02.00. **HIGH VELOCITY WATER (H.V.W) SPRAY SYSTEM**

H.V.W. spray type fire protection essentially consists of a network of projectors and an array of heat detectors around the Transformer/Reactor to be protected. On operation of one or more of heat detectors, Water under pressure is directed to the projector network through a Deluge valve from the pipe network laid for this system. This shall be provided for transformers and reactors in all 132kV & above substations (This is not applicable for extension of existing 220kV and 132kV substations where HVWS system is not available). Wet detection initiation system shall be employed for automatic operation.

The system shall be designed in such a way that the same can be extended to protect additional Transformer/ Reactor to be installed in future. However, for the purpose of design it shall be assumed that only one Transformer/ Reactor will be on fire. The main header pipe size in the yard shall be 200mmNB(for 220kV & 132kV switchyard). Branch to the equipment (shall not be more than 20metres length) shall be of the same size as of deluge valve.

2.02.01 The Electrical clearance between the Emulsifier system pipe work and live parts of the protected equipment shall not be less than the values given below :

1.	245 kV bushing	2150 mm
2.	145 kV bushing	1300 mm
3.	52 kV bushing	630 mm
4.	36 kV bushing	320 mm

2.02.02 System shall be designed in such a way that the Water pressure available at any spray nozzle shall be between 3.5bar and 5.0bar and shall be demonstrated through hydraulic calculations. Water shall be applied at a minimum rate of 10.2 LPM/M^2 of the surface area of the transformer / Reactor including radiator, conservator, oil pipes, bushing turrets, etc. (including bottom surface for transformer). The nozzle arrangement shall ensure direct impingement of water on all exterior surfaces of transformer tank, bushing turrets, conservator and oil pipes, except underneath the transformer, where horizontal spray may be provided.

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2.02.03 **Deluge Valve**

Deluge Valve shall be water pressure operated manual reset type. The Deluge valve shall be closed water tight when water pressure in the heat detector pipe work is healthy and the entire pipe work shall be charged with water under pressure up to the inlet of the Deluge valve. On fall of water pressure due to opening of one or more heat detectors, the valve shall open and water shall rush to the spray water network through the open Deluge valve. The valves shall be manually reset to initial position after completion of operation. Each Deluge Valve shall be provided with a water motor gong which shall sound an alarm when water after passing through the Deluge valve, is tapped through the water motor.

Each Deluge valve shall be provided with a local panel with provision of opening of Deluge valve from local and remote from control room/ remote centre. In addition to this, each valve shall be provided with local operation latch.

Deluge valves of 100mmNB size shall be used if the flow requirement is ≤ 200m^3/hr and 150mmNB size shall be used for flow requirement >200m^3/hr.

Test valves shall simulate the operation of Deluge valves and shall be of quick opening type. The general construction shall conform to requirements under clause no.7.00.00 for piping, valves and specialities.

2.02.04 **High Velocity Spray Nozzles (Projectors)**

High velocity spray system shall be designed and installed to discharge water in the form of a conical spray consisting of droplets of water travelling at high velocity, which shall strike the burning surface with sufficient impact to ensure the formation of an emulsion. At the same time the spray shall efficiently cut off oxygen supply and provide sufficient cooling.

2.02.05 Minimum set point of the heat detectors used in the HVW spray system shall be 79^{o}C. The optimum rating shall, however, be selected by the Bidder, keeping in mind the maximum and minimum temperature attained at site.

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2.03.00 **Fire Detection and alarm System**

This system shall be provided for control room building and Switchyard panel rooms of substations**.**

2.03.01 Suitable fire detection system using smoke detectors and/or heat detectors shall be provided for the entire building, including corridor and toilets. Fire detectors shall be located at strategic locations in various rooms of the building. Each Switchyard panel room shall be considered a separate zone. Adequate number of extra zones shall be provided for Switchyard panel rooms for future bays identified in Single line diagram of

the substation. The operation of any of the fire detectors/ manual call point should result in the following;

1. A visual signal exhibited in the annunciation panels indicating the area where the fire is detected.
2. An audible alarm sounded in the panel, and
3. An external audible alarm sounded in the building, location of which shall be decided during detailed engineering.
4. If the zone comprises of more than one room, a visual signal shall be exhibited on the outer wall of each room.

2.03.02 Each zone shall be provided with two zone cards in the panel so that system will remain healthy even if one of the cards becomes defective.

2.03.03 Coverage area of each smoke detector shall not be more than 80 m^2 and that of heat detectors shall not be more than 40 m^2. Ionisation type smoke detectors shall be provided in all areas except pantry room where heat detectors shall be provided. If a detector is concealed, a remote visual indication of its operation shall be provided. Manual call points (Break glass Alarm Stations) shall be provided at strategic locations in the control room building. All cabling shall be done through concealed conduits.

2.03.04 Cables used should be exclusively for fire detection and alarm system and shall be 2Cx1.5sq.mm Cu. cables. Un-armoured PVC insulated FR cables conforming to latest IEC / International standards shall be used.

2.04.00 Portable and Wheel/ Trolley mounted Fire Extinguishers

2.04.01 Portable Fire Extinguishers (4.5 Kg Capacity)

Adequate number of portable fire extinguishers of pressurised water, dry chemical powder, and Carbon dioxide type shall be provided in suitable locations in control room building and FFPH building as indicated in the drawing. In addition to this one (1) CO2 type fire extinguisher of 4.5kg capacity shall be provided for each Switchyard panel room. These extinguishers will be used during the early phases of fire to prevent its spread and costly damage.

The design, construction & testing of portable fire extinguishers shall meet the requirements as per clause 10.00.00.

2.04.02 Wheel/ Trolley mounted Fire Extinguishers

Wheel/Trolley mounted Mechanical foam type (50 Litre Capacity), DCP and CO^2 fire extinguishers of 22.5 Kg capacity, conforming to latest international standards, shall be provided for the protection of the following:

1. Transformers and reactors in 220kV and 132 kV substations where Hydrant/HVWS system is not available. Two (2) nos. for each 220kV or 132kV transformer and reactor.

2. LT transformers in all substations. One (1) no. for each LT transformer.

The design, construction & testing of Mechanical foam type 50 litre capacity shall meet the requirements of relevant International Codes and clause 10.00.00 of this specification.

2.05.00 Water Supply System

For **220kV and 132kV** level substations water for hydrant & HVW system shall be supplied by one electrical motor driven pump of rated capacity **273m3/hr**. at 70MWC head, with another pump of same capacity, driven by diesel engine, shall be used as standby. Water storage tank with two compartments of adequate capacity shall be provided. Pumps shall work under positive suction head. Annunciations of the hydrant & HVW spray systems shall be provided in fire water pump house and repeated in control room. Provision for sending data to remote control centre shall also be available.

The outdoor piping for the system in general shall be laid above ground on concrete pedestals with proper supporting arrangement. However, at road/rail crossings, in front/access of buildings, places where movement of cranes/vehicles is expected and at any other place where above ground piping is not advisable, the pipes shall be laid underground. Such locations shall be finalised during detailed engineering.

The whole system will be kept pressurised by providing combination of air vessel and jockey pump of $10.8M^3$/hr. capacity at 80MWC. The capacity of air vessel shall not be less than $3m^3$. Minor leakage will be met by Jockey pump. One additional jockey pump shall be provided as standby. All pumps shall be of horizontal centrifugal type. Pumps and air vessel with all auxiliary equipment will be located in firewater pump house. A pressure relief valve of suitable rating shall be provided in water header to release excess pressure due to atmospheric temperature variations.

Operation of all the pumps shall be automatic and pumps shall be brought into operation at pre-set pressure. Fire pumps shall only be stopped manually.

Manual start/stop provision shall be provided in local control panel.

2.05.01 The general design of the fire fighting pump sets shall meet the requirements under clauses no.5.00.00 for Horizontal centrifugal pumps, no.6.00.00 for Diesel engines and no.12.00.00 for Electrical motors.

2.05.02 Each pump shall be provided with a nameplate indicating suction lift/delivery head, capacity and number of revolutions per minute.

2.05.03 Design, construction, erection, testing and trial operation of piping, valves, strainers, hydrant valves, hoses, nozzles, branch pipes, hose boxes, expansion joints etc. shall conform to the requirements of clause no. 7.00.00.

2.06.00 **Instrumentation and Control System**

2.06.01 All instruments like pressure indicators, differential pressure indicators, pressure switches, level indicators, level switches, temperature indicators, alarms and all other instruments and panels as indicated in the specification and drawings and those needed for safe and efficient operation of the whole system shall be furnished according to the requirements of clause 11.00.00. Pump running/ fails to start signal shall be taken from the pressure switch immediately after the discharge of the pump.

2.06.02 **Control Panel**

Power feeder for motors will be from switchgear board located in control building but control supply for all local control panels, annunciation panels, battery charger units, space heaters etc. shall be fed from the AC and DC distribution boards located in pump house. These AC & DC distribution boards will be fed from the switchgears and DCDBs located in control building.

a) Panel for motor driven fire water pump

The panel shall be provided with the following:

1.	TPN switch	1 No.
2.	Auto/manual selection facility	
3.	Start/Stop facility with indication lamp	1 Set
4.	DOL starter with	1 Set

thermal O/L relay

5.	Indicating lamp showing power ON	1 Set
6.	Indication lamp with drive ON/OF	1 Set
7.	Indication lamp showing Motor Trip	1 No.

Additional provisions shall be made for controlling the following from the remote-control centre:

1. Auto/manual selection facility

2. Start/Stop facility

Main power cable from breaker feeder of main switchboard shall be terminated in this panel and another cable shall emanate from this panel which shall be terminated at motor terminals.

b) Panel for Two nos. Jockey Pump 1No.

The panel shall be provided with the following :

1.	Fuse-switch unit for Jockey pumps	1 Set for each pump
2.	Auto/manual selection facility for each pump	
3.	Selector switch for selecting either jockey pump	1 No.
4.	D.O.L. starter with overload relay self-resetting type, for all the drives.	1 No. each
5.	Start/stop push button for Jockey Pump with indication lamp with pad-locking arrangements in stop position	1 Set for each pump

6.	Indication lamp for trip indication	1 No. each for pump

Additional provisions shall be made for controlling the following from the remote-control centre:

1. Auto/manual selection facility for each pump**.**

a)	Panel for 2 Nos. battery charger & Diesel Engine driven fire water pump	1 No.

The panel shall be provided with the following:

1.	Auto/Manual selection facility for Diesel Engine driven pump	1 No.
2.	Start/Stop facility with indication lamp	1 Set
3.	Indicating lamp showing drive ON/OFF	1 Set
4.	D.C. Voltmeter/Ammeter in the battery charger circuit	1 No. each
5.	Battery charger will be as per specification described	1 Set
6.	Selector switch for selecting either of battery chargers for the battery sets.	1 No.
7.	Selector switch for selecting either set of batteries for Diesel engine starting.	1No.
8.	Selector switch for boost charging/Trickle charging of battery set.	1 Set

Additional provisions shall be made for controlling the following from the

remote-control centre:

1. Manual Start/Stop of Diesel Engine

d) Individual local control panel is to be considered for each transformer/ Reactor deluge system wherever this equipment is envisaged. This panel shall contain push buttons with indicating lamps for spray ON/OFF operation in the valve operation circuit. Push buttons shall be concealed behind glass covers, which shall be broken to operate the buttons. Provision shall be made in the panel for the field signal for the annunciations such as spray ON and fire in the Transformer/Reactor. A signal for spray ON shall also be provided in the control room fire alarm panel for employer's event logger. Remote operation facility to open the Deluge valve from control room/ remote centre shall also be provided.

2.06.03 **Annunciation Panels**

a) Location: Fire Water Pump House

i) Indicating lamps showing power supply "ON".

ii) Annunciation windows complete with buttons. Details are as follows:

Sl. No.	Description	Number
1.	Electric motor driven fire water pump running	1
2.	Electric motor driven fire water pump fails to start	1
3.	Diesel engine driven fire water pump running.	1
4.	Diesel engine driven water pump fails to start	1
5.	Jockey pump-1 running	1
6.	Jockey pump-1 fails to start	1
7.	Jockey pump-2 running	1
8.	Jockey pump-2 fails to start	1

9.	Fire in Transformer/ Reactor	1 for each equipment
10.	Deluge system operating for Transformer/Reactor	1 for each equipment
11.	Header pressure low	1
12.	Fire in smoke detection system zone (Common Fire Signal)	1
13.	Water storage tank water level low	2
14.	High speed diesel tank level low	1
15.	Spare	10

b) **Location: Substation Control Room**

i) Indication lamp showing power supply 'ON'

ii) Provision shall be made in the panel for a signal for spray ON for each Transformer/Reactor for owner's use for event logger.

iii) Each Switchyard panel room shall be considered as separate zone for fire detection and alarm system.

iv) Following annunciations shall be provided.

Sl. No.	Description	Number
1.	Fire in Transformer/ Reactor	1 for each equipment
2.	Diesel engine driven fire water pump in operation	1
3.	Motor driven fire water pump in operation	1

4.	Jockey pump in operation	1
5.	Fire fighting Water storage tank level Low	2
6.	Fire/Fault (zone alarm module)	1+1(duplicate) For each zone as applicable
7.	Spare windows complete in all respect, with relays	10
8.	Spare zone alarm modules required for the	Number of future A/c Kiosks bays identified as per SLD

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c) Each annunciation panel shall be provided with a hooter**.** A hooter in parallel to the hooter in fire panel shall be provided in the security room of substation for alert in case of fire.

d) Indication for fault in respective areas shall also be provided. Each zone alarm module shall exhibit 'FIRE' and 'FAULT' conditions separately.

e) **Provision for sending data to Remote Control Unit for the following**

(i) Fire in Switchyard Panel Room (Switchyard Panel room shall be considered as separate zone for fire detection and alarm system).

(ii) Fire in Transformer/Reactor (1 for each equipment)

(iii) Diesel engine driven fire water pump in operation.

(iv) Motor driven fire water pump in operation

(v) Fire/Fault in Control Room.

(vi) Water Storage tank level (low and very low for each storage tank).

(vii) High Speed Diesel tank level (low & very low)

(viii) AC Mains Supply Healthy/Fail for Main Pump & Jockey Pump

(ix) DC Control Supply Healthy/Fail for Main Pump & Jockey Pump

(x) DC Control Supply Healthy/Fail for Diesel Engine driven pump.

2.06.04 The control and interlock system for the fire protection system shall meet the following requirements:

1. **Electric Motor Driven Fire Water Pump**

Pump should start automatically when the System header pressure is low.

Pump should be stopped manually only. Pump should also be started manually if required from local control panel.

2. **Diesel Engine Driven Standby Pump**

The pump should automatically start under any of the following conditions:

a) System Header pressure low.

b) Electric motor operated fire water pump fails to start.

Pump should be stopped manually only. Pump should also be started manually if required from the local control panel. The battery set which is connected for starting of Diesel engine shall not be subjected to boost charge.

3. **Jockey Pump**

It shall be possible to select any one of the Jockey pumps as main and the other as standby. Main Jockey pump shall start automatically when water pressure in header falls below the set value. If the main jockey pump fails to start then the standby should start. Jockey pump shall stop automatically when the pressure is restored to its normal value.

Manual starting/stopping shall be possible from the local control panel.

3.00.00 **TESTS**

3.01.00 **Shop Tests**

3.01.01 Shop tests of all major equipment centrifugal pumps, diesel engines, electrical

drive motors, piping, valves and specialties, pressure and storage vessels, MCC, electrical panels, controls, instrumentation etc. shall be conducted as specified in various clauses and as per applicable standards/codes.

3.01.02 Shop tests shall include all tests to be carried out at Contractor's works, works of his sub-contractor and at works where raw materials supplied for manufacture of equipment are fabricated. The tests to be carried out shall include but not be limited to the tests described as follows:

a) Materials analysis and testing.

b) Hydrostatic pressure test of all pressure parts, piping, etc.

c) Dimensional and visual check.

d) Balancing test of rotating components.

e) Response of heat/smoke detectors.

f) Performance characteristics of HVW spray nozzles (projectors).

g) Flow rate and operational test on Flow control valves.

h) Operational test of alarm valve (water-motor gang).

i) Calibration tests on instruments and tests on control panel.

j) Destruction/burst tests on 2% or minimum one (1) no. of hoses and portable type fire extinguishers for each type as applicable. Any fraction number shall be counted as next higher integer.

k) Performance test on fire extinguishers as required in the code.

3.01.03 In the absence of any Code/Standard, equipment shall be tested as per mutually agreed procedure between the supplier and the Employer.

3.01.04 A comprehensive visual and functional check for panels would be conducted and will include a thorough check up of panel dimensions, material of construction, panel finish, compliance with tubing and wiring specifications, quality of work-manship, proper tagging & locations of instruments/accessories. The wiring check shall be complete point to point ring out and check for agreement with installation drawings and equipment vendor prints of the complete system and an inspection of all field connection terminals and levelling.

3.01.05 All test certificates and reports shall be submitted to the Employer for approval.

3.01.06 The Employer's representative shall be given full access to all tests. The manufacturer shall inform the Employer allowing adequate time so that, if the Employer so desires, his representatives can witness the test.

3.02.00 **Pre-commissioning Tests**

3.02.01 **General**

a) All piping and valves, after installation will be tested hydraulically at a pressure of 16kg/cm^2 for a period of 30 minutes to check against leak tightness.

b) All manually operated valves/gates shall be operated throughout 100% of the travel and these should function without any trouble whatsoever, to the satisfaction of the Employer.

c) All pumps shall be run with the specified fluid from shut off condition to valve wide open condition. Head developed will be checked from the discharge pressure gauge reading. During the test, the pumps and drives shall run smoothly without any undue vibration, leakage through gland, temperature rise in the bearing parts, noise, flow pulsation etc.

d) All pressure vessels should be tested hydraulically at the specified test pressure, singly or in the system.

e) Painting shall be checked by dry type thickness gauges.

f) Visual check on all structural components, welding, painting etc. and if doubt arises, these will be tested again.

g) All test instruments and equipment shall be furnished by the Contractor to the satisfaction of the Employer.

h) Automatic starting of all the fire pumps by operating the test valves.

i) Automatic operation of the Jockey pump

j) Operation of the Deluge valve by breaking a detector as well as manual and remote operation of the deluge valve.

k) Operation of entire annunciation system.

Replacement of fused/damaged quartzoid bulb detectors during the test shall be responsibility of contractor.

3.02.02 After erection at site, the complete HVW spray protection and hydrant system shall be subject to tests to show satisfactory performance for which detailed procedure shall be submitted for Employer's approval.

Full flow tests with water shall be done for the system piping as a means of checking the nozzle layout, discharge pattern and coverage, any obstructions and determination of relation between design criteria and actual performance, also to ensure against clogging of the smaller piping and the discharge devices by foreign matter carried by the water.

Rigidity of pipe supports shall also be checked during the water flow.

3.02.03 All the detectors installed shall be tested for actuation by bringing a suitable source of heat/smoke near the detector and creating a stream of hot air/ smoke over the detector. The exact procedure of this test shall be detailed out by the Employer to the successful Bidder.

4.00.00 **SPARE PARTS**

The Contractor shall indicate in his scope of supply all the mandatory spares in the relevant schedules. The list of mandatory spares is indicated in 'Section - Projects'.

5.00.00 **HORIZONTAL CENTRIFUGAL PUMPS**

This clause covers the design, performance, manufacturing, construction features and testing of horizontal centrifugal pumps used for the purpose of fire fighting.

5.01.00 The materials of the various components shall conform to the applicable BS/ASTM/DIN Standards.

5.01.01 In case of any contradiction with the aforesaid standards and the stipulations as per the technical specification as specified hereinafter, the stipulations of the technical specification shall prevail.

5.02.00 **General Performance Requirements**

5.02.01 The pump set shall be suitable for continuous operation at any point within the "Range of operation".

5.02.02 Pumps shall have a continuously rising head capacity characteristic from the specified duty point towards shut off point, the maximum being at shut off.

5.02.03 Pumps shall be capable of furnishing not less than 150% of rated capacity at a head of not less than 65% of the rated head. The shut off head shall not exceed 120% of rated head. Range of operation shall be 20% of rated flow to 150% of rated flow.

5.02.04 The pump-motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any mal-operation of the system.

5.02.05 **Drive Rating**

The drive rating shall not be less than the maximum power requirement at any point within the "Range of Operation" specified.

During starting under reverse flow condition, the motor shall be capable of bringing the pump to rated speed at normal direction with 90% rated voltage at motor terminals.

5.02.06 Pump set along with its drive shall run smooth without undue noise and vibration. Acceptable peak to peak vibration limits shall guided by applicable standards.

5.02.07 The Contractor under this specification shall assume full responsibility in the operation of the pump and drive as one unit.

5.03.00 **Design & Construction**

5.03.01 Pump casing may be axially or radially split. The casing shall be designed to withstand the maximum pressure developed by the pump at the pumping temperature.

5.03.02 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self-venting & priming. Casing drain, as required, shall be provided complete with drain valves.

5.03.03 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of

withstanding external reactions not less than those specified in API-610.

5.03.04 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.

5.03.05 **Impeller**

The impeller shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft impellers shall be secured to the shaft by an additional locknut or cap screw. All screwed fasteners shall tighten in the direction of normal rotation.

5.03.06 **Wearing Rings**

Replaceable type wearing rings shall be furnished to prevent damage to impeller and casing. Suitable method of locking the wearing ring shall be used.

5.03.07 **Shaft**

Shaft size selected shall take into consideration the critical speed, which shall be at least 20% away from the operating speed. The critical speed shall also be at least 10% away from runaway speed.

5.03.08 **Shaft Sleeves**

Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

5.03.09 Shaft sleeves shall be securely fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

5.03.10 **Bearings**

Bearings of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its "Range of Operation" and also at the shut-off condition. The bearing shall be designed on the basis of 20,000 working hours minimum for the load corresponding to the duty point.

Bearings shall be easily accessible without disturbing the pump assembly. A drain

plug shall be provided at the bottom of each bearing housing.

5.03.11 **Stuffing Boxes**

Stuffing box design shall permit replacement of packing without removing any part other than the gland. Stuffing boxes shall be sealed/cooled by the fluid being pumped and necessary piping, fittings, valves, instruments, etc. shall form an integral part of the pump assembly.

5.03.12 **Shaft Couplings**

All shafts shall be connected with adequately sized flexible couplings of suitable design. Necessary guards shall be provided for the couplings.

5.03.13 **Base Plates & Sole Plate**

A common base plate mounting both for the pump and drive shall be furnished.

The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimise misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust etc. Suitable drain taps and drip lip shall be provided.

5.03.14 Material of Construction

All materials used for pump construction shall be of tested quality. Material of construction of the major parts of the pumps shall be as given below or superior as per relevant latest International standards:

a)	Casing	Casting Grade 17 of BS 1452
b)	Impeller	Bronze Grade LG2-C of BS1400
c)	Wearing ring	Bronze Grade LG2-C of BS1400
d)	Shaft	Mild Steel.
e)	Shaft sleeve	Bronze Grade LG2-C of BS1400
f)	Stuffing box	2.5% Nickel CI Grade 17 of BS 1452

g) Gland --- do ---

5.03.15 **Balancing**

All rotating components shall be statically and dynamically balanced at shop.

5.03.16 All the components of pumps of identical parameters supplied under this specification shall be interchangeable.

5.04.00 **Tests and Inspection**

5.04.01 The manufacturer shall conduct all routine tests required to ensure that the equipment furnished conform to the requirements of this specification and are in compliance with the requirements of applicable Codes and Standards. The particulars of the proposed tests and the procedures for the tests shall be submitted to the Employer/Engineer for approval before conducting the tests.

5.04.02 Where stage inspection is to be witnessed by Employer, in addition to above, the Bidder shall submit to the Employer/Engineer at the beginning of the contract, the detailed PERT-Chart showing the manufacturing programme and indicating the period where Employer or his authorised inspecting agency are required at the shop.

5.04.03 **Material of Construction**

All materials used for pump construction shall be of tested quality. Materials shall be tested as per the relevant standards and test certificates shall be made available to the Employer/Engineer.

5.04.04 Where stage inspection is to be witnessed by Employer, all material test certificates shall be correlated and verified with the actual material used for construction before starting fabrication, by Employer's Inspector who shall stamp the material. In case mill test certificates for the material are not available, the Contractor shall carry out physical and chemical tests at his own cost from a testing agency approved by the Employer, as per the requirements of specified material standard. The samples for physical and chemical tests shall be drawn up in presence of Employer's inspector who shall also witness the tests.

5.04.05 Shaft shall be subjected to 100% ultrasonic test and machined portion of the impeller shall be subject to 100% DP test. On finished shaft DP test will also be carried out.

5.04.06 **Hydraulic test at shop**

All pressure parts shall be subjected to hydraulic testing at a pressure of 150% of maximum pressure generated by the pump at rated speed or 200% of total dynamic head whichever is higher, for a period not less than one (1) hour.

5.04.07 **Performance test at shop**

Pumps shall be subjected to routine tests to determine the performance of the pumps. These tests shall be conducted in presence of Employer/Engineer's representative as per the requirements of the ASME Power Test Code PTC 8.2/BS-599/I.S.S., latest edition. Routine tests shall be done on all the pumps.

5.04.08 Performance tests shall be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 150% of rated capacity upto pump shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point and the two extremities of the Range of operation specified.

5.04.09 Tests shall preferably be conducted along with the actual drives being supplied.

5.04.10 The Bidders shall submit in his proposal the facilities available at his works to conduct performance testing. If because of limitations of available facilities, a reduced speed test or model test has to be resorted to establish pump performance, the same has to be highlighted in the offer.

5.04.11 In case of model testing, the stipulations of latest edition of applicable standards shall be binding. Prototype or model tests, however, shall be conducted with the suction condition identical to the field conditions i.e. sigma values of prototype and model is to be kept same.

5.04.12 Prior to conducting model testing, calculations establishing model parameters, sizes and test procedure will be submitted to Employer/Engineer for approval.

5.04.13 All rotating components of the pumps shall be subjected to static and dynamic balancing tests.

5.04.14 The Employer or his authorised representative shall have full access to all tests. Prior to performance tests, the Contractor shall intimate the Employer allowing adequate time so that if the Employer so desires, his representative can witness the test.

5.04.15 Report and test certificates of the above tests shall be submitted to the

Employer/Engineer for approval.

5.04.16 **Pre-commissioning tests.**

After installation, pumps offered may be subjected to testing at field also by Employer. If the performances at field are not found to meet the requirement, then the equipment shall be rectified by the Contractor without any extra cost. Prior to performance testing, the procedure for such tests will be mutually agreed between Employer and Contractor. The Contractor shall furnish all necessary instruments, accessories and personnel for testing. Prior to testing, the calibration curves of all instruments and permissible tolerance limit of instruments shall be mutually agreed upon.

6.00.00 **DIESEL ENGINES**

This Clause covers the design, performance, manufacturing construction features and testing of compression ignition diesel engines, used primarily for driving centrifugal pumps, used for the purpose of fire fighting.

6.01.00 **Design and Construction**

General

6.01.01 The diesel engine shall be of multicylinder type four-stroke cycle with mechanical (airless) injection, cold starting type.

6.01.02 The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be atleast 20% greater than the requirement at the duty point of pump at rated RPM and in no case, less than the maximum power requirement at any condition of operation of pump.

6.01.03 Reference conditions for rated output of engine shall be as per ISO:3046, part I.

6.01.04 The engine shall be designed with regard to ease of maintenance, repair, cleaning and inspection.

6.01.05 All parts subjected to substantial temperature changes shall be designed and supported to permit free expansion and contraction without resulting in leakage, harmful distortion or misalignment.

6.01.06 **Starting**

The engine shall be capable of both automatic and manual start. The normal

mode of starting is automatic but in the event of failure of automatic start or at the discretion of the operator, the engine can be started manually from the LCP.

Since the fire pumping unit driven by the diesel engine is not required to run continuously for long periods and the operation will not be frequent, special features shall be built into the engine to allow it to start within a very short period against full load even if it has remained idle for a considerable period.

6.01.07 If provision for manual start (cranking) is provided, all controls/ mechanisms, which have to be operated during the starting process, shall be within easy reach of the operator.

6.01.08 Automatic cranking shall be affected by a D.C. motor having high starting torque to overcome full engine compression. Starting power will be supplied from either of the two (2) sets of storage batteries. The automatic starting arrangement shall include a 'Repeat Start' feature for 3 attempts. The battery capacity shall be adequate for 3 (three) consecutive starts without recharging with a cold engine under full compression.

6.01.09 The batteries shall be used exclusively for starting the diesel engine and be kept fully charged all the time in position. Arrangement for both trickle and booster charge shall be provided.

Diesel engine shall be provided with two (2) battery charger units of air-cooled design. The charger unit shall be capable of charging one (1) set of battery at a time. Provision shall, however, be made so that any one of the charger units can be utilised for charging either of the two (2) batteries.

6.01.10 For detail design of battery and battery charger, sub- section Electrical may be referred to.

6.01.11 **Governing System:**

The engine shall be fitted with a speed control device, which will control the speed under all conditions of load.

6.01.12 The governor shall offer following features:

a) Engine should be provided with an adjustable governor capable of regulating engine speed within 5% of its rated speed under any condition of load between shut-off and maximum load conditions of the pumps. The governor shall be set to maintain rated pump speed at maximum pump load.

b) Engine shall be provided with an over speed shut- down device. It shall be arranged to shut-down the engine at a speed approximately 20% above rated engine speed and for manual reset, such that the automatic engine controller will continue to show an over speed signal until the device is manually reset to normal operating position (Volpi, NFPA, 1978).

6.01.13 The governor shall be suitable for operation without external power supply.

6.01.14 **Fuel System**

The diesel engine will run on High Speed Diesel.

6.01.15 The engine shall be provided with fuel oil tank of 250 litres capacity. The fuel oil tank shall preferably be mounted near the engine. No fuel oil tank will be provided by the Employer.

6.01.16 The fuel oil tank shall be of welded steel constructed to relevant standards for mild steel drums. The outlet of the tank shall be above the inlet of fuel injection pump of the diesel engine to ensure adequate pressure at suction of injection pump.

6.01.17 The fuel oil tank shall be designed in such a way that the sludge and sediment set-tles down to the tank bottom and is not carried to the injection pump. A small sump shall be provided and fitted with drain plug to take out sludge/sediment and to drain oil. Adequate hand holes (greater than 80 mm size) shall be provided to facilitate maintenance.

6.01.18 Pipeline carrying fuel oil shall be gradually sloped from the tank to the injection pump. Any valve in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and it shall be locked in the open position. A filter shall be incorporated in this pipeline, in addition to other filters in the fuel oil system. Pipe joints shall not be soldered and plastic tubing shall not be used. Reinforced flexible pipes may also be used.

6.01.19 The complete fuel oil system shall be designed to avoid any air pocket in any part of the pipe work, fuel pump, sprayers/injectors, filter system etc. No air relief cock is permitted. However, where air relief is essential, plugs may be used.

6.01.20 A manual fuel pump shall be provided for priming and releasing of air from the fuel pipelines.

6.01.21 **Lubricating Oil System**

Automatic pressure lubrication shall be provided by a pump driven by the crank shaft, taking suction from a sump and delivering pressurised oil through cooler and fine mesh filters to a main supply header fitted in the bed plate casing. High pressure oil shall be supplied to the main and big end bearings, cam-shaft bearings, cam-shaft chain and gear drives, governor, auxiliary drive gears etc. Valve gear shall be lubricated at reduced pressure through a reducing valve and the cams by an oil bath.

6.01.22 **Cooling Water System**

Direct cooling or heat exchanger type cooling system shall be employed for the diesel engine. Water shall be tapped from the fire pump discharge. This water shall be led through duplex strainer, pressure breakdown orifice and then after passing through the engine, the water at the outlet shall be taken directly to the sump through an elevated funnel.

6.02.00 **Testing & Inspection**

6.02.01 The manufacturer shall conduct all tests required, to ensure that the equipment furnished conforms to the requirement of this sub-section and in compliance with requirements of applicable codes. The particulars of the proposed tests and the procedure for the tests shall be submitted to the Employer for approval before conducting the tests.

6.02.02 At manufacturer's works, tests shall be carried out during and after completion of manufacture of different component/parts and the assembly as applicable. Following tests shall be conducted.

6.02.03 Material analysis and testing.

6.02.04 Hydrostatic pressure testing of all pressure parts.

6.02.05 Static and dynamic balance tests of rotating parts at applicable over-speed and determination of vibration level.

6.02.06 MPI/DPT on machined parts of piston and cylinder.

6.02.07 Ultrasonic testing of crankshaft and connecting rod after heat treatment.

6.02.08 Dimensional check of close tolerance components like piston, cylinder bore etc.

6.02.09 Calibration tests of all fuel pumps, injectors, standard orifices, nozzles,

instruments etc.

6.02.10 Over speed test of the assembly at 120% of rated speed.

6.02.11 Power run test.

6.02.12 Performance test of the diesel engine to determine its torque, power and specific fuel consumption as function of shaft speed. Performance test of the engine shall be carried for 12 hours out of which 1 hour at full load and one hour at 110% overload.

6.02.13 Measurement of vibration & noise.

(i) Measurement of vibration

The vibration shall be measured during full load test as well as during the overload test and limit shall be 100 microns.

(ii) Measurement of noise level

The equivalent 'A' weighted sound level measured at a distance of 1.5 M above floor level in elevation and 1.0 M horizontally from the base of the equipment, expressed in dB to a reference of 0.0002 microbar shall not exceed 93 dBA.

Above tests for vibration shall be repeated at site as pre-commissioning tests.

6.02.14 Adjustment of speed governor as per BS:5514.

6.02.15 Diesel engine shall be subjected to routine tests as per BS:5514.

7.00.00 **PIPING, VALVES AND SPECIALITIES**

This clause covers the design, manufacture, shop testing, erection, testing and commissioning of piping, valves and specialities.

7.02.00 **Scope**

The piping system which shall include but not be limited to the following:

7.02.01 Plain run of piping, bends, elbows, tees, branches, laterals, crosses, reducing unions, couplings, caps, expansion joints, flanges, blank flanges, thrust blocks, anchors, hangers, supports, saddles, shoes, vibration dampeners, sampling

connections, hume pipes etc.

7.02.02 Gaskets, ring joints, backing rings, jointing material etc. as required. Also all welding electrodes and welding consumables including special ones, if any.

7.02.03 Instrument tapping connections, stubs etc.

7.02.04 Gate and globe valves to start/stop and regulate flow and swing check valves for one directional flow.

7.02.05 Basket strainers and Y-type strainers

7.02.06 Bolts, nuts, fasteners as required for interconnecting piping, valves and fittings as well as for terminal points. For pipe connections into Owner's R.C.C. works, Bidder will furnish all inserts.

7.02.07 Painting, anti-corrosive coatings etc. of pipes and equipment.

Adequate number of air release valves shall be provided at the highest points in the piping system to vent any trapped air in the system.

7.03.00 **Design**

7.03.01 Material of construction of various pipes shall be as follows:

(a) **Buried Pipes**

Mild steel black pipes as per ASTM A53 medium grade suitably lagged on the outside to prevent soil corrosion, as specified elsewhere.

(b) **Overground Pipes normally full of water**

Mild steel black pipes as per ASTM A53 medium grade.

(c) Overground pipes normally empty, but periodic charge of water and for detector line for HVW System**.**

Mild steel galvanised pipes as per ASTM A53 medium grade.

7.03.02 All fittings to be used in connection with steel pipe lines up to a size of 80 mm shall be as per ASTM A53 Mild steel tubulars and other wrought steel pipe fittings, Heavy grade. Fittings with sizes above 80 mm up to 150 mm shall be fabricated from ASTM A53 Heavy grade pipes or steel plates having thickness not less than

those of ASTM A53 Heavy grade pipes. Fittings with sizes above 150 mm shall be fabricated as per ASTM A53 standard. All fitting used in GI piping shall be threaded type. Welding shall not be permitted on GI piping.

7.03.03 Pipe sizes shall not be less than the sizes indicated in the attached drawings.

7.03.04 For steel pipeline, welded construction should be adopted unless specified otherwise.

7.03.06 All piping system shall be capable of withstanding the maximum pressure arising from any condition of operation and testing including water hammer effects.

7.03.09 Gate/sluice valve shall be used for isolation of flow in pipe lines and **construction** shall be as per BS 5150. Valves shall be of rising spindle type and of PN 1.6 class

7.03.10 Gate Valves shall be provided with the following:

(a) Hand wheel.

(b) Position indicator.

(c) Locking facility (where necessary).

7.03.11 Gate valves shall be provided with back seating bush to facilitate gland removal during full open condition.

7.03.12 Globe valves shall be provided with contoured plug to facilitate regulation and control of flow. All other requirements should generally follow those of gate valve.

7.03.13 Non-return valves shall be swing check type. Valves will have a permanent "arrow" inscription on its body to indicate direction of flow of the fluid.

7.03.14 Whenever any valve is found to be so located that it cannot be approached manually from the nearest floor/gallery/platform hand wheel with floor stand or chain operator shall be provided for the same.

7.03.15 Valves below 50 mm size shall have screwed ends while those of 50 mm and higher sizes shall have flanged connections.

7.03.14 **Basket Strainer**

a) Basket strainers shall be of 30mesh and have the following materials of

construction :

Body: Fabricated mild steel (Tested Quality). Strainer Wires: stainless steel (AISI : 316), 30 SWG, suitably reinforced.

b) Inside of basket body shall be protected by two (2) coats of heavy duty bit mastic paint.

c) Strainers shall be Simplex design. Suitable vent and drain connections with valves shall be provided.

d) Screen open area shall be at least 4 times pipe cross sectional area at inlet.

e) Pressure drop across strainer in clean condition shall not exceed 1.5 MWC at 410M3/hr (for 765kV/400kV substations) and 1 MWC at 273M3/hr flow (for 220kV & 132kV substations). Pressure drop test report of strainer of same design shall be furnished.

7.03.15 **Y-type On-line Strainer**

Body shall be constructed of mild steel (tested quality). Strainer wires shall be of stainless steel AISI:316, 30 SWG, 30 mesh.

Blowing arrangement shall be provided with removable plug at the outlet. Screen open area shall be at least 4 times pipe cross-sectional area at inlet.

Pressure drop test report of strainer of same design shall be furnished.

7.03.16 **Hydrant Valve (Outdoor) and Indoor Hydrant Valves (Internal Landing Valves).**

The general arrangement of outdoor stand post assembly, consisting of a column pipe and a hydrant valve with a quick coupling end shall be as per TAC requirement.

Materials of construction shall be as follows or superior:

a) Column pipe M.S. ASTM A53 med. grade.

b) Hydrant Valve

i) Body Stainless steel.

ii)	Trim	Leaded tin bronze.
iii)	Hand Wheel	Cast Iron.
iv)	Washer, gasket, etc.	Rubber.
v)	Quick coupling connection	Leaded tin bronze
vi)	Spring	Phosphor Bronze.
vii)	Cap and chain	Leaded tin bronze

The general design of hydrant valve shall conform to relevant latest international standards.

7.03.17 **Hoses, Nozzles, Branch pipes and Hose boxes**

(a) Hose pipes shall be of reinforced rubber-lined canvas construction with nominal size of 63 MM (2 1/2") and lengths of 15 metre or 7.5 metre, as indicated elsewhere.

(b) Hosepipes shall be capable of withstanding an internal water pressure of not less than 35**.7** kg/cm2 without bursting. It must also withstand a working pressure of 8.5 kg/cm2 without undue leakage or sweating.

(c) Each hose shall be fitted with instantaneous spring lock type couplings at both ends. Hose shall be fixed to the coupling ends by copper rivets and the joint shall be reinforced by 1.5 mm galvanised mild steel wires and leather bands.

(d) Branch pipes shall be constructed of copper and have rings of leaded tin bronze at both ends. One end of the branch pipe will receive the quick coupling while the nozzles will be fixed to the other end.

(e) Nozzles shall be constructed of leaded tin bronze.

(f) Suitable spanners of approved design shall be provided in adequate numbers for easy assembly and dismantling of various components like branch pipes, nozzles, quick coupling ends etc.

(g) Hose pipes fitted with quick coupling ends, branch pipes, nozzles spanner etc. will be kept in a hose box, which will be located near point of use.

(h) All instantaneous couplings, as mentioned under clause Nos.3.03.19, 3.03.20 and 3.03.21 above shall be of identical design (both male and female) so that any one can be interchanged with another. One male, female combination shall get locked in by mere pushing of the two halves together but will provide leak tightness at a pressure of 8 kg/cm2 of water. Designs employing screwing or turning to have engagement shall not be accepted.

7.04.00 **Fabrication & Erection**

7.04.01 The contractor shall fabricate all the pipe work strictly in accordance with the related approved drawings.

7.04.02 **End Preparation**

(a) For steel pipes, end preparation for butt welding shall be done by machining.

(b) Socket weld end preparation shall be sawing/machining.

(c) For tees, laterals, mitre bends, and other irregular details cutting templates shall be used for accurate cut.

7.04.03 **Pipe Joints**

(a) In general, pipes having sizes over 25 mm shall be joined by butt welding. Pipes having 25 mm size or less shall be joined by socket welding/screwed connections. Galvanised pipes of all sizes shall have screwed joints. No welding shall be permitted on GI pipes. Screwed joints shall have tapered threads and shall be assured of leak tightness without using any sealing compound.

(b) Flanged joints shall be used for connections to vessels, equipment, flanged valves and also on suitable straight lengths of pipe line of strategic points to facilitate erection and subsequent maintenance work.

7.04.04 **Overground Piping**

(a) Piping to be laid overground shall be supported on pipe rack/supports. Rack/supports details shall have to be approved by Employer/Engineer.

(b) Surface of overground pipes shall be thoroughly cleaned of mill scale, rust

etc. by wire brushing. Thereafter one (1) coat of **red oxide primer** shall be applied. Finally two (2) coats of synthetic enamel paint of approved colour shall be applied.

7.04.05 **Buried Pipe Lines**

(a) Pipes to be buried underground shall be provided with protection against soil corrosion by coating and wrapping with two coats of coal tar hot enamel paint and two wraps of reinforced fibre glass tissue. The total thickness of coating and wrapping shall not be less than 3 mm. Alternatively, corrosion resistant tapes can also be used for protection of pipes against corrosion.

(b) For Coating and wrapping, holiday testing to be performed in line with latest ASTM standards.

(c) Buried pipelines shall be laid with the top of pipe one meter below ground level.

(d) At site, during erection, all coated and wrapped pipes shall be tested with an approved Holiday detector equipment with a positive signalling device to indicate any fault hole breaks or conductive particle in the protective coating.

7.05.00 **General Instruction for Piping Design and Construction**

7.05.01 While erecting field run pipes, the contractor shall check, the accessibility of valves, instrument tapping points, and maintain minimum headroom requirement and other necessary clearance from the adjoining work areas.

7.05.02 Modification of prefabricated pipes, if any, shall have to be carried out by the contractor at no extra charge to the Employer.

7.05.03 **Welding**

(i) Welding shall be done by qualified welders only.

(ii) Before welding, the ends shall be cleaned by wire brushing, filing or machine grinding. Each weld-run shall be cleaned of slag before the next run is deposited.

(iii) Welding at any joint shall be completed uninterrupted. If this cannot be

followed for some reason, the weld shall be insulated for slow and uniform cooling.

(iv) Welding shall be done by manual oxyacetylene or manual shielded metal arc process. Automatic or semi-automatic welding processes may be done only with the specific approval of Employer/ Consultant.

(v) As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.

(vi) No backing ring shall be used for circumferential butt welds.

(vii) Welding carried out in ambient temperature of 5°C or below shall be heat-treated.

(viii) Tack welding for the alignment of pipe joints shall be done only by qualified welders. Since tack welds form part of final welding, they shall be executed carefully and shall be free from defects. Defective welds shall be removed prior to the welding of joints.

Electrodes size for tack welding shall be selected depending upon the root opening.

(ix) Tacks should be equally spaced as follows**:**

for 65 NB and smaller pipes : 2 tacks

for 80 NB to 300 NB pipes : 4 tacks

for 350 NB and larger pipes : 6 tacks

(x) Root run shall be made with respective electrodes/filler wires. The size of the electrodes/filler wires. The size of the electrodes shall not be greater than 3.25 mm (10 SWG) and should preferably be 2.3 mm (12 SWG). Welding shall be done with direct current values recommended by the electrode manufacturers.

(xi) Upward technique shall be adopted for welding pipes in horizontally fixed position. For pipes with wall thickness less than 3 mm, oxyacetylene welding is recommended.

(xii) The root run of butt joints shall be such as to achieve full penetration with

the complete fusion of root edges. The weld projection shall not exceed 3 mm inside the pipe.

(xiii) On completion of each run craters, weld irregularities, slag etc. shall be removed by grinding or chipping.

(xiv) Fillet welds shall be made by shielded metal arc process regardless of thickness and class of piping. Electrode size shall not exceed 10 SWG. (3.25 mm). At least two runs shall be made on socket weld joints.

7.06.00 **Tests at Works**

7.06.01 **Pipes**

(i) Mechanical and chemical tests shall be performed as required in the codes/standards.

(ii) All pipes shall be subjected to hydrostatic tests as required in the codes/standards.

(iii) 10% spot Radiography test on welds of buried pipes shall be carried out as per ASME VIII.

7.06.02 **Valves**

(i) Mechanical and chemical tests shall be conducted on materials of the valve as required in the codes/standards.

(ii) All valves shall be tested hydrostatically for the seat as well as required in the code/standards for a period of ten minutes.

(iii) Air test shall be conducted to detect seat leakage.

(iv) Visual check on the valve and simple operational test in which the valve will be operated thrice from full open to full close condition.

(v) No repair work on CI valve body, bonnet or wedge shall be allowed.

7.06.03 **Strainers**

(i) Mechanical and chemical tests shall be conducted on materials of the strainer.

(ii) Strainers shall be subjected to a hydrostatic test pressure of 1.5 times the design pressure or 10 kg/cm2g whichever is higher for a period of one hour.

7.06.04 **Hydrant valves and Indoor Hydrant Valves (Internal Landing Valves)**

(i) The stand post assembly along with the hydrant valve (valve being open and outlet closed) shall be pressure tested at a hydrostatic pressure of 21 kg/cm2g to detect any leakage through defects of casting.

(ii) Flow test shall be conducted on the hydrant valves at a pressure of 7 kg/cm2g and the flow through the valve shall not be less than 900 litres/min.

(iii) Leak tightness test of the valve seat shall be conducted at a hydrostatic test pressure of 14 kg/cm2g.

7.06.05 **Hoses, Nozzles, Branch Pipes and Hose Boxes**

Reinforced rubber-lined canvas hoses shall be tested hydrostatically. Following tests shall be included as per relevant latest International standard.

a) Hydrostatic proof pressure test at 21.4 kgf/cm2g

b) Internal diameter

The branch pipe, coupling and nozzles shall be subjected to a hydrostatic test pressure of 21 kg/cm2g for a period of $2^1/_2$ minutes and shall not show any sign of leakage or sweating.

Dimensional checks shall be made on the hose boxes and nozzle spanners.

8.00.00 **AIR VESSELS**

8.01.00 Air vessels shall be designed and fabricated of mild steel as class-II vessels as per BS 5500 for a pressure of 14kg/cm^2 and shall be minimum 3 m^3 capacity.

8.02.00 Inside surface of the tank shall be protected by anti-corrosive paints/coatings/linings as required.

8.03.00 Outside surfaces of the vessels shall be provided with one (1) coat of red lead primer with two (2) coats of synthetic enamel paint of approved colour and characteristics.

8.04.00 **Tests & Inspection**

8.04.01 Air vessels shall be hydraulically tested at 21kg/cm2 for a period not less than one (1) hour.

8.04.02 All materials used for fabrication shall be of tested quality and test certificates shall be made available to the Owner.

8.04.03 Welding procedure and Welder's qualification tests will be carried out as per relevant international Standard.

8.04.04 NDE tests, which will include 100% Radiography on longitudinal seams and spot Radiography for circumferential seams, for pressure vessel will be carried out.

9.00.00 **HEAT DETECTORS/FIRE DETECTORS AND SPRAY NOZZLES**

9.00.01 **Intent of Specification**

This specification lays down the requirements of the smoke detectors, heat detectors and spray nozzles for use in various sub-systems of the fire protection system.

9.00.02 **Codes and Standards**

All equipment supplied shall conform to internationally accepted codes and standards.

9.01.00 **Heat Detectors**, **Quartzoid bulb type.** (Used in HVW spray system)

a) Heat detectors shall be of any approved and tested type. Fusible chemical pellet type heat detectors are however not acceptable.

b) Temperature rating of the heat detector shall be selected by the Bidder taking into consideration the environment in which the detectors shall operate. Minimum set point shall, however, be 79oC.

c) Heat detectors shall be guaranteed to function properly without any maintenance work for a period of not less than twenty-five (25) years.

d) The heat detectors shall be mounted on a pipe network charged with water at suitable pressure. On receipt of heat from fire, the heat detector will release the water pressure from the network. This drop-in water pressure will actuate the Deluge valve.

9.02.00 **HVW Spray Nozzles (Projectors)**

High velocity water spray system shall be designed and installed to discharge water in the form of a conical spray consisting of droplets of water travelling at high velocity which shall strike the burning surface with sufficient impact to ensure the formation of an emulsion. At the same time the spray shall efficiently cut off oxygen supply and provide sufficient cooling. Integral non-ferrous strainers shall be provided in the projectors ahead of the orifice to arrest higher size particle, which are not allowed to pass through the projectors.

9.03.00 **Fire Detectors (Used in fire detection and alarm system)**

9.03.01 Fire detectors shall be approved by FOC-London or similar international authorities.

9.03.02 Both smoke and heat type fire detectors shall be used. Bidder shall clearly indicate the mode of operation of detectors in his proposal.

9.03.03 The set point shall be selected after giving due consideration for ventilating air velocity and cable insulation.

9.03.04 Fire detectors shall be equipped with an integral L.E.D. so that it shall be possible to know which of the detectors has been operated. The detectors, which are to be placed in the space above the false ceiling or in the floor void shall not have the response indicators on the body but shall be provided with remote response indicators.

9.03.05 Approval from competent authority shall be made available for ionisation type smoke detectors. All required accessories shall also be included in the scope of supply.

9.03.06 Fire detectors shall be guaranteed to function properly without any maintenance work for a period of not less than ten (10) years.

10.00.00 **PORTABLE AND WHEEL/ TROLLEY MOUNTED FIRE EXTINGUISHERS**

10.00.01 This specification lays down the requirement regarding fire extinguishers of following types:

Portable fire extinguishers.

a) Pressurised water type.

b) Dry chemical powder type

c) Carbon Dioxide type

Wheel/ Trolley mounted fire extinguishers.

a) Mechanical foam type
b) Dry chemical powder type
c) Carbon Dioxide type

10.00.02 All the extinguishers offered by the Bidder shall be of reputed make.

10.01.00 **Design and Construction**

10.01.01 All the portable extinguishers shall be of freestanding type and shall be capable of discharging freely and completely in upright position.

10.01.02 Each extinguisher shall have the instructions for operating the extinguishers on its body itself.

10.01.03 All extinguishers shall be supplied with initial charge and accessories as required.

10.01.04 Portable type extinguishers shall be provided with suitable clamps for mounting on walls or columns.

10.01.05 All extinguishers shall be painted with durable enamel paint of fire red colour conforming to relevant International Standards.

10.01.06 Pressurisation of water type fire extinguishers shall either be done by compressed air or by using gas cartridge. Both constant air pressure and the gas pressure type shall conform to their latest relevant International standards.

10.01.07 Dry chemical powder type portable extinguisher and trolley mounted extinguisher shall conform to its latest relevant International standards.

10.01.08 Carbon Dioxide type portable extinguisher and Carbon Dioxide type trolley mounted extinguisher shall conform to their latest relevant International standards.

10.01.09 Wheel/ trolley mounted fire extinguishers of 50 litre capacity Mechanical foam type shall conform to its **latest relevant International standards.**

10.02.00 **Tests and Inspection**

10.02.01 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.

10.02.02 Performance testing of extinguisher shall be in line of applicable International Standards. In case where no International 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.

10.03.00 **Painting**

Each fire extinguisher shall be painted with durable enamel paint of fire red colour conforming to relevant International Standards.

11.00.00 **INSTRUMENTS**

11.00.01 **Intent of Specification**

The requirements given in the sub-section shall be applicable to all the instruments being furnished under this specification.

11.00.02 All field mounted instruments shall be weather and dust tight, suitable for use under ambient conditions prevalent in the subject plant. All field mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance can be achieved.

11.01.00 **Local Instruments**

Pressure/ Differential Gauges & Switches.

11.01.01 The pressure sensing elements shall be continuous 'C' bourdon type.

11.01.02 The sensing elements for all gauges/switches shall be properly aged and factory tested to remove all residual stresses. They shall be able to withstand atleast twice the full scale pressure/vacuum without any damage or permanent deformation.

11.01.03 For all instruments, connection between the pressure sensing element and socket shall be braced or hard soldered.

11.01.04 Gauges shall be of 150 mm diameter dial with die-cast aluminium, stoved enamel black finish case, aluminium screwed ring and clear plastic crystal cover glass. Upper range pointer limit stop for all gauges shall be provided.

11.01.05 All gauges shall be with stainless steel bourdon having rotary geared stainless steel movements.

11.01.06 Weatherproof type construction shall be provided for all gauges. This type of construction shall be fully dust tight, drip tight, weather resistant and splash proof with anti-corrosive painting conforming to NEMA- 4.

11.01.07 All gauges shall have micrometre type zero adjuster.

11.01.08 Neoprene safety diaphragm shall be provided on the back of the instruments casing for pressure gauges of ranges 0-10 Kg/cm^2 and above.

11.01.09 Scales shall be concentric, white with black lettering and shall be in metric units.

11.01.10 Accuracy shall be $\pm$ 1.0 percent of full range or better.

11.01.11 Scale range shall be selected so that normal process pressure is approximately 75 percent of full scale reading. For pressure gauges and pressure switches, the range shall not be less than 0 -16 Kg/cm^2

11.01.12 All gauges shall have 1/2 inch NPT bottom connection.

11.01.13 All instruments shall conform to their **latest relevant International standards.**

11.01.14 All instruments shall be provided with 3 way gauge isolation valve or cock. Union nut, nipple and tail pipe shall be provided wherever required.

11.01.15 Switch element contact shall have two (2) NO and two (2) NC contacts rated for 240 Volts, 10 Amperes A.C. or 220 Volts, 5 Amperes D.C. Actuation set point shall be adjustable throughout the range. ON-OFF differential (difference between switch actuation and de-actuation pressures) shall be adjustable. Adjustable range shall be suitable for switch application.

11.01.16 Switches shall be sealed diaphragm, piston actuated type with snap action switch

element. Diaphragm shall be of 316 SS.

11.01.18 Necessary accessories shall be furnished.

11.02.00 **Timers**

11.02.01 The timers shall be electro-mechanical type with adjustable delay on pick-up or reset as required.

11.02.02 Each timer shall have two pairs of contacts in required combination of NO and NC.

11.03.00 **Level Gauges/Indicator/Switches**

11.03.01 **Level Gauges**

i) Gauge glasses shall be used for local level indication wherever shown in the flow diagram.

ii) Gauge glasses, in general, shall be flag glass type with bolted cover. Body and cover material shall be of carbon steel with rubber lining.

iii) Level coverage shall be in accordance with operating requirements. Maximum length of a single gauge glass shall not exceed 1.4 M. Should a larger gauge glass be required, multiple gauges of preferably equal length shall be used with 50 mm overlap in visibility.

iv) Reflex type gauge glasses shall be used for colourless liquids and transparent type gauge glasses shall be used for all liquids having colour.

v) Each gauge glass shall be complete with a pair of offset valves. Valves shall have union bonnet, female union level connection, flanged tank connection, and vent and drain plug.

vi) Offset valves shall have corrosion resistant ball-check to prevent fluid loss in the event of gauge glass breakage. Valve body shall have a working pressure of 200 percent of the maximum static pressure at the maximum process fluid temperature. Valve body materials shall be of carbon steel with rubber lining.

11.03.02 **Level Indicators**

i) Float type mechanical level gauges with linear scale type indicator shall be offered for measuring level of tanks wherever shown in the flow diagram.

ii) AISI-316 stainless steel float, guide rope and tape shall be used. Housing shall be of mild steel painted with anti-corrosive painting.

iii) The scale indicator shall be provided at a suitable height for ease of reading.

iv) Accuracy shall be + 1% of scale range or better.

11.03.03 **Level Switches**

i) Level switches shall be of ball float operated magnetic type complete with cage.

ii) Materials of construction shall be suitable for process and ambient conditions. The float material shall be AISI-316 stainless steel.

iii) Actuating switches shall be either hermetically sealed mercury type or snap acting micro-switches. Actuation set point shall be adjustable. ON-OFF differential (difference between switch actuation and de-actuation levels) shall be adjustable. Adjustable range shall be suitable for switch application. All switches shall be repeatable within + 1.0 percent of liquid level change required to activate switch. Contacts shall be rated for 50 watts resistive at 240 V A.C. Number of contacts shall be two NOS and two NC for each level switch.

11.04.00 **Solenoid Valves**

11.04.01 The body of the valves shall be Forged brass or stainless steel.

11.04.02 The coil shall be continuous duty, epoxy moulded type Class-F, suitable for high temperature operation.

11.04.03 The enclosure shall be watertight, dust-tight and shall conform to NEMA-4 Standard.

11.04.04 The valves shall be suitable for mounting in any position.

11.05.00 **Switches, Lamps, Meters Etc.**

All electrical components on the panel namely push buttons, switches, lamps, meters etc. shall meet the requirements of sub-section Electrical enclosed with the specification.

11.06.00 All local instruments shall be inspected by Employer/Consultant as per the agreed quality plan.

11.07.00 Makes of control panel and local instruments, accessories shall be as per Employer's approval.

12.00.00 **ELECTRIC MOTORS**

12.01.00 **General**

12.01.01 This clause covers the requirements of three phase squirrel cage induction motors and single-phase induction motors.

12.01.02 The motors to be furnished, erected and commissioned as covered under this specification shall be engineered, designed, manufactured, erected, tested as per the requirements specified herein. These requirements shall however be read along with the requirements of the respective driven equipment being supplied under the specification of which this specification forms a part.

12.01.03 The motor supplied under this specification shall conform to the standards specified in GTR.

12.01.04 Terminal point for all motors supplied under this specification shall be at the respective terminal boxes.

12.01.05 Materials and components not specifically stated in this specification but are necessary for satisfactory operation of the motor shall be deemed to be included in the scope of supply of this specification.

12.01.06 Notwithstanding anything stated in this motor specification, the motor has to satisfy the requirement of the mechanical system during normal and abnormal conditions. For this the motor manufacturer has to co-ordinate with the mechanical equipment supplier and shall ensure that the motor being offered meets the requirements.

12.02.00 **Codes & Standards**

12.02.21 The design, manufacture, installation and performance of motors shall conform to the provisions of latest Electricity Act and Electricity Rules. Nothing in these specifications shall be construed to relieve the Contractor of his responsibility.

12.02.22 In case of contradiction between this specifications and IEC, the stipulations of this specification shall be treated as applicable.

12.02.23 National Electrical code for hazardous location and relevant NEMA standard shall also be applicable for motors located in hazardous location.

12.03.00 **Design Features**

12.03.01 **Rating and type**

(i) The induction motors shall be of squirrel cage type unless specified otherwise.

(ii) The motors shall be suitable for continuous duty in the specified ambient temperature.

(iii) The MCR KW rating of the motors for 50C ambient shall not be less than the power requirement imposed at the motor shaft by the driven equipment under the most onerous operation conditions as defined elsewhere, when the supply frequency is 51.5 Hz (and the motor is running at 103% of its rated speed).

(iv) Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously in the system having the following particulars:

a) Rated terminal voltage

From 0.2 to 200 KW 400V (3 Phase, solidly earthed)

Below 0.2 KW 230 V (1 Phase, solidly earthed)

Variation in voltage $\pm$ 6%.

b) Frequency 50 Hz $\pm$ 3%.

c) Any combination of (a) & (b)

12.03.02 Enclosure

Motors to be installed outdoor and semi-outdoor shall have hose proof enclosure equivalent to IP-55. For motors to be installed indoor, the enclosure shall be dust proof equivalent to IP-54.

12.03.03 **Cooling method**

Motors shall be TEFC (totally enclosed fan cooled) type.

12.03.04 **Starting requirements**

(i) **Induction motor**

a) All induction motors shall be suitable for full voltage direct on-line starting. These shall be capable of starting and accelerating to the rated speed along with 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 electro-dynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.

c) The starting current of the motor at rated voltage shall not exceed six (6) times the rated full load current subject to tolerance as given in IEC 60034.

d) Motors when started with the driven equipment imposing full starting torque under the supply voltage condition specified under Clause 12.03.01 (iv) (a) shall be capable of withstanding at least two successive starts with coasting to rest between starts and motor initially at the rated load operating temperature. The motors shall also be suitable for three equally spread starts per hour, the motor initially at a temperature not exceeding the rated operating temperature.

e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than the starting time with the driven equipment at minimum permissible voltage (clause 12.03.04 (i) (a) 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 speeds 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.

12.03.05 **Running requirements**

(i) When the motors are operating at extreme condition of voltage and frequency given under clause no.12.03.01 (iv) the maximum permissible

temperature rise over the ambient temperature of 50oC shall be within the limits specified in IEC 60034 after adjustment due to increase ambient temperature specified herein.

(ii) The double amplitude of motor vibration shall be within the limits specified in IEC/International standards. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

(iii) 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.

(iv) Induction motors shall be so designed as to be capable of withstanding the voltage and torque stresses developed due to the difference between the motor residual voltage and incoming supply voltage during fast changeover of buses. The necessary feature incorporated in the design to comply with this requirement shall be clearly indicated in the proposal.

(v) Motors shall be capable of developing the rated full load torque even when the supply voltage drops to 70% of rated voltage. Such operation is envisaged for a period of one second. The pull out torque of the induction motors to meet this requirement shall not be less than 205% of full load torque.

(vi) The motors shall be capable of withstanding for 10 seconds without stalling or abrupt change in speed (under gradual increase of torque) an excess torque of 60 percent of their rated torque, the voltage and frequency being maintained at their rated value.

(vii) Guaranteed performance of the motors shall be met with tolerances specified in respective standards.

12.04.00 **Construction Features**

12.04.01 **Stator**

(i) **Stator frame**

The stator frames and all external parts of the motors shall be rigid fabricated steel or of casting. They shall be suitably annealed to eliminate any residual stresses introduced during the process of fabrication and machining.

(ii) **Stator core**

The stator laminations shall be made from suitable grade magnetic sheet steel varnished on both sides. They shall be pressed and clamped adequately to reduce the core and teeth vibration to minimum.

(iii) **Insulation and winding**

All insulated winding conductor shall be of copper. The overall motor winding insulation for all 400 volts motors shall be of epoxy thermosetting type i.e., class 'F' but limited to class-B operating from temperature rise consideration. Other motors may be of conventional class-B type. The windings shall be suitable for successful operation in hot, humid, tropical climate with the ambient temperature of 50oC.

12.04.02 **Rotor**

(i) Rotors shall be so designed as to keep the combined critical speed with the driven equipment away from the running speed by atleast 20%.

(ii) Rotors shall also be designed to withstand 120% of the rated speed for 2 minutes in either direction of rotation.

12.04.03 **Terminal box leads**

(i) For motors of 400 Volts and below a single terminal box may be provided for power and accessories leads.

(ii) Terminal boxes shall be of weatherproof construction designed for outdoor service. To eliminate entry of dust and water, gaskets of neoprene or approved equivalent shall be provided at cover joints and between box and motor frame.

(iii) Terminal box shall be suitable for top and bottom entry of cables.

(iv) Unless otherwise approved, the terminal box shall be capable of being turned through 360o in steps in 90o.

(v) The terminals shall be complete with all accessories for connecting external cables. They shall be designed for the current carrying capacity and shall ensure ample phase to phase to ground clearances.

(vi) Suitable tinned brass compression type cable glands and cable lugs shall be supplied by the Contractor to match Employer's cable.

(vii) Terminal box for single core cable shall be of non- magnetic material.

(viii) Marking of all terminals shall be in accordance with IEC / International standard.

12.04.04 **Rating Plates**

(i) Rating plates shall be provided for all motors giving the details as called for in IEC 60034 (for three phase squirrel cage induction motors).

(ii) In addition to above, the rating plate shall indicate the following:

a) Temperature rise in oC under normal working conditions.

b) Phase sequence corresponding to the direction of rotation for the application.

c) Bearing identification number (in case of ball/ roller bearing) and recommended lubricants.

12.04.05 **Other Constructional Features**

(i) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of Employer's earthing conductor to be specified to the successful Bidder.

(ii) Motor weighing more than 25 kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

12.05.00 **Paint and Finish**

12.05.01 Motor external parts shall be finished and painted to produce a neat and durable surface, which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, all sharp edges and scales removed and treated with one coat of primer and two coats of grey enamel paint.

12.05.02 Motor fans shall also be painted to withstand corrosion.

12.05.03 All fasteners used in the construction of the equipment shall be either of corrosion resistant material or heavy cadmium plated.

12.05.04 Current carrying fasteners shall be either of stainless steel or high tensile brass.

12.06.00 **Tests at Manufacturers Works**

12.06.01 Motors shall be subject to routine tests in accordance with IEC 60034.

12.06.02 In addition, the following tests shall also be carried out :

a) 20% over speed test for 2 minutes on all rotors.

b) Measurement of vibration.

c) Measurement of noise level.

d) Phase sequence and polarity checks relative to mechanical rotation.

12.06.03 **Tests after installation at site**

(i) After installation and commissioning at site, the motors along with the driven equipment shall be subject to tests to ascertain their conformity with the requirement of this specification and those of the driven equipment specification and the performance data quoted by the Bidder.

(ii) In case of non-conformity of the motor with these specifications and performance requirement, the Engineer may at his discretion reject or ask for necessary rectification/replacement as detailed in general Terms and Conditions of Contract (GCC) Volume-I.

13.00.00 **BATTERY & BATTERY CHARGERS**

This clause covers the design, performance, manufacturing, construction features and testing of Battery and Battery charger used primarily for starting the diesel engine driving the fire water pumps. Battery Chargers shall be housed in Diesel Engine Panel.

13.01.00 **General Information**

13.01.01 The equipment specified hereinafter are required for starting the diesel engines and other operation of the plant as required.

13.01.02 For each diesel engine there shall be two (2) sets of Battery and two (2) sets of Battery Charger.

13.01.03 The D.C. voltage shall be obtained normally after necessary rectification by

battery charger. The Battery Charging system shall be capable of meeting the following requirements:

13.01.04 Float charging the Battery.

13.01.05 Boost Charging the Battery.

13.01.06 The battery shall be large enough to crank the engine **3** times without charging in between and without getting drained to an extent which will affect its life.

13.01.07 The Bidder shall indicate the battery voltage and battery capacity in Ampere-Hour at ten (10) hour discharge rate. The battery voltage at any time during operation shall not be less than the minimum voltage required for operation of the D.C. loads.

13.02.00 **General Design**

The Battery shall be located indoor

13.02.01 **Battery**

(i) The cells shall be lead-acid type. The Battery shall be automotive type.

(ii) The cells shall be sealed in type with anti-splash type vent plug.

(iii) The cell terminal posts shall be provided with connector bolts and nuts, effectively coated with lead to prevent corrosion. Lead or lead coated copper connectors shall be furnished to connect up cells of battery set.

(iv) Positive and Negative terminal posts shall be clearly and indelibly marked for easy identification.

(v) The electrolyte shall be of battery grade Sulphuric Acid. Water for storage batteries conforming to relevant standards shall be used in the preparation of the electrolyte.

13.02.02 **Battery Charger**

(i) The Bidder shall furnish the battery charging scheme complete with all necessary accessories such as transformers, switches, fuses, starters, contactors, diodes, ammeters, voltmeters and other devices as required for trouble free operation. All devices and equipment shall conform to relevant International Standard or shall be Superior to it.

(ii) The scheme of the battery charger shall be such that the battery can be charged automatically as well as manually.

(iii) The boost charger shall have sufficient capacity to restore a fully discharged Battery to a state of full charge in eight (8) hours with some spare margin over maximum charging rate. Suitable provision shall be kept so that, for a particular engine, any of the two (2) charger units can be used for charging any of the two (2) batteries.

(iv) The instruments, switches and lamps shall be flush/semi-flush mounted on the front panel. Name plate of approved type shall be provided for each of these equipment.

(v) The panel shall be complete with internal wiring and input-output terminal block. Terminal blocks shall be clip on type of suitable rating. All equipment and wire terminals shall be identified by symbols corresponding to applicable schematic/wiring diagram.

(vi) Space heaters of adequate capacity shall be provided to prevent moisture condensation in the panel.

13.03.00 **Testing**

13.03.01 The Battery Charger shall also be subjected to the following tests at manufacturer's works as per IEC 60146.

13.03.02 Insulation test.

13.03.03 Connection checking.

13.03.04 Measurement of voltage regulation.

13.03.05 Auxiliary of devices.

13.03.06 Alternating current measurement.

13.03.07 Performance test.

13.03.08 Temperature rise test.

13.03.09 Following acceptance tests shall be carried out in batteries as per IEC/International standard.

a) Marking and packing

b) Verification of dimensions

c) Test for capacity

d) Test for voltage during discharge

Battery and battery charger shall be checked for auto charging and providing sufficient power for three consecutive starting kicks to diesel engine within five minutes with A.C. supply switched off.

14.00.00 CONTROL & ANNUNCIATION PANELS

14.01.00 Intent of Specification

The following requirement shall be applicable to the control and annunciation panels furnished under these specifications.

14.02.00 General Information

14.02.01 The equipment specified herein are required for controlling, metering, monitoring and indication of electrical systems of the plant offered.

14.02.02 The selection and design of all the equipment shall be so as to ensure reliable and safe operation of the plant and shall be subjected to approval by the Employer.

14.02.03 The reference ambient temperature outside the panel shall be taken as 50oC and relative humidity 100%.

14.03.00 Equipment to be Furnished

Control & annunciation panels shall be furnished complete with all accessories and wiring for safe and trouble free operation of the plant. Details are included in sub-section General.

14.04.00 Constructional Details

14.04.01 The panel frames shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.5 mm.

Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary.

14.04.02 Panels shall be of free standing type and shall be provided with hinged door with locking arrangement. The access doors, cutest and covers shall be equipped with neoprene/synthetic rubber gaskets (conforming to IEC 60149) all around and the latches sufficiently strong to hold them in alignment when closed. The panels to be installed outdoor or semi outdoor shall have a degree of protection of IP:55 and those installed indoor shall have a degree of protection of IP:52 as per IEC 60947.

14.04.03 If a panel consists of a number of panels, each panel should be mounted side by side and bolted together to form a compact unit, when two panels meet, the joints shall be smooth, close fittings and un-obstructive.

14.04.04 Removable eye bolt or lifting lugs shall be provided on all panels to facilitate easy lifting.

14.04.05 The heights of all operating equipment on the panel shall be between 800 mm to 1600 mm from the finished floor level. The proper supporting arrangement shall be provided by the Contractor.

14.04.06 Cable entries to the panel may be from bottom or top. The cable entry required will be intimated to the successful Bidder. A suitable removable gland plate of 3 mm thick shall be mounted not less than 200 mm above the floor level.

14.04.07 All equipment mounted on the front face of the panels shall be flush or semi-flush type. All equipment shall be so located that their terminal and adjustment are readily accessible for inspection or maintenance and their removal and replacement can be done without interruption of service to other equipment. The contractor shall submit the panel general arrangement drawings clearly bringing out internal mounting details, dimensions of equipment, clearance between the equipment and the edges of the panel, for approval.

14.05.00 **Name Plates and Labels**

14.05.01 Each panel shall be provided with prominent, engraved identification plates for all front mounted equipment. Panel identification name plate shall be provided at front and rear as required.

14.05.02 All name plates shall be of non-rusting metal or 3 ply lanichol, with white engraved lettering on black background. Inscription and lettering sizes shall be subjected to Employer's approval.

14.05.03 Suitable plastic sticker labels shall be provided for easy identification of all equipment located inside the panel. These labels shall be positioned so as to be clearly visible and shall give the device number, as mentioned in the wiring drawings.

14.06.00 **AC/DC Power Supply**

14.06.01 The Employer will provide one feeder each for AC and DC to the panel. The Contractor shall make for his own arrangements for providing these power supplies to different panels.

14.06.02 The Contractor shall provide suitable isolating switch fuse unit in the control panel for receiving the above incoming AC and DC supplies. Fuse and link shall be provided for isolating of individual circuit without disturbing other circuits.

14.07.00 **Wiring**

14.07.01 All inter panel wiring and connections between panels (if there is group of panels) including all bus wiring for AC & DC supplies shall be provided by the Contractor.

14.07.02 All internal wiring shall be carried out with 1100 V grade, single core, 1.5 square mm or larger stranded copper wires having colour-coded PVC insulation. CT circuits shall be wired with 2.5 square mm copper wires, otherwise similar to the above.

14.07.03 Extra-flexible wire shall be used for wiring to devices mounted on moving parts such as doors.

14.07.04 Spare contacts of auxiliary relays, timers and switches shall be wired out to the terminal blocks as required by the Employer/Engineer at the time of detailed engineering.

14.08.00 **Terminal Blocks**

14.08.01 Terminal Blocks shall be of 650V grade, rated for 10 Amps and in one-piece moulding. It shall be complete with insulating barriers, clip-on-type terminals, and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. It shall be similar to 'Elmex-Standard' type terminals.

14.08.02 Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal block.

14.08.03 The terminal blocks shall have at least 20% spare terminals.

14.09.00 **Grounding**

A continuous copper bus 25 x 3 mm size shall be provided along the bottom of the panel structure. It shall run continuously throughout the length of the panel and shall have provision at both ends for connection to the station grounding grid (25 x 6 mm MS Flat).

14.10.00 **Space Heater and Lighting**

14.10.01 Space heaters shall be provided in the panels for preventing harmful moisture condensation.

14.10.02 The space heaters shall be suitable for continuous operation on 230V AC, 50 Hz, single phase supply and shall be automatically controlled by thermostat. Necessary isolating switches and fuses shall also be provided.

14.10.03 Free standing panel shall have a 230V AC, plug point and a fluorescent light operated by door switch.

14.11.00 **Control and Selector Switches**

14.11.01 Control and selector switches shall be of rotary type, with escutcheon plates clearly marked to show the function and positions.

14.11.02 Control/selector switches shall be spring return or stay put type as per the requirements. Handles of control/selector switches shall be black in colour. Shape and type of handles shall be to the approval of the Employer.

14.11.03 The contact ratings shall be at least the following:

i) Make and carry continuously 10 Amp.

ii) Breaking current at 220/110V DC 1Amp. (Inductive)

iii) Breaking current at 240V DC 5 Amp. at 0.3 p.f. lagging

14.12.00 **Push Buttons**

14.12.01 Push buttons shall be spring return, push to actuate type and rated to continuously carry and break 10A at 230V AC and 0.5A (Inductive) at 220/110V DC. The push buttons shall have at least 1 NO and 1 NC contact. All contact faces

shall be of silver or silver alloy.

14.12.02 All push buttons shall be provided with integral escutcheon plates marked with its function.

14.12.03 The colour of buttons shall be as follows :

Green For motor START, Breaker CLOSE, Valve/ damper OPEN.

Red For motor TRIP, Breaker OPEN, Valve/ damper CLOSE.

Black For all annunciation functions, overload reset and miscellaneous.

14.12.04 Red push buttons shall always be located to the left of green push buttons. In case of clinker grinder etc. the push buttons would be black-red-green from left to right.

14.13.00 **Indicating Lamps**

14.13.01 Indicating lamps shall be of the panel mounting, filament type and of low-watt consumption. Lamps shall be provided with series resistors preferably built-in-the lamps assembly. The lamps shall have escutcheon plates marked with its function, wherever necessary.

14.13.02 Lamp shall have translucent lamp covers of the following colours:

Red for motor OFF, Valve/damper OPEN, Breaker CLOSED.

Green for motor ON, Valve/damper CLOSED, Breaker OPEN.

White for motor AUTO-TRIP.

Blue for all healthy conditions (e.g. control supply, lob oil pressure and also for spring charged).

Amber for all ALARM conditions (e.g. pressure low, over load and also for 'service' and 'Test' position indication).

14.13.03 Bulbs and lamps covers shall be easily replaceable from the front of the panel.

14.13.04 Indicating lamps should be located directly above the associated push button/control switches. Red lamps shall variably be located to the right of the green lamp. In case a white lamp is also provided, it shall be placed between the

red and green lamps. Blue and amber lamps should normally be located above the red and green lamps.

14.14.00 **Fuses**

14.14.01 All fuses shall be of HRC cartridge plug-in-type and shall be of suitable rating, depending upon circuit requirements.

14.14.02 All fuses shall be mounted on fuse carriers, which shall be mounted on fuse-bases.

14.15.00 **Contactors**

14.15.01 Contactors shall be of air break, electromagnetic type rated as per requirement.

14.15.02 Operating coils of AC contactors shall be of 230V AC or 220/110V DC as required. AC contactors shall operate satisfactorily between 85% to 110% of the rated voltage. The Contactor shall not drop out at 70% of the rated voltage.

14.15.03 DC contactors shall have a coil voltage of 220/110V DC and shall be suitable for satisfactory continuous operation at 80% to 110% of the rated voltage.

14.16.00 **Relays and Timers**

14.16.01 All auxiliary relays & timers shall be of proven design and of reputed make. Contacts of relays and timers shall be of solid silver or silver cadmium oxide or solid silver faced. Timers shall have the provision to adjust the delay on pick-up or reset as required.

14.16.02 All relays and timers shall have at least two NO and two NC contacts.

14.16.03 All relays and timers shall be suitable for 230V AC and 220/110V DC as required. DC relays shall operate satisfactorily between 70% to 110% and AC relays shall be suitable for voltage variation between 80% to 110%.

14.17.00 **Indication Instruments**

14.17.01 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 2.0 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

14.17.02 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for

zero adjustment removing or dismantling the instruments.

14.17.03 All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.

14.17.04 Ammeters provided on motor feeders shall have a compressed scale at the upper current region to cover the starting current.

14.18.00 **Annunciation System**

14.18.01 The annunciation system shall be complete with all necessary relays, flashers and other accessories required for the proper operation of the equipment and shall be completely solid state. The control circuit shall be mounted on plug-in type glass epoxy printed circuit boards. Audible alarms for the system shall be mounted inside the panel. One set of acknowledge, test and reset push buttons shall be mounted on the panel.

14.18.02 Indications shall be engraved on Acrylic inscription plate window and shall be visible clearly when the indication lamp is lighted (black letters on white background). Each window shall be provided with two lamps.

14.18.03 Audible hooter shall sound when a trouble contact operates and shall continue to sound until the acknowledge button is pressed. In addition to the hooters provided on annunciation panels, a hooter shall be provided outside FFPH which shall sound in any fire alarm condition.

14.18.04 Indication lamps shall flash when trouble contact operates and shall continue flashing until acknowledge button is pressed.

14.18.05 After acknowledge button is pressed, the hooter and flashing shall stop but the indication lamp shall remain lighted.

14.18.06 After trouble is cleared indication lamps shall be ready and shall go off only when reset.

14.18.07 Silencing the hooter in conjunction with one trouble contact shall not stop and hooter sounding if another trouble contact operates.

14.18.08 When test button is pressed, all lamps shall flash and hooter shall sound.

14.18.09 Annunciator systems shall operate on 220/110V DC Systems as applicable.

14.18.10 The annunciation system shall include alarm for AC control system failure

(working on DC supply), DC supply failure (working on AC supply) and test facilities for these alarms.

14.18.11 List of annunciations required on the panels has been listed elsewhere. The Contractor shall also provide additional annunciations if desired by the Employer/Engineer during Vendor drawing review stage and for such additional annunciations no extra charges shall be claimed by the Contractor, if the number of such additions are within 10% of the number stipulated in this specification.

14.18.12 20% spare windows shall be provided on the panel.

14.19.00 **Painting**

14.19.01 **Painting procedure adopted shall conform to requirements given in GTR**. The paint thickness shall not be less than **60** microns. Finished parts shall be coated by peekable compound by spraying method to protect the finished surface from scratches, grease, dirt and oily spots during testing, transportation handling and erection.

14.20.00 **Tests**

14.20.01 Following tests/inspection shall be carried out by the Contractor in the presence of Employer's representative:

(A) Factory Tests

1. Compliance with approved drawings, data and specification.

2. Visual check for workmanship.

3. Wiring continuity and functional checks.

4. Calibration of instruments, relays and metres wherever required by inspector.

5. HV test

6. Insulation resistance measurement before and after HV test.

(B) Inspection/Testing at site:

1. IR test before and after HV test

2. HV Test

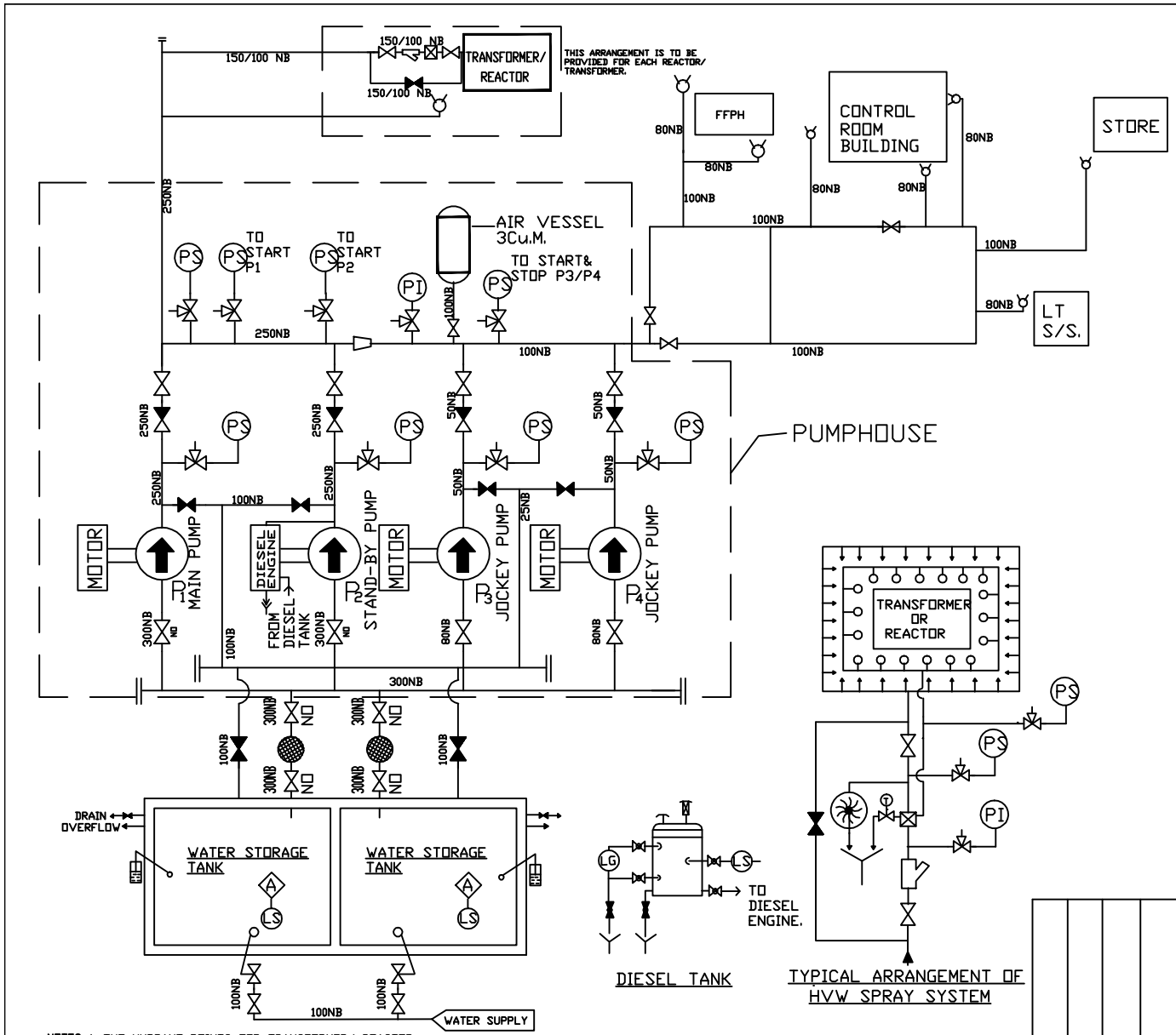
3. Functional Testing.

(C)

1. The Fire detection and annunciation panel shall be subjected to functional tests.

2. The Annunciation System shall be routine tested

APPENDIX-I
TO TECHNICAL SPECIFICATION
FOR FIRE PROTECTION SYSTEM REV.-6



LEGEND

- ALARM
- GATE VALVE NORMALLY OPEN
- GATE VALVE NORMALLY CLOSED
- NON-RETURN VALVE
- GLOBE VALVE NORMALLY OPEN
- GLOBE VALVE NORMALLY CLOSED
- FLOAT OPERATED GATE VALVE
- TEST VALVE
- PRESSURE GAUGE
- PRESSURE SWITCH
- LEVEL GAUGE
- LEVEL SWITCH
- BASKET STRAINER
- FLOAT OPERATED LEVEL GAUGE
- Y-TYPE STRAINER
- WATER MOTOR GONG
- REDUCER
- THREE WAY COCK/ VALVE
- VENT
- DRAIN
- OUT DOOR HYDRANT
- QUARTZOID BULB DETECTOR
- HVW SPRAY NOZZLE
- PUMP
- WATER LINE
- DELUGE VALVE

NOTES: 1. THE HYDRANT POINTS FOR TRANSFORMER/ REACTOR SHALL BE LOCATED AT LEAST 20M AWAY FROM THEM.

2. AS SAFETY MEASURE, A WARNING PLATE SHALL BE PLACED NEAR HYDRANT POINTS FOR TRANSFORMER/ REACTOR TO CLEARLY INDICATE THAT WATER SHALL BE SPRAYED ONLY AFTER ENSURING THAT THE POWER TO THE TRANSFORMER/ REACTOR WHICH IS ON FIRE IS SWITCHED OFF AND THERE ARE NO LIVE PART WITHIN 20 M. DISTANCE OF THE PERSONNEL USING THE HYDRANT.

FOR TENDER PURPOSE ONLY

APPD.					
RECOMMENDED	DATE	DRAWN	CHKD.	APPD.	
	22.11.2001	A.J.XAVIER	A.J.XAVIER		

TITLE: PIPING & INSTRUMENTATION DIAGRAM FOR HYDRANT & HVW SPRAY SYSTEM.

NTS | DRG.NO. C/ENGG/STD/FP/1 Sheet 1 of 1 | REV. 4

TECHNICAL SPECIFICATION

VOL-II, SEC-XII

POWER & CONTROL CABLE

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SECTION XII
POWER & CONTROL CABLES

1. POWER & CONTROL CABLES [FOR WORKING VOLTAGES UP TO AND INCLUDING 1100 V]

CRITERIA FOR SELECTION OF POWER & CONTROL CABLES

1.1.1. Aluminium conductor XLPE insulated armoured cables shall be used for main power supply purpose from LT Aux. Transformers to control room, between distribution boards and for supply for colony lighting from control room.

1.1.2 Aluminium conductor PVC insulated armoured 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 armoured control cables of minimum 2.5 sq. mm. size with stranded Copper conductors shall be used.

1.1.4 Employer has standardised the sizes of power cables for various feeders. 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:

S. No.	From	To	Cable size	Cable type
1.	Main Switch Board	LT Transformer	2-1C X 630 mm^2 per phase 1-1C X 630 mm^2 for neutral	XLPE
2.	Main Switch Board	AC Distribution Board	2-3½C X 300 mm^2	XLPE
3.	Main Switch Board	Oil Filtration Unit	1-3½C X 300 mm^2	XLPE
4.	Main Switch Board	Colony Lighting	1-3½C X 300 mm^2	XLPE
5.	Main Switch Board	HVW pump LCP	1-3½C X 300 mm^2	XLPE
6.	Main Switch Board	Main Lighting distribution board (Through lighting	2-3½C X 300 mm^2	XLPE

		transformer)		
7.	AC Distribution Board	D.G. Set AMF Panel	2-3½C X 300 mm^2	XLPE
8.	AC Distribution Board	Emergency Lighting distribution board	1-3½C X 70 mm^2	PVC
9.	AC Distribution Board	ICT MB	1-3½C X 70 mm^2	PVC
10.	AC Distribution Board	Bay MB	1-3½C X 70 mm^2	PVC
11.	Bay MB	AC Kiosk	1- 3 ½ x 70 mm^2	PVC
12.	AC Distribution Board	Battery Charger	1-3½C X 70 mm^2	PVC
13.	DCDB	Battery	2-1C X 150 mm^2	PVC
14.	DCDB	Battery Charger	2-1C X 150 mm^2	PVC
15.	DCDB	Protection/PLCC panel	1-4C X 16 mm^2	PVC
16.	Main Lighting DB	Lighting panels(Indoor)	1-3½C X 35 mm^2	PVC
17.	Main Lighting DB	Lighting panels (outdoor)	1-3½C X 70 mm^2	PVC
18.	Main Lighting DB	Receptacles (Indoor)	1-3½C X 35 mm^2	PVC
19.	Main Lighting DB	Receptacles (Outdoor)	1-3½C X 70 mm^2	PVC
20.	Lighting Panel	Sub lighting panels	1-4C X 16 mm^2	PVC
21.	Lighting Panel	Street Lighting Poles	1-4C X 16 mm^2	PVC
22.	Lighting Panel/ Sub lighting panels	Lighting Fixtures (Outdoor)	1-2C X 6 mm^2	PVC
23.	Bay MB	Equipment's	1-4C X 16 mm^2 /1-4C X 6 mm^2 /1-2C X 6 mm^2	PVC

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 Employer's approval**.

1.1.6 Cables shall be laid as per relevant IEC/International Standards.

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 At least 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.

1.1.11 Technical data requirement sheets for cable sizes are being enclosed at Annex-I.

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 current of at least 45 kA for at least 0.12 second, with an initial peak of 105 kA in one of the phases at rated conductor temperature (70 degC for PVC insulated cables and 90 degC for XLPE insulated cables). 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 for conductors shall be of H2 grade. In case of single core cables armours shall be of H4 grade Aluminium.

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 metres at every one metre shall be provided on the outer sheath of all cables.

1.2.1.7. Strip wire armouring method 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) / IEC: 60502 (Part-I)

1.2.1.10. The normal current rating of all PVC insulated cables shall be as per IS: 3961 / IEC: 60502.

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 2 mm.

1.2.2. XLPE Power Cables

1.2.2.1. The XLPE insulated cables shall be of FR type, C1 category conforming to IS: 7098 (Part-I) / IEC: 60502 (Part-I) and its amendments read along with 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 / IEC: 60502. 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 / IEC: 60502 for all XLPE cables.

1.2.3. PVC Power Cables

1.2.3.1. The PVC (70°C) insulated power cables shall be of FR type, C1 category, conforming to IS: 1554 (Part – I) / IEC: 60502 (Part-I) and its amendments read along with 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-A of IS: 5831 / IEC: 60502. 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-1 of IS: 5831 / IEC: 60502 for all cables.

1.2.4. PVC Control Cables

1.2.4.1. The PVC ***(70°C) insulated*** control cables shall be of FR type C1 category conforming to IS: 1554 (Part – I) / IEC: 60502 (Part-1) and its amendments, read along with this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS: 5831 / IEC: 60502. A distinct inner sheath shall be provided in all cables whether armoured or not. The over sheath shall be extruded PVC to type ST-1 of IEC: 60502 and shall be grey in colour.

1.2.4.2. Cores shall be identified as per IS: 1554 (Part – I) / IEC: 60502 (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 IS: 1554 (Part – I) / IEC: 60502 (Part-1).

2. HV POWER CABLES [FOR WORKING VOLTAGES FROM 3.3 kV AND INCLUDING 33 kV]

2.1.1. *HV* POWER CABLE FOR AUXILIARY POWER SUPPLY

The HV cable of 1Cx185 mm^2 (Aluminium Conductor) or 1Cx120mm^2 (Copper Conductor) of voltage class as specified for 315 kVA LT transformer for interconnecting 315kVA LT transformer to the PDD/SEB feeder shall be, XLPE insulated, armoured cable conforming to IS: 7098 (Part-II) / IEC: 60502 (Part-2). Terminating accessories shall conform to IS: 17573 / IEC 61442-1997/IEC60502-4 1998.

2.1.2. Bidder may offer sizes other than the sizes specified in clause 2.1. 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 Employer's approval.

2.2. **Constructional Requirements**

Cable shall have compacted circular Aluminum conductor, Conductor screened with extruded semi conducting compound, XLPE insulated, insulation screened with extruded semi conducting compound, armored with non-magnetic material, followed by extruded PVC outer sheath (Type ST-2), with FR properties.

2.4 Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of the cable.

2.5 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.

2.6 Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.

3 CABLE DRUMS

3.1 Cables shall be supplied in 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. Maximum, One (1) number non-standard lengths of cable size(s) may be supplied in drums for completion of project.

3.3 A layer of water proof 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 drum shall carry the manufacturer's name, the Employer'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 TYPE TESTS

4.1 All cables shall conform to all type, routine and acceptance tests listed in the relevant IS / IEC.

4.2 XLPE INSULATED POWER CABLES (For working voltages up to and including 1100V):-

4.2.1 Following type tests (on one size in a contract) as per IS: 7098 (Part I) / IEC: 60502 (Part 1) including its amendments shall be carried out as a part of acceptance tests on XLPE insulated power cables for working voltages up to and including 1100 V:

a) Physical tests for insulation
   i) Hot set test
   ii) Shrinkage test
b) Physical tests for outer sheath
   i) Shrinkage test
   ii) Hot deformation
   iii) Heat shock test
   iv) Thermal stability

4.2.2 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section- GTR for the following tests-

a) Water absorption (gravimetric) test.
b) Ageing in air oven
c) Loss of mass in air oven
d) Short time current test on power cables of sizes 240 sqmm and above on
   i) Conductors.
   ii) Armours.
e) Test for armouring wires/strips.
f) Oxygen and Temperature Index test.
g) Flammability test.

4.3 PVC INSULATED POWER & CONTROL CABLES (For working voltages up to and including 1100V)-

4.3.1 Following type tests (on one size in a contract) as per IS: 1554 (Part I) / IEC: 60502 (Part 1) including its amendments shall be carried out as a part of acceptance tests

on PVC insulated power & control cables for working voltages up to and including 1100 V:

a) Physical tests for insulation and outer sheath
   i) Shrinkage test
   ii) Hot deformation
   iii) Heat shock test
   iv) Thermal stability

b) High voltage test.

4.3.2 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section- GTR for the following-

a) High voltage test.
b) Ageing in air oven.
c) Loss of mass in air oven.
d) Short time current test on power cables of sizes 240 sqmm and above on
   i) Conductors.
   ii) Armours.
e) Test for armouring wires/strips.
f) Oxygen and Temperature Index test.
g) Flammability test.

4.4 XLPE INSULATED HV POWER CABLES (For working voltages from 3.3 kV and including 33 kV)-

4.5

4.4.1 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, section- GTR for XLPE insulated HV power cables IS: 7098 (Part II) / (as per IEC: 60502 Part-2).

4.5 Terminating/jointing accessories as per IEC 60840:1999/ IEC62067

TECHNICAL SPECIFICATION
VOL-II, SEC-XIII
AIR CONDITIONING SYSTEM

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SECTION-XIII

TECHNICAL SPECIFICATION FOR

AIR CONDITIONING SYSTEM

1 GENERAL

1.1 This specification covers supply, installation, testing and commissioning and handing over to RECTPCL/PDD, J&K of Air conditioning system for the control room building and relay panel rooms.

1.2 Air conditioning units for control room building shall be set to maintain the inside DBT at 24 ° C ± 2°C and the air conditioning system for relay panel rooms shall be set to maintain DBT inside relay panel rooms below 24°C.

1.3 Controllers shall be provided in Control room and Battery room for controlling and monitoring the AC units in these rooms.

1.4 Each relay panel room shall be provided with temperature transducer to monitor the temperature of the panel room. The Temperature transducer shall have the following specification:

Sensor	:	Air temperature sensor (indoor use)
Output	:	4 to 20mA
Temperature range	:	-5°C to 60°C
Resolution	:	0.1°C
Accuracy	:	0.5°C or better.

1.5 **Keeping in view of temperature variation of -15 degC to 40 Deg C in Lassoer, J&K, provision of heating as well as cooling arrangement is to be made in the air conditioning system.**

2 AIR CONDITIONING SYSTEM FOR CONTROL ROOM BUILDING.

2.1 Air conditioning requirement of control room building shall be met using a combination of following types Air Conditioning units as required.

a) Duct able Split unit of 8.5TR.
b) Cassette type split AC units of 3TR.
c) High wall types split AC units of 2TR.

2.2 **Scope**

The scope of the equipment to be furnished and services to be provided under the contract are outlined hereinafter and the same is to be read in conjunction with the provision contained in other sections/ clauses. The scope of the work under the contract shall be deemed to include all such items, which although are not specifically mentioned in the bid documents and/or in Bidder's proposal, but are required to make the equipment/system complete for its safe, efficient, reliable and trouble-free operation.

2.2.1 Required number of Duct able split type AC units of 8.5 TR capacity with air cooled outdoor condensing unit with semi hermetic/hermetic compressors including refrigerant pipes, controls, thermostats, filters, outlet dampers, etc.

2.2.2 Required number of Cassette type split AC units of 3TR capacity each complete with air cooled outdoor condensing unit having hermetically sealed compressor unit with cordless remote controller.

2.2.3 Required number of High wall type split AC units of 2TR capacity each complete with air cooled outdoor condensing unit having hermetically sealed compressor and high wall type indoor evaporator unit with cordless remote controller.

2.2.4 Copper refrigerant piping complete with insulation between the indoor and outdoor units as required.

2.2.5 First charge of refrigerant and oil shall be supplied with the unit.

2.2.6 GSS/Aluminium sheet air distribution ducting for distributing conditioned dehumidified air along with supply air diffusers and return air grilles with volume control dampers and necessary splitters etc., suitable fixtures for grilles/diffusers and supports for ducting complete with insulation.

2.2.7 Local start/stop facility for local starting/ stopping of all electrical equipment/ drives.

2.2.8 All instruments and local control panels along with controls and interlock arrangements and accessories as required for safe and trouble free operation of the units.

2.2.9 PVC drain piping from the indoor units up to the nearest drain point.

2.2.10 Supply and erection of Power and control cable and earthing.

2.2.11 MS Brackets for outdoor condensing units, condensers as required.

2.3 **Technical specifications.**

2.3.1 **Duct able split type AC units.**

2.3.1.1 Each Split Air conditioner shall have an indoor unit and an outdoor unit, designed to provide free delivery of conditioned air to the conditioned space. The indoor unit shall be suitable for mounting on the ceiling concealed above the false ceiling. Outdoor unit can be placed on the roof. Each unit shall include a primary source of refrigeration for cooling and dehumidification, means for circulation and cleaning air.

2.3.1.2 Cabinet

The cabinets housing the components of indoor units & outdoor units shall be of heavy gauge sheet steel and suitable for floor mounting/mounting from ceiling. The access panels shall be of easily removable type. The entire casing shall be lined with 25mm thick insulation of totally flame proof type. Suitable drain connection shall be provided for removal of condensate collected inside a tray under cooling coil.

2.3.1.3 Compressor

The compressor shall be Semi hermetically/hermetically sealed type and complete with drive motor. The compressor shall be mounted on spring inside the lower most section of the unit so that it is easily accessible for servicing.

2.3.1.4 Condenser

Air cooled condenser of adequate surface area shall be offered. The air-cooled condenser shall be made of copper tubes with external fins.

2.3.1.5 Air Handling Fan

The air handling fan shall be centrifugal type complete with belt drive and electric motor.

2.3.1.6 Filter

Pre-filter at the suctions to remove dust particles down to 10-micron size with 90% efficiency and fine filters to remove dust particles down to 5 micron size with 99% efficiency at the outlet. All filters shall be of panel type.

2.3.1.7 Cooling Coil

Cooling coils shall be of direct expansion type and made of heavy gauge copper with aluminium fins. Rows shall be staggered in the direction of air flow. Separate tubing's from the distributor shall feed refrigerant uniformly to different sections of the coil.

2.3.1.8 Refrigerant Piping

Refrigerant piping shall be of heavy gauge copper, heavy class seamless M.S. pipe complete with thermostatic expansion valve, liquid strainer, dehydrator, liquid line shut off valve, high and low-pressure gauges.

2.3.1.9 Condensate Trays

An adequate method of condensate removal shall be provided. Condensate tray of adequate size, made of corrosion-resistant material or suitably treated with corrosion-resistant coating shall be provided. The tray shall be adequately insulated to avoid condensation over its external surface.

2.3.1.10 Refrigerant Strainer

A refrigerant strainer shall be provided in the liquid line immediately before the expansion device.

2.3.1.11 Vibration Isolator

A minimum of six 25 thick neoprene rubber pads shall be supplied for each unit.

2.3.1.12 Cooling capacity of 8.5TR unit shall not be less than 102000 btu/hr.

2.3.2 **Cassette type split AC units**.

The Cassette type AC units shall be complete with indoor evaporator unit, outdoor condensing units and cordless remote-control units.

2.3.2.1 Outdoor unit shall comprise of hermetically/ semi hermetically sealed compressors mounted on vibration isolators, 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 weather-proof type. They shall be compact in size and shall have horizontal discharge of air.

2.3.2.2 Indoor units shall be of 4-way, ceiling mounted cassette type. The indoor unit shall be compact and shall have elegant appearance. They shall have low noise centrifugal blowers driven by suitable motors and copper tube aluminium finned cooling coils. Removable and washable polypropylene filters shall be provided. They shall be complete with multi-function cordless remote-control unit with special features like programmable timer, sleep mode etc.

2.3.2.3 Cooling capacity of 3TR AC units shall not be less than 36000btu/hr. and their EER shall not be less than 2.7.

2.3.3 **High wall types split AC units**

2.3.3.1 The split AC units shall be complete with indoor evaporator unit, outdoor condensing units and cordless remote-control units.

2.3.3.2 Outdoor unit shall comprise of hermetically/semi hermetically sealed 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 weather-proof type. They shall be compact in size and shall have horizontal discharge of air.

2.3.3.3 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 suitable motors and copper tube aluminium finned cooling coils. Removable and washable polypropylene filters shall be provided. They shall be complete with multi-function cordless remote-control unit with special features like programmable timer, sleep mode and soft dry mode etc.

2.3.3.4 Cooling capacity of 2TR AC units shall not be less than 22000btu/hr. and shall have energy efficiency rating of 3star or above. **Heating capacity requirement and its arrangement is to be designed and finalised during detailed Engineering.**

2.3.4 Controllers shall be provided in Control room and Battery room, one controller for each room, to control and monitoring of AC units and shall have the following facilities;

- Standby units shall come in to operation automatically when the running

main unit fails

- Main and standby units shall be changed over periodically which shall be finalised during detailed engineering.
- Following alarms shall be provided:

a. Compressor On/OFF condition of each unit
b. Compressor failure of each unit
c. Power OFF to AC unit
d. High temperature in room.

2.4 Warranty

All compressors shall have minimum 5 years Warranty from the date of commissioning.

TECHNICAL SPECIFICATION

VOL-II, SEC-XIV

DIESEL GENERATOR SET

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SECTION XIV
DIESEL GENERATOR SET

1.1. **SCOPE OF SUPPLY**

1.1.1. The scope covers supply of Diesel Generator set of stationary type having a net electrical output of 250kVA/**100kVA**(as applicable) capacity at specified site conditions of 40° 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, Fondation blots etc.
(vi) Day tank of 990 Litre Capacity.
(vii) Engine Cooling and lubrication system.
(viii) Engine air filtering system.
(ix) Exhaust silencer package.
(x) Set of GI pipes, valves, strainers, unloading hose pipes as required for fuel transfer system from storage area to fuel tank including electrically driven fuel pump.
(xi) All lubricants, consumable, touch up paints etc. for first filing, testing & commissioning at site. The fuel oil for first commissioning will also be provided by the contractor.
(xii) AMF panel for control, metering and alarm.
(xiii) Enclosure for silent type D.G. Set

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 equipment's / materials required for the purpose.
d) Drawings, data, design calculations and printed erection, operation & maintenance manual.
e) Certification and compliance for meeting noise level & emission parameters and other requirements in accordance with latest Notification of MOEF.

1.3. **TECHNICAL REQUIREMENTS**

1.3.1. The rating of DG sets are as follows:

DG set net output after considering deration for engine and alternator separately due to altitude of 1700M above MSL, temperature rise in side the enclosure and on account of power reduction due to auxiliaries shall be 250kVA/**100kVA (as applicable), 1500RPM, 0.8Pf, 400V, 3 phases, 50Hz. The above ratings are the minimum requirements.**

1.3.1.1. DG sets shall also be rated for 110% of full load for 1 hour in every twelve hrs. of continuous running.

1.3.2. The output voltage, frequency and limits of variation from open circuit to full load shall be as follows:

a) Voltage variation ±10% of the set value provision shall exist to adjust the set value between 90% to 110% of nominal Generator voltage of 400V.

b) Frequency 50Hz +2.5%

1.3.3. The Diesel Generator and other auxiliary motor shall be of H class with temperature rise limited to Class-F for temperature rise consideration.

1.3.4. NOISE LEVEL & EMISSION PARAMETERS: These shall be as per latest Notification of MOEF

1.4. **PLANT DESIGN**

1.4.1. **DIESEL ENGINE**

1.4.1.1. The engine shall comply with the IS: 10002/BS 5514/ISO 3046; latest edition

1.4.1.2. Diesel engine shall be turbo charged multi-cylinder V-type in line type with mechanical fuel injection system.

1.4.1.3. The engine with all accessories shall be enclosed in an enclosure to make it work silently (within permissible noise level) without any degradation in its performance.

1.4.1.4. The Diesel Engines shall be directly water cooled. Cooling of water through radiator and fan as envisaged.

1.4.1.5. The fuel used shall be High Speed Diesel oil (HSD) or Light Diesel Oil (LDO).

1.4.2. **AIR SUCTION & FILTRATION**

1.4.2.1. Suction of air shall be from indoor for ventilation and exhaust flue gasses will be let out to outside atmosphere, Condensate traps shall be provided on the exhaust pipe.

1.4.2.2. Filter shall be dry type air filter with replaceable elements.

1.4.3. **FUEL AND LUBRICATING OIL SYSTEM**

1.4.3.1. 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.

1.4.4. **ENGINE STARTING SYSTEM**

1.4.4.1. Automatic electric starting by DC starter motor shall be provided.

1.4.5. **FUEL INJECTION AND REGULATOR**

1.4.5.1. The engine shall be fitted with electronic governor.

1.4.5.2. The engine shall be fitted with a heavy, dynamically balanced fly wheel suitable for constant speed governor duty.

1.4.6. **ALTERNATOR**

1.4.6.1. The alternator shall comply with IS: 4722/IEC 60034; latest edition.

1.4.6.2. The alternator shall be of continuously rated duty, suitable for 400 V, 3 Phase, 50 Hz. Power development having brush-less, synchronous, self-excited, self-regulating system.

1.4.6.3. The alternator shall be drip-proof, screen protected as per IP-23 degree of Protection.

1.4.6.4. The rotor shall be dynamically balanced to minimize vibration.

1.4.6.5. The alternator shall be fitted with shaft mounted centrifugal fan.

1.4.6.6. It shall have the winding of class H but limited to Class-F for temperature rise consideration.

1.4.6.7. The Alternator regulator shall be directly coupled to the engine and shall be complete with the excitation system, automatic voltage regulation of +/- 1%, voltage adjusting potentiometer and under/over speed protection.

1.4.6.8. **TERMINAL BOX**

1.4.6.8.1. Six (6) output terminals shall be provided in alternator terminal box. Terminals shall be Suitable for 1 No. of single core, 630 mm^2 XLPE cables per phase for 250kVA DG set and 3½Core 300 mm^2 XLPE cable for 100kVA DG set. 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.

1.4.6.9. The alternator with all accessories shall be enclosed in a enclosure to make it work Silently (within permissible noise level)

1.4.7. **COUPLING**

1.4.7.1. The engine and alternator shall be directly coupled by means of self-aligning flexible flange coupling to avoid misalignment.

1.4.7.2. The coupling shall be provided with a protecting guard to avoid accidental contract.

1.4.8. **MOUNTING ARRANGEMENT**

1.4.8.1. The engine and alternator shall be mounted on a common heavy duty, rigid fabricated steel base frame constructed from ISMC of suitable sections.

1.4.8.2. Adequate number of anti-vibration mounting pads shall be fixed on the common base frame on which the engine and the alternator shall be mounted to isolate the vibration from passing on to the common base frame or the foundation of the D.G. Set.

1.4.9. **PERIPHERALS**

1.4.9.1. **FUEL TANK**

1.4.9.1.1. The Fuel tank of 990 Litre capacity shall be provided on a suitably 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.** Fuel tank shall be kept outside of enclosure. The fuel piping shall be carried out to connect the D.G set kept inside.

1.4.9.1.2. For transferring fuel to Fuel tank transfer pump is envisaged. The capacity of transfer pump shall be adequate to fill the day tank in about 30 minutes. Fuel pump shall be electrically driven.

1.4.9.2. **BATTERY and BATTERY CHARGER**

1.4.9.2.1. Two nos. 24V batteries complete with all leads, terminals and stand shall be provided. Each battery shall have sufficient capacity to give 10 nos. successive starting impulse to the diesel engine.

1.4.9.2.2. The battery charger shall be complete with transformer, suitable rating (400 V, 3 Ph., 50 Hz. /230V, 1Ph., 50 Hz) rectifier circuit, charge rate selector switch for "trickle"/'boost' charge, D.C. ammeter & voltmeter, annunciation panel for battery charge indication / loading / failures.

1.4.9.2.3. The charger shall float and Boost Charge the battery as per recommendation of manufacturer of battery. The charger shall be able to charge a fully discharged battery to a state of full charge in 8 Hrs. with 25% spare capacity.

1.4.9.2.4. Manual control for coarse and fine voltage variation shall be provided. Float charger shall have built-in load limiting features.

1.4.9.2.5. Ripple shall not be more than 1% (r.m.s) to get smooth DC voltage shall be provided.

1.4.9.2.6. Charger shall be provided with Out-put Voltmeter & Ammeter.

1.4.9.2.7. Changeover scheme for selecting battery and battery charger by changeover switch should be provided.

1.5. **CONTROL AND INSTRUMENTATION**

1.5.1. Each D.G. Set 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 along with 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/IEC: 60529.

1.5.2. 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.

1.5.3. Testing facility for automatic operation of D.G. Set shall be provided in AMF panel.

1.5.4. 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.

1.5.5. Following instruments shall be provided with Diesel Engine

a) Lub. oil pressure gauge
b) Water temperature thermometers
c) Engine tachometer/HR
d) Any other instruments necessary for DG Set operation shall be provided.

1.5.6. 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 400V ACDB). However, interlock shall be provided to prevent shutting down operation as long as D.G. Circuit breaker is closed.

1.5.7. 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 and cooling water~~.~~
d) High temperature inside enclosure
e) Low lube oil pressure
f) Generator differential protection
g) Short circuit protection
h) Under voltage
i) Over voltage
j) Further interlocking of breaker shall be provided to prevent parallel operation of DG set with normal station supply.

Following indication lamps for purposes mentioned as under shall be provided in AMF panel:

1.5.7.1. 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

1.5.7.2. 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 secs after receiving the first start impulse
e) high cooling water temperature
f) Low level in daily service fuel tank
g) Overspeed trip
h) Audio & visual Annunciation for alternator fault.

1.5.8. 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.

1.5.9. 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 switchgear. manufacturer) single phase CT's with KPV 300V & RCT 0.25 ohm for differential protection of DG Set on neutral side only for

d) 250kVA/100kVA

e) .One (1) DC Ammeter (0-40A)

f) One (1) DC Voltmeter (0-30V)

g) One (1) Voltmeter Selector switch

h) One (1)AC Ammeter

i) One (1)AC Voltmeter

j) Three (3) Timers (24V DC)

k) Two (2) Auto/Manual Selector Switch

l) Two (2) Auto/test/Manual Selector Switch

m) Eleven (11) Aux. Contactors suitable for 24V DC

n) One (1)Motorised potentiometer for voltage adjustment

o) Two (2) Set Battery charger as specified in Technical Specification

p) One (1)Set Phase & Neutral busbars.

q) Any other item required for completion of Control scheme shall be deemed to be included.

1.6. **D.G. SET ENCLOSURE**

1.6.1. **General requirements**

1.6.1.1. Diesel engine, alternator, AMF panel, Batteries and Chargers shall be installed outdoor in a suitable weather-proof enclosure which shall be provided for protection from rain, sun, dust etc. Further, in addition to the weather proofing, acoustic enclosures shall also be provided such that the noise level of acoustic enclosure DG set shall meet the requirement of MOEF the diesel generator sets should also conform to Nepal Environment (Protection) Rules. An exhaust fan with louvers shall be installed in the enclosure for temperature control inside the enclosure. The enclosure shall allow sufficient ventilation to the enclosed D.G. Set so that the body temperature is limit to 50°C. The air flow of the exhaust fan shall be from inside to

the outside the shelter. The exhaust fan shall be powered from the DG set supply output so that it starts with the starting of the DG set and stops with the stopping of the DG set. The enclosure shall have suitable viewing glass to view the local parameters on the engine.

1.6.1.2. Fresh air intake for the Engine shall be available abundantly; without making the Engine to gasp for air intake. A chicken mess shall be provided for air inlet at suitable location in enclosure which shall be finalised during detailed engineering.

1.6.1.3. The Enclosure shall be designed and the layout of the equipment inside it shall be such that there is easy access to all the serviceable parts.

1.6.1.4. Engine and Alternator used inside the Enclosure shall carry their manufacturer's Warranty for their respective Models and this shall not degrade their performance.

1.6.1.5. Exhaust from the Engine shall be let off through Silencer arrangement to keep the noise level within desired limits. Interconnection between silencer and engine should be through stainless steel flexible hose/ pipe.

1.6.2. All the Controls for Operation of the D.G. Set shall be easily assessable. There should be provision for emergency shut down from outside the enclosure.

1.6.3. Arrangement shall be made for housing the Battery set in a tray inside the Enclosure.

1.6.4. **CONSTRUCTION FEATURES:**

1.6.4.1. The enclosure shall be fabricated from at least 14 Gauge CRCA sheet steel and of Modular construction for easy assembling and dismantling. The sheet metal components shall be pre-treated by Seven Tank Process and Powder coated (PURO Polyester based) both-inside and outside – for long life. The hard-ware and accessories shall be high tensile grade. Enclosure shall be given a lasting anti-rust treatment and finished with pleasant environment friendly paint. All the hardware and fixtures shall be rust proof and able to withstand the weather conditions.

1.6.4.2. Doors shall be large sized for easy access and provided with long lasting gasket to make the enclosure sound proof. All the door handles shall be lockable type.

1.6.4.3. The Enclosure shall be provided with anti-vibration pads (suitable for the loads and vibration they are required to carry) with minimum vibration transmitted to the surface the set is resting on.

1.6.4.4. High quality rock wool of required density and thickness shall be used with fire retardant thermo – setting resin to make the Enclosure sound proof.

1.6.5. Provision for Neutral/Body Earthing

1.6.5.1. Points shall be available at two side of the enclosure with the help of flexible copper wires from alternator neutral, and electrical panel body respectively. The earthing point shall be isolated through insulator mounted on enclosure.

1.7. **INSTALLATION ARRANGEMENT**

1.7.1. DG set enclosed in enclosure shall be installed on Concrete Pedestal 300mm above FGL.

1.8. **DOCUMENTS**

1.8.1. Following drawings and data sheet shall be submitted for approval:
(i) Data sheet for Engine, Alternator, Battery, AMF panel and Enclosure
(ii) GA drawing of DG set
(iii) Layout of DG set in the enclosure along with sections
(iv) GA and schematic of AMF panel
(v) Arrangement of inclined roof and pedestal.

1.8.2. The D G Set shall be supplied with
(i) D G Set test certificate
(ii) Engine Operation & maintenance Manual.
(iii) Engine Parts Catalogue.
(iv) Alternator Operation, maintenance & Spare parts Manual.
(v) Alternator test certificate.

1.9. **TESTS**

a) The Diesel generator sets shall be tested for routine and acceptance tests as per the relevant IEC standards.

1.10. **COMMISSIONING CHECKS**

In addition to the checks and test recommended by the manufacturer, the Contractor shall carryout the following commissioning tests to be carried out at site.

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:

a) Ambient temperature.
b) Exhaust temperature if exhaust thermometer is fitted.
c) Cooling water temperature at a convenient point adjacent to the water output from the engine jacket.
d) Lubricating oil temperature where oil cooler fitted.
e) Lubricating oil pressure.
f) Colour of exhaust gas
g) Speed
h) Voltage, wattage and current output.
i) Oil tank level

The necessary load to carry out the test shall be provided by the purchaser.

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 x (rated voltage in KV) +1

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.

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.

5. Functional Tests

   a) Functional tests on control panel.
   b) Functional test on starting provision on the engine.
   c) Functional tests on all Field devices.
   d) Functional tests on AVR and speed governor.

6. Measurement of Vibration

   The vibration shall be measured at load as close to maximum achievable load and shall not exceed 250microns.

7. Noise Level shall be less than 75dBA at a distance of one meter.

8. 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 applicable IEC/International Standards.

TECHNICAL SPECIFICATION

VOL-II, SEC-XV

SWITCHYARD ERECTION

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ANNEXURE-A SHORT CIRCUIT FORCES AND SPACER SPAN FOR 220KV GANTRY STRUCTURE

ANNEXURE-B STANDARD TECHNICAL DATASHEET FOR AAC/ACSR CONDUCTORS, GS EARTHWIRE AND ALUMINIUM TUBE

ANNEXURE-C CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

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 items.

A. Supply of

- String insulators and hardware
- AAC / 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 Insulators & Hardware**

The insulators for suspension and tension strings shall conform to IEC-60383 and long rod insulators shall conform to IEC-60433. Insulator hardware shall conform to IS: 2486 or equivalent international standard. Composite long rod insulator shall conform to IEC: 61109.

1.1.1 **Construction Features**

1.1.1.1 **For porcelain insulators**

a) 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.

b) 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.

c) Glazing of the porcelain shall be uniform brown colour, free from blisters, burrs and other similar defects.

1.1.1.2 **For glass insulators**

It shall be made of toughened glass. Glass used for the shells shall be sound, free from defects, flows bubbles, inclusions, etc. and be of uniform toughness over its entire surface. All exposed glass surfaces shall be smooth.

1.1.1.3 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.

1.1.1.4 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. All ferrous parts shall be hot dip galvanized. The zinc used for galvanizing shall be of grade Zn-99.95. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains bulky white deposits and blisters.

1.1.1.5 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.

1.1.1.6 Clamps for insulator strings and Corona Control rings shall be of aluminum alloy as stipulated for clamps and connectors.

1.1.1.7 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.

1.1.1.8 The tension Insulator hardware assembly shall be designed for minimum 12000 kg tensile load. Earth wire tension clamp shall be designed for minimum 1000 kg tensile load with a factor of safety of two (2).

1.1.1.9 The tension string assemblies shall be supplied along with suitable turn buckle. Sag compensation springs if required may also be provided.

1.1.1.10 All hardware shall be bolted type.

1.2 Long Rod Porcelain Insulators

1.2.1 As an alternative to disc insulator, Bidder can offer long rod porcelain insulators strings, with suitable hardware. The combination should be suitable for application

specified and should offer the identical/equivalent parameters as would be available from insulator string comprising disc insulators and hardware combination.

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 following type tests, acceptance tests and routine tests:

1.3.1 **Type Tests on Insulator Strings:** The test reports for following type tests shall be submitted for approval as per clause 9.0 of Section - GTR.

a) Power frequency voltage withstand test with corona control rings under wet condition as per IEC- 60383.

b) Lightning Impulse voltage withstand test with corona control rings under dry condition as per IEC-60383

c) Voltage distribution test (Dry)

The voltage across each insulator unit shall be measured by sphere gap method. The result obtained shall be converted into percentage. The voltage across any disc shall not exceed 13% for 220KV suspension and tension insulator strings, 20% and 22% for 132KV suspension and tension insulator strings respectively.

e) Corona Extinction Voltage test (Dry) :- (As per Annexure – C)

The sample assembly when subjected to power frequency voltage shall have a corona extinction voltage of not less than 156kV (rms) for 220kV line to earth under dry condition. There shall be no evidence of Corona on any part of the sample. The atmospheric condition during testing shall be recorded and the test results shall be accordingly corrected with suitable correction factor as stipulated in IEC 60383.

f) RIV Test (Dry)

Under the conditions as specified under (e) above the insulator string along with complete hardware fittings shall have a radio interference voltage level below 1000 microvolts at 1 MHz when subjected to 50 Hz AC line to earth voltage of 156kV for 220kV string under dry conditions. The test procedure shall be in accordance with IEC 60437.

g) Mechanical strength test

The complete insulator string along with its hardware fitting excluding arcing horn, corona control ring, grading ring, tension/suspension clamps shall be subjected to a load equal to 50% of the specified minimum ultimate

tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to dismantle them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

1.3.2 **Type Tests on Insulators**

Type test report for Thermal Mechanical Performance tests as per IEC - 60575, Clause 3 / IEC: 61109, clause 5.1 (for composite long rod insulators) shall be submitted for approval as per clause 9.2 of Section - GTR.

1.3.3 **Acceptance Tests for Insulators:**

a) Visual examination as per IEC-60383/ IEC-61109 clause no. 7.2 (for composite long rod insulators).

b) Verification of Dimensions as per IEC- 60383.

c) Temperature cycle test as per IEC- 60383.

d) Puncture Test as per IEC-60383 (Applicable only for porcelain insulators).

e) Galvanizing Test as per IEC- 60383.

f) Mechanical performance test as per IEC-60575 Cl. 4 / IEC-61109 clause no. 7.2 (for composite long rod insulators).

g) Test on locking device for ball and socket coupling as per IEC-60372(2).

h) Porosity test as per IEC- 60383 (Applicable only for porcelain insulators).

i) Thermal shock test as per IEC-60383 (Applicable only for glass insulators)

1.3.4 **Acceptance Test on Hardware Fitting**

a) Visual Examination as per Cl. 5.10 of IS: 2486 (Part-I).

b) Verification of Dimensions as per Cl. 5.8 of IS: 2486 (Part-I)

c) Galvanizing / Electroplating tests as per Cl. 5.9 of IS: 2486 (Part-I).

d) Slip strength test as per Cl 5.4 of IS- 2486 (part-I)

e) Shore hardness test for the Electrometer (if applicable as per the value guaranteed by the Bidder).

f) Mechanical strength test for each component (including corona control rings

and arcing horns).

The load shall be so applied that the component is stressed in the same way as it would be in actual service and the procedure as given in 1.3.1 (g) above should be followed.

g) Test on locking devices for ball and socket coupling as per IEC -60372(2).

1.3.5 **Routine Test on Insulator**

a) Visual Inspection as per IEC-60383

b) Mechanical Routine Test as per IEC-60383

c) Electrical Routine Test as per IEC-60383

1.3.6 **Routine Test on hardware Fittings**

a) Visual examination as per clause 5.10 of IS: 2486 (Part-I) / IEC-61109 (for composite long rod insulators).

b) Mechanical strength Test as per clause 5.11 of IS: 2486 (Part-I) / IEC-61109 (for composite long rod insulators).

1.3.7 **Test during manufacture on all Components as applicable on insulator**

a) Chemical analysis of zinc used for galvanizing:

Samples taken from the zinc ingot shall be chemically analyzed. The purity of zinc shall not be less than 99.95%.

b) Chemical Analysis, mechanical hardness tests and magnetic particle inspection for malleable casting:

The chemical analysis, hardness tests and magnetic particle inspection for malleable casting will be as per the internationally recognized procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding tests will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Program.

1.3.8 Test during manufacture on all components as applicable on hardware fittings:

a) Chemical analysis of zinc used for galvanizing:

Samples taken from the zinc ingot shall be chemically analyzed. The purity of zinc shall not be less than 99.95%

b) Chemical analysis, hardness tests and magnetic particle for forgings:

The chemical analysis, hardness tests and magnetic particle inspection for

forgings will be as per the internationally recognized procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding tests will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Program me.

c) Chemical analysis and mechanical hardness tests and magnetic particle inspection for fabricated hardware:

The chemical analysis, hardness tests and magnetic particle inspection for fabricated hardware will be as per the internationally recognized procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding tests will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance program me.

1.4 Parameters

1.4.1 Disc Insulators

Sl. No.	Description	For 220/132kV
a)	Type of insulators	Anti-Fog type
b)	Size of insulator units (mm)	255x145 or 280x145
c)	Electro mechanical strength	120 kN
d)	Creepage distance of individual insulator units (minimum and as required to meet total creepage distance)	430 mm
e)	Markings	
i)	For Porcelain insulators	Markings on porcelain
ii)	For toughened glass insulators	Markings shall be done on initial parts
f)	Power frequency puncture withstand voltage	1.3 times the actual wet flashover voltage

1.4.2 INSULATOR STRING

Sl. No.	Description	220kV	132kV
a)	Power frequency withstand voltage of the complete string with corona control ring (wet) – KV rms	460	275
b)	Lightning impulse withstand Voltage of string with corona control rings (dry) - kVp	± 1050	± 650
c)	Switching surge withstand voltage of string with corona control rings (wet) - kVp	NA	NA

d)	Minimum corona extinction voltage level of string with Corona Control rings (dry) - kV rms	156	NA
e)	Maximum RIV level in micro volts of string with Corona Control rings at 508 kV (rms) for 765 kV, 320 kV (rms) for 400 kV string and 156 kV for 220 kV string across300 Ohms resistor at 1 MHz	1000	NA
f)	Minimum total creepage distance of the insulator string (mm)	6125	3625
g)	Total no. of discs per strings	15	10

For tension application, double insulator strings for 220 KV and single insulator strings for 132 kV system shall be used. For suspension purpose single suspension insulator string shall be used for 220 KV & 132 kV system

1.4.2.1 **INSULATOR STRING (33 KV)**

a) Power frequency withstand voltage of the complete string with Corona Control ring (wet) - kV rms : 75

b) Lightning impulse withstand Voltage of string with corona control rings (dry) – kVp : ±170

c) Power frequency puncture with-stand voltage for a string insulator : 1.3 times actual wet flashover voltage of the unit

d) Total creepage distance of the complete insulator string (mm) : 900

f) Total no. of discs per strings : 5 (S/T & S/S)

1.5 ***COMPOSITE LONG ROD INSULATOR***

As an alternative to disc insulator/long rod porcelain, Bidder can also offer composite long rod insulators with suitable hardware.

1.5.1 ***Details of Composite Long Rod Insulators***

1.5.1.1 Contractor shall offer such composite insulators which have proven use under foggy/ humid operational conditions in polluted industrial environment combined with smoke and dust particles. The Bidder shall furnish evidence in the form of certification from the power utilities that the similar type of product supplied to them had been performing satisfactorily. The Bidder shall also submit certified test report for an accelerated ageing test of 5000 hours such as that described in Appendix-C of IEC-61109 or test at multiple stresses of 5000 hrs. as described in Annexure –B of IEC-62217.

1.5.1.2 Insulators shall have sheds of the "open aerodynamic profile without any under

ribs" with good self-cleaning properties. Insulator shed profile, spacing projection etc. shall be strictly in accordance with the recommendation of IEC-60815.

1.5.2 Ball and socket shall be 20 mm designation for 120 KN Insulators in accordance with the standard dimensions stated in IEC:60120. Insulators shall be interchangeable and shall be suitable for forming either suspension or tension strings. Each insulator shall have rated strength markings on each composite insulator rod unit. no negative tolerance shall be applicable to creepage distance of composite insulators

1.5.3 All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/Sq.m and shall be in accordance with the latest edition of equivalent International standard. The zinc used for galvanizing shall be of purity of 99.95%. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash rust stains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand at least six successive dips each lasting for one (1) minute duration under the standard preece test. The galvanizing shall be carried out only after any machining.

1.5.4 ***Materials***

1.5.4.1 ***Core***

It shall be a glass-fiber reinforced (FRP rod) epoxy resin rod of high strength. The rod shall be resistant to hydrolysis. Glass fibers and resin shall be optimized. The rod shall be electrical grade corrosion resistant (ECR), boron free glass and shall exhibit both high electrical integrity and high resistance to acid corrosion.

1.5.4.2 **Housing & Weather sheds**

The FRP rod shall be covered by a sheath of a silicone rubber compound of a thickness of minimum 3mm. The housing & weather sheds should have silicon content of minimum 30% by weight. It should protect the FRP rod against environmental influences, external pollution and humidity. It shall be extruded or directly molded on the core. The interface between the housing and the core must be uniform and without voids. The strength of the bond shall be greater than the tearing strength of the polymer. The manufacturer shall follow non-destructive technique (N.D.T.) to check the quality of jointing of the housing interface with the core.

The weather sheds of the insulators shall be of alternate shed profile. The weather sheds shall be vulcanized to the sheath (extrusion process) or molded as part of the sheath (injection molding process) and free from imperfections. The vulcanization for extrusion process shall be at high temperature and for injection molding shall be at high temperature & high pressure. Any seams/ burrs protruding axially along the insulator, resulting from the injection molding process shall be removed completely without causing any damage to the housing. The track resistance of housing and shed material shall be class 1A4.5 according to IEC60587. The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The composite insulator shall be capable of high pressure washing.

1.5.4.3 **End Fittings**

End fittings transmit the mechanical load to the core. They shall be made of malleable cast iron/ spheroidal graphite or forged steel. They shall be connected to the rod by means of a controlled compression technique. The manufacturer shall have in-process Acoustic emission arrangement or some other arrangement to ensure that there is no damage to the core during crimping. This verification shall be in-process and done on each insulator. The system of attachment of end fitting to the rod shall provide superior sealing performance between housing and metal connection. The gap between fitting and sheath shall be sealed by a flexible silicone rubber compound. The sealing shall stick to both housing and metal end fitting. The sealing must be humidity proof and durable with time.

End fittings shall have suitable provisions for fixing grading rings at the correct position as per design requirements.

1.5.4.4 **Grading Rings**

Grading rings shall be used at both ends of each composite insulator unit for reducing the voltage gradient on and within the insulator and to reduce radio and TV noise to acceptable levels. The size and placement of the metallic grading rings shall be designed to eliminate dry band arcing/corona cutting/ exceeding of permissible electrical stress of material.

1.5.2 **Tests and Standards**

1.5.2.1 **Type Tests**

The test reports for following type tests on long rod units, components, materials or complete strings shall be submitted for approval as per clause 9.2 of Section - GTR.

1.5.2.1.1 On the complete composite Long Rod Insulator String with Hardware Fittings:-

a) Power frequency voltage withstand test with corona control rings/grading ring and arcing horns (if provided) under wet condition as per IEC:60383-1993/

b) Switching surge voltage withstand test under wet condition as per IEC:60383-1993.

c) Impulse voltage withstand test under dry condition as per IEC:60383-1993

d) Corona and RIV test under dry condition.

The sample assembly when subjected to power frequency voltage shall have a corona extinction voltage of not less than 156kV (rms) for 220kV line to earth under dry condition. There shall be no evidence of Corona on any part of the sample. The atmospheric condition during testing shall be recorded and the test results shall be accordingly corrected with suitable correction factor as stipulated in IEC 60383.

Under the conditions as specified above the insulator string alongwith complete hardware fittings shall have a radio interference voltage level below 1000 microvolts at 1 MHz when subjected to 50 Hz AC line to earth voltage of 156kV for 220kV under dry conditions. The test procedure shall be in accordance with IEC 60437.

e) Mechanical Strength test

The complete insulator string along with its hardware fitting

excluding arcing horn, corona control ring, grading ring, tension/suspension clamps shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to dismantle them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

f) Salt-fog pollution withstand test as per IEC: 60507. The salinity level for composite long rod insulators shall be 160 Kg/m3 NACL.

1.5.2.1.2 ***On Composite Insulator Units***

a) Tests on interfaces and connections of metal fittings as per IEC: 61109-2008.

b) Assembled core load time test as per IEC: 61109-2008.

c) Damage limit proof test and test of tightness of interface between end firings and insulator housing as per IEC: 61109-2008

d) High Pressure washing test

The washing of a complete insulator of each E&M rating is to be carried out at 3800 kPa with nozzles of 6 mm diameter at a distance of 3m from nozzles to the insulator, the washing shall be carried out for 10minutes. There shall be no damage to the sheath or metal fitting to housing interface.

e) Brittle fracture resistance test

The test arrangement shall be according to Damage limit proof test with simultaneous application of 1N-HNO3 acid directly in contact with naked FRP rod. The contact length of acid shall not be less than 40mm and thickness around the core not less than 10mm.The rod shall withstand 80% of SML for 96 hours.

f) Dye penetration test as per IEC: 61109-2008

g) Water diffusion test as per IEC: 61109-2008

h) Tracking and erosion test as per IEC: 61109-2008.

i) Hardness test as per IEC: 61109-2008.

j) Accelerated weathering test as per IEC: 61109-2008.

k) Flammability test as per IEC: 61109-2008.

l) Silicone content test

Minimum content of silicone as guaranteed by supplier shall be verified through FT-

IR spectroscopy & TGA analysis or any other suitable method mutually agreed between Employer & Supplier in Quality Assurance Programme.

m) Recovery of Hydrophobicity test

1. The surface of selected samples shall be cleaned with isopropyl alcohol. Allow the surface to dry and spray with water. Record the HC classification. Dry the sample surface.

2. Treat the surface with corona discharges to destroy the hydrophobicity. This can be done utilizing a high frequency corona tester, Holding the electrode approximately 3mm from the sample surface, slowly move the electrode over an area approximately 1" x 1". Continue treating this area for 2 – 3 minutes, operating the tester at maximum output.

3. Immediately after the corona treatment, spray the surface with water and record the HC classification. The surface should be hydrophilic, with an HC value of 6 or 7. If not, dry the surface and repeat the corona treatment for a longer time until an HC of 6 or 7 is obtained. Dry the sample surface.

4. Allow the sample to recover and repeat the hydrophobicity measurement at several time intervals. Silicone rubber should recover to HC 1 – HC 2 within 24 to 48 hours, depending on the material and the intensity of the corona treatment.

n) Torsion test

Three complete insulators of each E&M rating shall be subjected to a torsional load of 55Nm. The torsional strength test shall be made with test specimen adequately secured to the testing machine. The torsional load shall be applied to the test specimen through a torque member so constructed that the test specimen is not subjected to any cantilever stress. The insulator after torsion test must pass the Dye Penetration Test as per IEC 61109.

o) Accelerated ageing test of 5000hrs as described in appendix-C of IEC 61109 or Test at multiple stresses of 5000 hrs. as described in Annex-B of IEC -62217

1.5.2.2 ***Acceptance Tests:***

1.5.2.2.1 ***For Composite Long Rod Insulators***

a.	Verification of dimensions	IEC: 61109-2008
b.	Galvanizing test	IEC: 60383
c.	Verification of end fittings	IEC: 61109-2008
d.	Recovery of Hydrophobicity	As per above
e.	Verification of tightness of interface between end fittings and insulator housing and of specified mechanical load	IEC: 61109-2008

f.	Silicone content test	As per above
g.	Brittle fracture resistance test	As per above
h.	Dye penetration test	IEC: 61109-2008
i.	Water diffusion test	IEC: 61109-2008

In the event of failure of the sample to satisfy the acceptance test(s) specified in 4.2 above, the retest procedure shall be as per IEC 61109.

1.5.2.3 **Routine Tests**

1.5.2.3.1 **For Composite Long Rod Insulator Units**

a)	Visual Examination	As per IEC:61109-2008
b)	Mechanical routine test	As per IEC:61109 -2008

1.5.3 ***Guaranteed Technical Particulars***

1.5.3.1 ***Electrical system Data***

Sl.	**Parameters**	**Unit**	**System Voltage**	
1.	Nominal Voltage	kV	**220**	**132**
2.	Maximum system voltage	kV	245	145
3.	BIL (Impulse)	kV (Peak)	±1050	±650
4.	Power frequency withstand voltage (Wet)	kV (rms)	460	275
5.	Switching surge withstand voltage (Wet)	kV (rms)	NA	NA
6.	Minimum Corona extinction voltage at 50 Hz AC system under dry condition	kV (rms) phase to earth	156	NA
7.	Radio interference voltage at one MHz for phase to earth voltage of 508 KV under dry condition.	Micro Volts	1000 (Max)	NA
8.	Minimum creepage distance.	mm	6125	3625
9.	Electromechanical strength of Insulator Unit.	KN	120	120

2.0 **AAC / ACSR CONDUCTOR**

2.1 **Details of AAC Conductor**

2.1.1 The contractor shall supply the conductor as per the standard guaranteed technical particulars enclosed in Annexure-B of the technical specification, Section XV–

Switchyard Erection and separate approval is not required during detailed engineering.

Owner has also standardized the guaranteed technical particulars for the conductors which are enclosed in Annexure-E of the technical specification, Section-XV Switchyard Erection. The contractor shall supply the conductor as per the standard guaranteed technical particulars.

2.1.2 The details of the AAC Bull conductor are tabulated below:

Sl. No.	**Description**	**Unit**	**AAC BULL**
a)	Stranding and wire diameter	mm	61/4.25
b)	Number of Strands		
	1st Aluminum Layer	Nos.	1
	2nd Aluminum Layer	Nos.	6
	3rd Aluminum Layer	Nos.	12
	4th Aluminum Layer	Nos.	18
	5th Aluminum Layer	Nos.	24
c)	Total sectional area	Sq.mm	865.36
d)	Overall diameter	mm	38.25
e)	Approximate weight	kg/ km	2400
f)	Calculated D.C. resistance at 20oC	ohm/km	0.0334
g)	Minimum UTS	KN	139

2.1.3 The details of Aluminum strand are as follows:

Sl. No.	**Description**	**Unit**	**AAC BULL**
a)	Minimum breaking load of strand before stranding	KN	2.23
b)	Minimum breaking load of strand after stranding	KN	2.12
c)	Maximum D.C. resistance of strand at 20 deg. Centigrade	Ohm/KM	3.651

2.2 **Details of ACSR Conductor**

2.2.1 The details of the ACSR Moose conductors shall be as per the standard guaranteed technical particulars enclosed in Annexure-A are tabulated below:

ACSR MOOSE CONDUCTOR:

Sl. No.	Description	Unit	ACSR MOOSE
a)	Stranding and wire diameter	mm	54/3.53 (Al)+ 7/3.53 (Steel)
b)	Number of Strands		
	Steel center	Nos.	1

	1st Steel Layer	Nos.	6
	1st Aluminum Layer	Nos.	12
	2nd Aluminum Layer	Nos.	18
	3rd Aluminum Layer	Nos.	24
c)	Sectional area of Aluminum	Sq. mm	528.5
d)	Total sectional area	Sq. mm	597.00
e)	Overall diameter	mm	31.77
f)	Approximate weight	kg/ km	2004
g)	Calculated D.C. resistance at 20oC	ohm /km	0.05552
h)	Minimum UTS	KN	161.2

2.2.2 The details of Aluminum strand are as follows:

ACSR MOOSE CONDUCTOR:

Sl. No.	Description	Unit	ACSR MOOSE
a)	Minimum breaking load of strand before stranding	KN	1.57
b)	Minimum breaking load of strand after stranding	KN	1.49
c)	Maximum D.C. resistance of strand at 20 deg. Centigrade	Ohm /KM	2.921

2.2.3 The details of steel strand are as follows:

ACSR MOOSE CONDUCTOR:

Sl. No.	**Description**	**Unit**	**ACSR MOOSE**
a)	Minimum breaking load of strand before stranding	KN	12.86
b)	Minimum breaking load of strand after stranding	KN	12.22
c)	Minimum number of twists to be withstood in torsion test when tested on a gauge length of 100 times diameter of wire	Nos.	18 (Before stranding) 16 (Before stranding

2.3 Workmanship

2.3.1 The finished conductor shall be smooth, compact, uniform and free from all imperfections including kinks (protrusion of wires), wire cross over, over riding, looseness (wire being dislocated by finger/hand pressure and/or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black

spot (on account of reaction with trapped rain water etc.), dirt, grit etc.

2.3.2 All the Aluminum and steel strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die marks, scratches, abrasions, etc., after drawing.

2.3.3 The steel strands shall be hot dip galvanized and shall have a minimum zinc coating of 260 gms/sq. after stranding of the uncoated wire surface. The zinc coating shall be smooth, continuous and of uniform thickness, free from imperfections and shall withstand minimum three dips in standard Preece test. The finished strands and the individual wires shall be of uniform quality and have the same properties and characteristics as prescribed in ASTM designation: B 498-74.

2.3.4 The steel strands shall be performed and post formed in order to prevent spreading of strands in the event of cutting of composite core wire. Care shall be taken to avoid, damages to galvanization during pre-forming and post-forming operation.

2.4 Joints in Wires

2.4.1 Aluminum Wires

Joints in aluminum wires shall be as per relevant International standard.

2.4.2 Steel Wires

There shall be no joint of any kind in the finished wire entering into the manufacture of the strand. There shall also be no strand joints or strand splices in any length of the completed stranded steel core of the conductor.

2.5 Tolerances

The manufacturing tolerances shall be as per relevant International standard.

A. AAC Bull and AAC Tarantula conductor:

a)	Diameter of Aluminum and Steel Strands						
		AAC BULL			AAC TARANTALA		
		Standard	Maximum	Minimum	Standard	Maximum	Minimum
	Aluminum	4.25 mm	4.29 mm	4.21 mm	5.23	5.28	5.18

b)	Lay ratio of Conductor					
			AAC BULL		AAC TARANTALA	
			Maximum	Minimum	Maximum	Minimum
	Aluminum	6 wire layers	16	10	16	10
		12 wire layers	16	10	16	10
		18 wire layers	16	10	16	10
		24 wire layers	14	10	-	-

B. ACSR Bertsimas and ACSR Moose conductor:

a)	Diameter of Aluminum and Steel Strands						
		ACSR BERSIMIS			ACSR MOOSE		
		Standard	Maximum	Minimum	Standard	Maximum	Minimum
	Aluminum	4.57 mm	4.61 mm	4.53 mm	3.53 mm	3.55 mm	3.51 mm
	Steel	2.54 mm	2.57 mm	2.51 mm	3.53 mm	3.60 mm	3.46 mm

b)	Lay ratio of Conductor					
			ACSR BERSIMIS		ACSR MOOSE	
			Maximum	Minimum		
	Steel	6 wire layers	18	13	18	16
	Aluminum	8/12 wire layer	17	10	14	12
		14/18 wire layer	16	10	13	11
		20/24 wire layer	14	10	12	10

2.6 Materials

2.6.1 Aluminum

The aluminum strands shall be hard drawn from electrolytic aluminum rods having purity not less than 99.5% and a copper content not exceeding 0.04%.

2.6.2 Steel

The steel wire strands shall be drawn from high carbon steel wire rods and shall conform to the following chemical composition:

Element	% Composition
Carbon	0.50 to 0.85
Manganese	0.50 to 1.10
Phosphorous	Not more than 0.035
Sulphur	Not more than 0.045
Silicon	0.10 to 0.35

2.6.3 **Zinc**

The zinc used for galvanizing shall be electrolytic High Grade Zinc of 99.95% purity.

2.7 **Standard Length**

2.7.1 The conductor shall be supplied as required. No joint shall be allowed within a single span of stringing, jumpers and equipment interconnection.

2.8 Tests:

2.8.1 The following type, acceptance & routine tests and tests during manufacturing shall be carried out on the conductor.

2.8.2 **Type Tests**

In accordance with the stipulation of specification, the following type

tests reports of the conductor shall be submitted for approval as per clause 9.2 of Section -GTR.

a) UTS test on stranded conductor.

b) Corona extinction voltage test (dry)

(c) Radio Interference voltage test (dry)

(d) DC resistance test on stranded conductor

2.8.3 **Acceptance Tests**

a) Visual check for joints, scratches etc. and lengths of conductor

b) Dimensional check on steel and aluminum strands

c) Check for lay ratios of various layers

d) Galvanizing test on steel strands

e) Torsion and Elongation test on steel strands

f) Breaking load test on steel and aluminum strands

g) Wrap test on steel and aluminum strands

h) DC resistance test on aluminum strands

i) UTS test on welded joint of aluminum strands

NOTE:

All the above tests except test mentioned at (a) shall be carried out on aluminum and steel strands after stranding only.

2.8.4 **Routine Tests**

a) Check to ensure that the joints are as per specification.

b) Check that there are no cuts, fins etc. on the strands.

c) All acceptance test as mentioned in Clause 2.8.3 above to be carried out on each coil.

2.8.5 **Tests During Manufacture**

a) Chemical analysis of zinc used for galvanizing

b) Chemical analysis of aluminum used for making aluminum strands

c) Chemical analysis of steel used for making steel strands

2.8.6 **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 Department. The sample shall be manufactured strictly in accordance with the Quality Assurance Plan approved by Owner.

3.0 Galvanized Steel Earth wire

3.1 Details of Earth wire

3.1.1 The contractor shall supply the earth wire as per the standard guaranteed technical particulars enclosed in Annexure-E of the technical specification, Section-XV Switchyard Erection and separate approval is not required during detailed engineering.

Owner has also standardized the guaranteed technical particulars for the earth wire which are enclosed in Annexure-E of the technical specification, Section-XV Switchyard Erection. The contractor shall supply the earth wire as per the standard guaranteed technical particulars.

3.1.2 The basic details of the earth wire are tabulated below:

S.No.	Description	Unit	Value
1.	Stranding & Wire diameter	mm	7/3.66 (steel)
2.	Strands a) Steel Core b) Outer layer	 No. No.	 1 (one) 6 (six)

3.	Total sectional area	Sq. mm.	73.65

Other technical details are furnished in of Annexure -E of this Specification.

3.2 Workmanship

3.2.1 All steel strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die marks, scratches, abrasions and kinks after drawing and also after stranding.

3.2.2 The finished material shall have minimum brittleness as it will be subjected to appreciable vibration while in use.

3.2.3 The steel strands shall be hot dip galvanized (and shall have minimum Zinc coating of 275 gms/sq.) after stranding of the uncoated wire surface. The zinc coating shall be smooth, continuous, of uniform thickness, free from imperfections and shall withstand three and a half dips after stranding in standard Preece test. The steel wire rod shall be of such quality and purity that, when drawn to the size of the strands specified and coated with zinc, the finished strands shall be of uniform quality and have the same properties and characteristics as prescribed in ASTM designation B498-74.

3.2.4 The steel strands shall be preformed and post formed in order to prevent spreading of strands while cutting of composite earth wire. Care shall be taken to avoid damage to galvanization during preforming and post forming operation.

3.2.5 To avoid susceptibility towards wet storage stains (white rust), the finished material shall be provided with a protective coating of boiled linseed oil.

3.3 Joints in Wires

There shall be no joint of any kind in the finished steel wire strand entering into the manufacture of the earth wire. There shall be no strand joints or strand splices in any length of the completed stranded earth wire.

3.4 Tolerances

The manufacturing tolerance to the extent of the following limits only shall be permitted in the diameter of the individual steel strands and lay length of the earth wire:

	Standard	Maximum	Minimum
Diameter	3.66 mm	3.75 mm	3.57 mm
Lay length	181 mm	198 mm	165 mm

3.5 **Materials**

3.5.1 Steel

The steel wire strands shall be drawn from high carbon steel rods and shall conform to the following requirements as to the chemical composition.

Element	% Composition
Carbon	Not more than 0.55
Manganese	0.4 to 0.9
Phosphorous	Not more than 0.04
Sulphur	Not more than 0.04

Silicon	0.15 to 0.35

3.5.2 Zinc

The zinc used for galvanizing shall be electrolytic High-Grade Zinc of 99.95% purity. It shall conform to and satisfy all the requirements of IS: 209 -1979/ Equivalent BS standard.

3.6 Standard Length

3.6.1 The earth wire shall be supplied in standard drum length of manufacturer.

3.8 **TESTS**

3.8.1 The following type, routine & acceptance tests and tests during manufacturing shall be carried out on the earth wire.

3.8.2 **TYPE TESTS**

In accordance with the stipulation of specification, the following type tests reports of the earth wire shall be submitted for approval as per clause 9.2 of Section - GTR.

a) UTS test

b) DC resistance test

3.8.3 **ACCEPTANCE TESTS**

a) Visual check for joints, scratches etc. and length of Earth wire

b) Dimensional check

c) Galvanizing test

d) Lay length check

e) Torsion test

f) Elongation test

g) Wrap test

h) DC resistance test

i) Breaking load test

j) Chemical Analysis of steel

3.8.4 **ROUTINE TESTS**

a) Check that there are no cuts, fins etc. on the strands.

b) Check for correctness of stranding.

3.8.5 **TESTS DURING MANUFACTURE**

a) Chemical analysis of zinc used for galvanizing

b) Chemical analysis of steel

3.8.6 **SAMPLE BATCH FOR TYPE TESTING**

The Contractor shall offer material for sample selection for type testing, only after getting quality assurance program me approved by the Owner. The samples for type testing shall be manufactured strictly in accordance with the Quality Assurance Programme approved by the Owner.

4.0 **TUBULAR BUS CONDUCTORS**

4.1 **General**

The contractor shall supply the aluminum tubes as per the standard guaranteed technical particulars enclosed in Annexure- E of the technical specification, Section-XV Switchyard Erection and separate approval is not required during detailed engineering.

Owner has also standardized the guaranteed technical particulars for the aluminum tube which are enclosed in Annexure- E of the technical specification, Section-XV Switchyard Erection. The contractor shall supply the aluminum tube as per the standard guaranteed technical particulars.

4.2 **Constructional Features**

4.2.1 For outside diameter (OD) & thickness of the tube there shall be no minus tolerance, other requirements being as per relevant International standard.

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 stipulations of the specification, Routine tests shall be conducted on tubular bus conductors. Also, the wall thickness and ovality of the tube shall be measured. In addition to the above tests, 0.2% proof tests on both parent metal and Aluminum tube after welding shall be conducted.

4.4 **Technical Parameters**

Sl. No.	Description	4" AL. TUBE
1.	Size	4" IPS (EH Type)

2.	Outer diameter	114.2 mm
3.	Thickness	8.51 mm
4.	Cross-sectional area	2825.61 sq.mm
5.	Weight	7.7 kg/m

5.0 **EARTHING CONDUCTORS**

5.0 **General**

The conductor of earthing grid shall consist of mild steel rod of minimum size (dia) 40 mm. All conductors above ground level and earthing leads shall be of galvanized steel.

6.0 **SPACERS**

6.1 **General**

The spacers are to be located at a suitable spacing to limit the short circuit forces as per IEC -60865. Wherever Employer's 220kV & 132kV standard gantry structures are being used, the spacer span(s) for different conductor / span configurations and corresponding short circuit forces shall be as per Annexure-D. For strung buses, flexible type spacers shall be used whereas for jumpers and other connections rigid type spacers shall be used.

Wherever Employer's 220kV & 132kV standard gantry structures are not being used, necessary spacer span calculation shall be provided by the contractor during detailed engineering for the approval of Employer.

6.2 **Constructional Features**

6.2.1 No magnetic material shall be used in the fabrication of spacers except for GI bolts and nuts.

6.2.2 Spacer design shall be made to take care of fixing and removing during installation and maintenance.

6.2.3 The design of the spacers shall be such that the conductor does not come in contact with any sharp edge.

6.3 **Tests**

Each type of spacers shall be subjected to the following type tests, acceptance tests and routine tests:

6.3.1 Type Tests: Following type test reports shall be submitted for approval as per clause 9.2 of Section - GTR.

a) **Clamp slip tests**

The sample shall be installed on test span of twin conductor bundle string or quadruple conductor bundle string (as applicable) at a tension of 44.2 kN. One of the clamps of the sample when subjected to a longitudinal pull of 2.5

KN parallel to the axis of the conductor shall not slip on the conductor. The permanent displacement between the conductor and the clamp of sample measured after removal of the load shall not exceed 1.0 mm. Similar tests shall be performed on the other clamps of the same sample.

b) Fault current test.

c) Corona Extinction Voltage Test (Dry).

This test shall be performed on 220 kV equipment as per procedure mentioned at Annexure - C, Minimum Corona Extinction voltage shall be 156 kV (rms) line to earth for 220 kV spacers.

d) RIV Test (Dry)

This test shall be performed as per procedure mentioned at Annexure - C, Maximum RIV level at 156 kV (rms) line to earth for 220 kV spacers shall be 1000 micro volts, across 300-ohm resistor at 1 MHz

e) Resilience test (if applicable)

f) Tension Test

g) Log decrement test (if applicable)

h) Compression test

i) Galvanizing test

6.3.2 **Acceptance Test**

a) Visual examination

b) Dimensional verification

c) Movement test

d) Clamp slip test

e) Clamp bolt torque test (if applicable)

f) Assembly torque test

g) Compression test

h) Tension test

i) Galvanizing test

j) Hardness test for neoprene (if applicable)

The shore hardness of different points on the elastometer surface of cushion grip clamp shall be measured by shore hardness meter. It shall be between

65 to 80.

k) Ultimate Tensile Strength Test

The UTS of the retaining rods shall be measured. It shall not be less than 35 kg/Sq. mm.

6.3.3 **Routine test**

a) Visual examination

b) Dimensional verification

7.0 **BUS POST INSULATORS**

The post insulators shall conform in general to latest IEC-60168, IEC 60273 and IEC-60815.

7.1 **Constructional Features**

7.1.1 Post type insulators shall consist of a porcelain part permanently secured in a metal base to be mounted on the supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators will be acceptable.

7.1.2 Porcelain used shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

7.1.3 Glazing of the porcelain shall be of uniform brown in colour, free from blisters, burrs and other similar defects.

7.1.4 The insulator shall have alternate long and short sheds with aerodynamic profile, the shed profile shall also meet the requirements of IEC-60815 for the specified pollution level.

7.1.5 When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or insulators by the formation of substance produced by chemical action.

7.1.6 The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

7.1.7 All ferrous parts shall be hot dip galvanized. The zinc used for galvanizing shall be grade Zn 99.95. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux ash, rust stains, bulky white deposits and blisters. The metal parts shall not produce any noise generating corona under the operating conditions.

7.1.8 a) Every bolt shall be provided with a steel washer under the nut so that part of the threaded portion of the bolts is within the thickness of the parts bolted

together.

b) Flat washer shall be circular of a diameter 2.5 times that of bolt and of suitable thickness. Where bolt heads/nuts bear upon the beveled surfaces they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the bolt.

c) All bolts and nuts shall be of steel with well-formed hexagonal heads forged from the solid and shall be hot dip galvanized. The nuts shall be good fit on the bolts and two clear threads shall show through the nut when it has been finally tightened up.

7.1.9 Bidder shall make available data on all the essential features of design including the method of assembly of shells and metals parts, number of shells per insulator, the manner in which mechanical stresses are transmitted through shells to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

7.2 **Tests**

In accordance with the stipulations of the specification, the post insulators shall be subject to type, acceptance, sample and routine tests as per IEC-60168.

7.2.1 In addition to acceptance/sample/routine tests as per IEC-60168, the following tests shall also be carried out.

a) Ultrasonic test as an acceptance test

b) Soundness test, metallurgical tests and magnetic test on MCI caps and pedestal tests as acceptance test.

c) All hot dip galvanized components shall be subject to check for uniformity of thickness and weight of zinc coating on sample basis.

d) The bending test shall be carried out at 50% minimum failing load in four directions as a routine test and at 100% minimum failing load in four directions as an acceptance test.

e) Acceptance norms for visual defects allowed at site and also at works shall be agreed in the Quality plan.

7.2.2 In accordance with the stipulation of specification, the following type tests reports of the post insulators shall be submitted for approval as per clause 9.2 of Section - GTR.

a) Power frequency withstand test (dry & wet)

b) Lightning impulse test (dry)

c) Measurement of R.I.V (Dry)

d) Corona extinction voltage test (Dry)

.

e) Test for deflection under load

f) Test for mechanical strength.

7.3 **Technical Parameters of Bus Post Insulators.**

Sl. No.	Description	245 kV	145 kV
a)	Type	Solid Core	Solid Core
b)	Voltage Class (kV)	245	145
c)	Dry and wet one-minute power frequency withstand voltage (kV rms)	460	275
d)	Dry lightning impulse withstand Voltage (kVp)	± 1050	±650
e)	Wet switching surge withstand voltage (kVp)	—-	—-
f)	Max. radio interference voltage (in microvolts) at voltage of 508 kV (rms) , 305 kV (rms) and 156 (rms) for 765 kV, 400 kV &220 kV respectively between phase to earth.	500	500
g)	Corona extinction voltage (kV rms) (min.)	156	105
h)	***Cantilever Strength***		
(i)	Total minimum cantilever strength (Kg)	800	600
(ii)	***Total minimum breaking strength (Kg)***	***1000***	***720***
i)	Minimum torsional moment	As per IEC-273	As per IEC-273
j)	Total height of insulator (mm)	2300	
k)	P.C.D Top (mm)	127	***127***
	Bottom (mm)	254	***254***
l)	No. of bolts		
	Top	4	***4***
	Bottom	8	***8***
m)	Diameter of bolt/holes (mm)		
	Top	M16	***M16***
	Bottom dia	18	***18***
n)	Pollution level as per IEC-815	Heavy(III)	Heavy(III)
o)	Minimum total creepage distance for Heavy Pollution (mm)	6125	3165

7.3.1 33kV Bus Post Insulators.

a) Type Solid Core

b) Voltage class (kV) 36

c) Dry and wet one-minute power frequency withstand voltage (kV rms) 70

d) Dry lightning impulse withstand Voltage (kVp) ±170

e)	Total minimum cantilever strength (Kg)	450
f)	Minimum torsional moment	as per IEC-273
g)	Total height of insulator (mm)	As per requirement
h)	Pollution level as per IEC-815	Heavy(III)
i)	Minimum creepage distance for Heavy Pollution (mm)	900

7.3.2 If corona extinction voltage is to be achieved with the help of corona ring or any other similar device, the same shall be deemed to be included in the scope of the Contractor. Material of Corona ring shall be aluminum/aluminum alloy of 63401W grade or equivalent.

8.0 EARTHING SYSTEM

8.1 GENERAL

This specification covers the design, supply, delivery, installation and testing of the complete earthing system as described below.

The complete station earthing work shall be in accordance with the recommendation in the "Guide for Safety in Substation EARTHING" IEEE No. 80 and the requirements of this section.

8.2 EARTHING INSTALLATION FEATURES

8.2.1 The installation shall be complete in all respects for efficient and trouble-free service. All work shall be carried out in a first-class neat workman like manner. earthing conductors shall be handled carefully to avoid kinking and cutting of the conductors during laying and installation. All exposed earth conductors run shall be taken in a neat manner, horizontal, vertical and parallel to building walls or columns and shall not be laid haphazardly.

8.2.2 For all connections made to equipment or to the structures, the earthing conductor, connectors and equipment enclosures shall have good clean contact surfaces. Earthing conductor connection to all electrical equipment, switchgear, transformers, motors, panels, conduit system, equipment enclosures, cable trays, distribution boards, equipment frames, bases, steel structure, etc. shall be by pressure type or bolting type connectors.

8.2.3 All lap, cross and tee connections between two earthing conductors shall be made by thermo welding process or compression type connector. The various joints shall have adequate mechanical strength as well as necessary electrical conductivity not less than that of the parent conductors of the joints. All accessories for earthing installation shall be of quality and design approved by the Employer. The earthing connection between earthing pad of equipment/structures shall be made by two earthing leads.

8.2.4 Earth conductors, when crossing under earth trenches, directly laid under earth pipe and equipment foundation, if any, shall be at least 300mm below the bottom elevation of such trenches/pipes.

8.2.5 The terminals for connecting earth mat and equipment shall be terminated whenever necessary. The new earthing shall be bonded with existing earthing network at the existing Substations.

8.3 EARTHING CONDUCTOR

8.3.1 Main Earth Grid
The main earth system shall consist of an earthing grid buried minimum 0.6 meter below grade level. The earthing grid shall consist of Mild steel rod of minimum size (dia.) 40 mm.

8.3.2 Earth Electrodes
The earth electrodes shall be 40mm diameter and 3.0-meter-long (min.) of mild steel. These shall be driven into earth and connected to the main earth grid.

8.3.3 Risers
The risers shall consist of Galvanized steel of adequate size (75 x12mm for Main equipment, column 7 aux. structure 50 x 6mm for Panels, MOM boxes, outdoor cable trench etc.) connected at one end to the main earth mat and at the other end to the equipment.

8.4 DESIGN REQUIREMENTS

8.4.1 The Contractor shall measure the soil resistivity in presence of the Employer. Based on the resistivity the contractor shall calculate the total length of buried earth conductor, number of earthing electrode and their depth and spacing to achieve a earthing system resistance of less than 1.0 (One) Ohm.

8.4.2 The Contractor shall calculate the cross-section considering the maximum fault level of 40 kA and 31.5KA for 220kV and 132kV respectively.

8.4.3 The Contractor shall submit the details of calculations of the earthing system for the employer's approval. The earthing system shall be of single earthing system for the whole substation i.e. all earthing shall be connected to main earthing grid.

8.5 TESTS

On completion of the installation, either wholly or in sections, it shall be tested in compliance with relevant Code by the Contractor in presence of the Employer. The cost of any test including labor, material and equipment charges shall be borne by the Contractor. If the earth grid resistance cannot be obtained as per his design, then additional earthing conductors shall be buried in the earth, or if necessary, buried in treated soil to obtain the required low earth resistance without any additional cost.

8.6 LIGHTNING PROTECTION

The outdoor equipment of the substation and the substation building shall be protected against lightning. The lightning protection shall be achieved by installing

Lightning mast and/or an overhead lightning shield system of galvanized steel wire of 7/3.66 mm, which shall be connected to the main earthing grid by steel conductor of 7/3.66 mm. Lighting mast with electrode length of 2.5mtr (maximum) may be used in switchyard area for lighting protection as per requirement. The above electrode may be connected to the main earthing grid by steel conductor of 7/3.66 mm up to LM base and then connected to 75 x12mm G.S Flat. The design of the lightning protection system shall be subject to the approval of the Employer.

8.7 **DRAWINGS**

After award of the Contract, the Contractor shall furnish the earthing layout drawing with dimensions showing the location of earthing grids, electrodes, test link chambers and risers, backed up by necessary calculations for Employer's approval. The work shall have to be started at site only after getting approval from the Employer. If alteration is required for any work done before getting Employer's approval, the same shall have to be done by the Contractor at no extra cost to the Employer.

9.0 **Main Bus Bars (Applicable for Aluminum tube)**

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.

9.1 The Contractor shall furnish supporting calculations where applicable for the bus bars/conductors to show adequacy of design parameters for:

a) Fiber-stress

b) Cantilever strength of post insulators

c) Aeolian vibrations

d) Vertical deflection of bus bars

e) Short circuit forces in bundle conductor and spacer location for each span of ACSR conductor stringing as per layout drawings.

9.1.1 The welds in the aluminum 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 Aluminum tube. Welding sleeve shall be of 600mm length

9.1.2 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 Aluminum alloy similar to that of clamps & connectors.

9.1.3 To minimize the vibrations in the aluminum tubes, damping conductor shall be provided inside the aluminum tubes. For this purpose, the cut pieces of ACSR conductor which otherwise are considered wastages, shall be used as damping

conductor.

9.1.4 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.

10.0 **BAY EQUIPMENT**

10.1 The disposition of various bay equipment's shall be as per single line diagrams and layout drawings.

10.2 Bay Marshalling Kiosk:-

One no. of bay marshalling kiosk shall be provided for each 220 kV and 132 kV bay under present scope. In addition to the requirements specified elsewhere in the specification, the bay marshalling kiosk shall have two distinct compartments for the following purpose:-

(i) To receive two incoming 400V, 3 phase, 63Amps, AC supply with auto changeover and MCB unit and distribute minimum six outgoing 400V, 3 phase, 16 Amps AC supplies controlled by MCB.

(ii) To distribute minimum ten outgoing 230V, 10 Amps single phase supplies to be controlled by MCB to be drawn from above 3 phase incomers.

(iii) 200 nos. terminal blocks in vertical formation for interlocking facilities for substations without automation system.

(iv) Necessary Terminal Blocks for terminating cables from ACDB and switchyard panel rooms.

11.0 **EQUIPMENT ERECTION DETAILS**

11.1 For equipment interconnection, the surfaces of equipment terminal pads, Aluminium tube, conductor & terminal clamps and connectors shall be properly cleaned. After cleaning, contact grease shall be applied on the contact surfaces of equipment terminal pad, Aluminium tube/conductor and terminal clamps to avoid any air gap in between. Subsequently bolts of the terminal pad/terminal connectors shall be tightened and the surfaces shall be cleaned properly after equipment interconnection.

11.2 Muslin or leather cloth shall be used for cleaning the inside and outside of hollow insulators.

11.3 All support insulators, circuit breaker interrupters and other fragile equipment shall preferably be handled with cranes having suitable booms and handling capacity.

11.4 Bending of Aluminium tube and compressed air piping if any should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced.

11.5 Cutting of the pipes wherever required shall be such as to avoid flaring of the ends. Hence only a proper pipe cutting tool shall be used. Hack saw shall not be used.

11.6 Handling of equipment shall be done strictly as per manufacturer's/supplier's instructions/instruction manual.

11.7 Handling equipment, sling ropes etc. should be tested periodically before erection for strength.

11.8 The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc.

12.0 **STORAGE**

12.1 The Contractor shall provide and construct adequate storage shed for proper storage of equipments, where sensitive equipments shall be stored indoors. All equipments during storage shall be protected against damage due to acts of nature or accidents. The storage instructions of the equipment manufacturer/Owner shall be strictly adhered to.

13.0 **CABLING MATERIAL**

13.1 **CABLE TAGS AND MARKERS**

13.1.1 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

13.1.2 The tag shall be of aluminum with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.

13.1.3 Location of cables laid directly under earth shall be clearly indicated with cable marker made of galvanized iron plate.

13.1.4 Location of under earth cable joints shall be indicated with cable marker with an additional inscription "Cable joints".

13.1.5 The marker shall project 150 mm above earth 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.

13.1.6 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 centers, control and relay panels etc., wherever required for cable identification, where a number of cables enter together through a gland plate.

13.2 **Cable Supports and Cable Tray Mounting Arrangements**

13.2.1 The Contractor shall provide embedded steel inserts on concrete floors/walls to secure supports by welding to these inserts or available building steel structures.

13.2.2 The supports shall be fabricated from standard structural steel members.

13.2.3 Insert plates will be provided at an interval of 750 mm wherever cables are to be supported without the use of cable trays, such as in trenches, while at all other places these will be at an interval of 2000 mm.

13.2.4 Vertical run of cables on equipment support structure shall be supported on perforated cable trays of suitable width which shall be suitably bolted/clamped with the equipment support structure.

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13.3 **Cable Termination and Connections**

13.3.1 The termination and connection of cables shall be done strictly in accordance with cable and termination kit manufacturer's instructions, drawing and/or as directed by the Owner.

13.3.2 The work shall include all clamping, fittings, fixing, plumbing, soldering, drilling, cutting, taping, heat shrinking (where applicable), connecting to cable terminal, shorting and EARTHING as required to complete the job.

13.3.3 Supply of all consumable material shall be in the scope of Contractor.

13.3.4 The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for drilling of gland plates, painting and touching up. Holes shall not be made by gas cutting.

13.3.5 Control cable cores entering control panel/switchgear/MCCB/MCC/ miscellaneous panels shall be neatly bunched, clamped and tied with nylon strap or PVC perforated strap to keep them in position.

13.3.6 The Contractor shall tag/ferrule control cable cores at all terminations, as instructed by the Owner. In panels where a large number of cables are to be terminated and cable identification may be difficult, each core ferrule may include the complete cable number as well.

13.3.7 Spare cores shall be similarly tagged with cable numbers and coiled up.

13.3.8 All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.

13.3.9 Double compression type nickel plated (coating thickness not less than 10 microns) brass cable glands shall be provided by the Contractor for all power and control cables to provide dust and weather proof terminations.

13.3.10 They shall comprise of heavy duty brass casting, machine finished and nickel plated, to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and of tested quality. Cable glands shall be of approved make.

13.3.11 The cable glands shall also be suitable for dust proof and weather proof termination. The test procedure, if required, has to be discussed and agreed to between Owner and cable gland manufacturer.

13.3.12 If the cable-end box or terminal enclosure provided on the equipment is found unsuitable and requires modification, the same shall be carried out by the Contractor, as directed by the Owner.

13.3.13 Crimping tool used shall be of approved design and make.

13.3.14 Cable lugs shall be tinned copper solderless crimping type conforming to IS-8309 & 8394/ Equivalent International standard. Bimetallic lugs shall be used depending upon type of cables used.

13.3.15 Solderless crimping of terminals shall be done by using corrosion inhibitory compound. The cable lugs shall suit the type of terminals provided.

13.4 **STORAGE AND HANDLING OF CABLE DRUMS**

13.4.1 Cable drums shall be unloaded, handled and stored in an approved manner and rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum.

14.0 **DIRECTLY BURIED CABLES**

14.1 The Contractor shall construct the cable trenches required for directly buried cables. The scope of work shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or concrete protective covers, back filling and ramming, supply and installation of route markers and joint markers. The Bidder shall ascertain the soil conditions prevailing at site, before submitting the bid.

14.2 The cable (power and control) between LT station, control room, DG set location and fire lighting pump house shall be laid in the buried cable trenches. In addition to the above, for lighting purpose also, buried cable trench can be used in outdoor area.

14.3 Cable route and joint markers and RCC warning covers shall be provided wherever required. The voltage grade of cables shall be engraved on the marker.

15.0 **INSTALLATION OF CABLES**

15.1 Cabling in the control room shall be done on ladder type cable trays for vertical runs while cabling in switchyard area shall be done on angles in the trench.

15.2 All cables from bay cable trench to equipment's including and all interpole cables (both power and control) for all equipment, shall be laid in PVC pipes of minimum 50 mm nominal outside diameter which shall be buried in the earth at a depth of 250mm below finish formation level. Separate PVC pipes shall be laid for control and power cables. Cable pull boxes of adequate size shall be provided if required.

15.3 Cables shall be generally located adjoining the electrical equipment through the pipe insert embedded in the floor. In the case of equipments located away from cable

trench either pipe inserts shall be embedded in the floor connecting the cable trench and the equipment or in case the distance is small, notch/opening on the wall shall be provided. In all these cases necessary bending radius as recommended by the cable manufacturer shall be maintained.

15.4 Cable racks and supports shall be painted after installation with two coats of metal primer (comprising of red oxide and zinc chromate in a synthetic medium) followed by two finishing coats of aluminum paint.

15.5 Suitable arrangement should be used between fixed pipe / cable trays and equipment terminal boxes, where vibration is anticipated.

15.6 Power and control cables in the cable trench shall be laid in separate tiers. The order of laying of various cables shall be as follows, for cables other than directly buried.

a) Power cables on top tiers.

b) Control instrumentation and other service cables in bottom tiers.

15.7 Single core cables in trefoil formation shall be laid with a distance of three times the diameter of cable between trefoil Centre lines. All power cables shall be laid with a minimum Centre to Centre distance equal to twice the diameter of the cable of higher size of cables.

15.8 Trefoil clamps for single core cables shall be of pressure die cast aluminum (LM-6), Nylon -6 or fiber glass and shall include necessary fixing GI nuts, bolts, washer etc. These are required at every 2 meter of cable runs.

15.9 Power and control cables shall be securely fixed to the trays/supports with self locking type nylon ties with deinterlacing facility at every 5-meter interval for horizontal run. Vertical and inclined cable runs shall be secured with 25 mm wide and 2 mm thick aluminum strip clamps at every 2m.

15.10 Cables shall not be bent below the minimum permissible limit. The permissible limits are as follows:

Table of Cable and	Minimum bending radius
Power cable	12 D
Control cable	10 D

D is overall diameter of cable

15.11 Where cables cross roads, drains and rail tracks, these shall be laid in reinforced spun concrete or steel pipes buried at not less than one-meter depth.

15.12 In each cable run some extra length shall be kept at a suitable point to enable one (for LT cables)/two (for H.T. cables) straight through joints to be made in case the cable develop fault at a later date.

15.13 Selection of cable drums for each run shall be so planned as to avoid using straight

through joints. Cable splices will not be permitted except where called for by the drawings, unavoidable or where permitted by the Owner. If straight through joints are unavoidable, the Contractor shall use the straight through joints kit of reputed make.

15.14 Control cable terminations inside equipment enclosures shall have sufficient lengths so that changing of termination in terminal blocks can be done without requiring any splicing.

15.15 Metal screen and armor of the cable shall be bonded to the earthing system of the station, wherever required by the Owner.

15.16 Rollers shall be used at intervals of about two meters while pulling cables.

15.17 All due care shall be taken during unreeling, laying and termination of cable to avoid damage due to twist, kinks, sharp bends, etc.

15.18 Cable ends shall be kept sealed to prevent damage. In cable vault, fire resistant seal shall be provided underneath the panels.

15.19 Inspection on receipt, unloading and handling of cables shall generally be in accordance with relevant international standard.

15.20 Wherever cable pass through floor or through wall openings or other partitions, GI/PVC wall sleeves with bushes having a smooth curved internal surface so as not to damage the cable, shall be supplied, installed and properly sealed by the Contractor at no extra charges.

15.21 Contractor shall remove the RCC/Steel trench covers before taking up the work and shall replace all the trench covers after the erection-work in that particular area is completed or when further work is not likely to be taken up for some time.

15.22 Contractor shall furnish three copies of the report on work carried out in a particular week, indicating cable numbers, date on which laid, actual length and route, testing carried out, terminations carried out, along with the marked-up copy of the cable schedule and interconnection drawing wherever any modifications are made.

15.23 Contractor shall paint the tray identification number on each run of trays at an interval of 10 m.

15.24 In case the outer sheath of a cable is damaged during handling/installation, the Contractor shall repair it at his own cost to the satisfaction of the Owner. In case any other part of a cable is damaged, the same shall be replaced by a healthy cable at no extra cost to the Owner, i.e. the Contractor shall not be paid for installation and removal of the damaged cable.

15.25 All cable terminations shall be appropriately tightened to ensure secure and reliable connections. The Contractor shall cover the exposed part of all cable lugs whether supplied by him or not with insulating tape, sleeve or paint.

15.26 **Cable trays**

i) The cable trays shall be of G. S. sheet and minimum thickness of sheet shall be 2mm.

ii) The Contractor shall perform all tests and inspection to ensure that material and workmanship are according to the relevant standards.

A 2.5-meter straight section of 300mm, 600mm wide cable tray shall be simply supported at two ends. A uniform distributed load of 76 kg/m shall be applied along the length of the tray. The maximum deflection at the mid-span shall not exceed 7mm.

15.27 **Conduits, Pipes and Duct Installation**

15.27.1 Contractor shall supply and install all rigid conduits, mild steel pipes, flexible conduits, Hume pipes etc. including all necessary sundry materials such as tees, elbows, check nuts, bushing, reducers, enlargers, coupling cap, nipples, gland sealing fittings, pull boxes etc. as specified and to be shown in detailed drawing. The size of the conduit/pipe shall be selected on the basis of 40% fill criterion.

15.27.2 Contractor shall have his own facility for bending, cutting and threading the conduits at site. Cold bending should be used. All cuts & threaded ends shall be made smooth without leaving any sharp edges. Anticorrosive paint shall be applied at all field threaded portions.

15.27.3 All conduit/pipes shall be extended on both sides of wall/floor openings. The fabrication and installation of supports and the clamping shall be included in the scope of work by Contractor.

15.27.4 When two lengths of conduits are joined together through a coupling, running threads equal to twice the length of coupling shall be provided on each conduit to facilitate easy dismantling of two conduits.

15.27.5 Conduit installation shall be permanently connected to earth by means of special approved type of earthing clamps. GI pull wire of adequate size shall be laid in all conduits before installation.

15.27.6 Each conduit run shall be painted with its designation as indicated on the drawings such that it can be identified at each end.

15.27.7 Embedded conduits shall have a minimum concrete cover of 50 mm.

15.27.8 Conduit run sleeves shall be provided with the bushings at each end.

15.27.9 Metallic conduit runs at termination shall have two locknuts and a bushing for connection. Flexible conduits shall also be suitably clamped at each end with the help of bushings. Bushings shall have rounded edges so as not to damage the cables.

15.27.10 Where embedded conduits turn upwards from a slab or fill, the termination dimensions shown on the drawings, if any, shall be taken to represent the position of the straight extension of the conduit external to and immediately following the bend. At least one half of the arc length of the bend shall be embedded.

15.27.11 All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed in an approved manner to prevent damage to threaded portions and entrance of moisture and foreign material.

15.27.12 For under earth runs, Contractor shall excavate and back fill as necessary.

15.27.13 Contractor shall supply, unload, store and install conduits required for the lighting installation as specified. All accessories/fittings required for making the installation complete, including but not limited to pull out boxes, ordinary and inspection tees and elbow, checkouts, male and female bushings (brass or galvanized steel), caps, square headed male plugs, nipples, gland sealing fittings ,pull boxes, conduits terminal boxes, gaskets and box covers, saddle terminal boxes, and all steel supporting work shall be supplied by the Contractor. The conduit fittings shall be of the same material as conduits.

15.27.14 All unarmored cables shall run within the conduits from lighting panels to lighting fixtures, receptacles etc.

15.27.15 Size of conduit for lighting shall be selected by the Contractor during detailed engineering.

15.27.16 Exposed conduits shall be run in straight lines parallel to building columns, beams and walls. Unnecessary bends and crossings shall be avoided to present a neat appearance.

15.27.17 Conduit supports shall be provided at an interval of 750mm for horizontal runs and 1000mm for vertical runs.

15.27.18 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 raw plugs. Wooden plug inserted in the masonry or concrete for conduit support is not acceptable.

15.27.19 Embedded conduits shall be securely fixed in position to preclude any movement. In fixing embedded conduit, if welding or brazing is used, extreme care should be taken to avoid any injury to the inner surface of the conduit.

15.27.20 Spacing of embedded conduits shall be such as to permit flow of concrete between them.

15.27.21 Where conduits are placed along with cable trays, they shall be clamped to supporting steel at an interval of 600mm.

15.27.22 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.

15.27.23 Conduit shall be installed in such a way as to ensure against trouble from trapped condensation.

15.27.24 Conduits shall be kept, wherever possible, at least 300mm away from hot pipes,

heating devices etc. when it is evident that such proximity may reduce the service life of cables.

15.27.25 Slip joints shall be provided when conduits cross structural expansion joints or where long run of exposed conduits are installed, so that temperature change will cause no distortion due to expansion or contraction of conduit run.

15.27.26 For long conduit run, pull boxes shall be provided at suitable intervals to facilitate wiring.

15.27.27 Conduit shall be securely fastened to junction boxes or cabinets, each with a lock nut inside and outside the box.

15.27.28 Conduits joints and connections shall be made thoroughly water-tight and rust proof by application of a thread compound which insulates the joints. White lead is suitable for application on embedded conduit and red lead for exposed conduit.

15.27.29 Field bends shall have a minimum radius of four (4) times the conduit diameter. All bends shall be free of kinks, indentations of flattened surfaces. Heat shall not be applied in making any conduit bend. Separate bends may be used for this purpose.

15.27.30 The entire metallic conduit system, whether embedded or exposed, shall be electrically continuous and thoroughly earthed. Where slip joints are used, suitable bounding shall be provided around the joint to ensure a continuous earth circuit.

15.27.31 After installation, the conduits shall be thoroughly cleaned by compressed air before pulling in the wire.

15.27.32 Lighting fixtures shall not be suspended directly from the junction box in the main conduit run.

16.0 JUNCTION BOX

a) The Contractor shall supply and install junction boxes complete with terminals as required. The brackets, bolts, nuts, screws etc. required for erection are also included in the scope of the Contractor.

b) Junction boxes having volume less than 1600 cubic centimeters may be installed without any support other than that resulting from connecting conduits where two or more rigid metallic conduits enter and accurately position the box. Boxes shall be installed so that they are level, plumb and properly aligned to present a pleasing appearance.

c) Boxes with volumes equal to or greater than 1600 cubic cm, and smaller boxes terminating on less than two rigid metallic conduits or for other reasons not rigidly held, shall be adequately supported by auxiliary steel of standard steel shapes or plates to be fabricated and installed. The Contractor shall perform all drilling, cutting, welding, shimming and bolting required for attachment of supports.

17.0 TESTING AND COMMISSIONING

17.1 An indicative list of tests for testing and commissioning is given below. Contractor

shall perform any additional test based on specialties of the items as per the field Q.P./instructions of the equipment Contractor or Owner without any extra cost to the Owner. The Contractor shall arrange all equipment's instruments and auxiliaries required for testing and commissioning of equipment's alongwith calibration certificates and shall furnish the list of instruments to the Owner for approval.

17.2 **GENERAL CHECKS**

(a) Check for physical damage.

(b) Visual examination of zinc coating/plating.

(c) Check from name plate that all items are as per order/specification.

(d) Check tightness of all bolts, clamps and connecting terminals using torque wrenches.

(e) For oil filled equipment, check for oil leakage, if any. Also check oil level and top up wherever necessary.

(f) Check earth connections for quality of weld and application of zinc rich paint over weld joint of galvanized surfaces.

(g) Check cleanliness of insulator and bushings.

(h) All checks and tests specified by the manufacturers in their drawings and manuals as well as all tests specified in the relevant code of erection.

(i) Check for surface finish of grading rings (Corona control ring).

(j) Pressure test on all pneumatic lines at 18.5 times the rated pressure shall be conducted.

17.3 **STATION EARTHING**

a) Check soil resistivity

b) Check continuity of grid wires

c) Check earth resistance of the entire grid as well as various sections of the same.

d) Check for weld joint and application of zinc rich paint on galvanized surfaces.

e) Dip test on earth conductor prior to use.

17.4 **AAC/ ACSR STRINGING WORK, TUBULAR BUS WORK AND POWER CONNECTORS**

a) Physical check for finish

b) Electrical clearance check

c) Testing of torque by torque wrenches on all bus bar power connectors and other accessories.

d) Millivolt drop test on all power connectors.

e) Sag and tension check on conductors.

17.5 **ALUMINIUM TUBE WELDING**

a) Physical check

b) Millivolt drop test on all joints.

c) Dye penetration test & Radiography test on 10% sample basis on weld joints.

c) Test check on 5% sample joints after cutting the weld piece to observe any voids etc.

17.6 INSULATOR

Visual examination for finish, damage, creepage distance etc.

17.7 All pre/commissioning activities and works work for substation equipment shall be carried out in accordance with owner's ''Pre- Commissioning procedures and formats for substation bay equipment's" by the contractor. This document shall be provided to the successful contractor during detailed engineering stage.

ANNEXURE – A

A. SHORT CIRCUIT FORCES AND SPACER SPAN FOR 220 kV GANTRY STRUCTURE

Sl. No.	Max. Span	Conductor Configuration	Ph-Ph Spacing	Normal Tension	SCF per Phase	Spacer span
I.	**For Fault Level of 40 kA for 1 sec.**					
1.	54 mtr	QUAD ACSR	4.5 mtr	4 T	5.00 T	2.5 mtr
2.	54 mtr	TWIN ACSR	4.5 mtr	2 T	3.50 T	2.5 mtr
3.	74 mtr	TWIN ACSR	4.5 mtr	4 T	5.00 T	2.5 mtr
4.	54 mtr	QUAD ACSR	4.0 mtr	4 T	5.70 T	2.5 mtr
5.	54 mtr	TWIN ACSR	4.0 mtr	2 T	3.50 T	2.5 mtr
6.	74 mtr	TWIN ACSR	4.0 mtr	4 T	5.70 T	2.5 mtr
7.	48 mtr	QUAD ACSR	4.0 mtr	4 T	5.30 T	2.5 mtr
8.	52 mtr	QUAD ACSR	4.0 mtr	4 T	5.35 T	2.5 mtr
9.	68 mtr	TWIN ACSR	4.0 mtr	4 T	5.20 T	2.5 mtr
10.	56 mtr	QUAD ACSR	4.0 mtr	4 T	5.50 T	2.5 mtr
11.	72 mtr	TWIN ACSR	4.0 mtr	4 T	5.27 T	2.5 mtr

NOTE: ACSR conductor as mentioned above indicates that it is suitable for ACSR MOOSE conductor.

B. SHORT CIRCUIT FORCES AND SPACER SPAN FOR 132 kV GANTRY STRUCTURE

Sl. No.	Max. Span	Conductor Configuration	Ph-Ph Spacing	Normal Tension	SCF per Phase	Spacer span
I.	**For Fault Level of 31.5kA for 1 sec.**					
1.	36 mtr	Twin Moose/ Zebra ACSR	3 mtr	1 T	2.15 T	2.5 mtr
2.	31.5 mtr	Twin Moose/ Zebra ACSR	2.7mtr	1 T	2.15 T	2.5 mtr
3.	48 mtr	Single Moose/ Zebra ACSR	3 mtr	1 T	2.05 T	NA
4.	42 mtr	Single Moose/ Zebra ACSR	2.7 mtr	1 T	2.03 T	NA

ANNEXURE-B

STANDARD TECHNICAL DATA SHEETS FOR AAC/ACSR CONDUCTORS, GS EARTHWIRE AND ALUMINIUM TUBE

1.0 GENERAL

Owner has standardized the guaranteed technical particulars for the following AAC/ACSR conductors, Galvanized steel earth wire and aluminum tube. The contractor shall supply the conductors as per the standard GTP mentioned below. Any deviation to the following GTP shall be clearly brought out by the bidder in their bid.

1.1 Guaranteed Technical Particulars (GTP) for conductors:

A. GTP of ACSR MOOSE conductor:

Sl.	Description	Unit	ACSR MOOSE
1.0	**Applicable Standard**	IEC-61089	
2.0	**Raw Materials**		
2.1	Aluminum		
a)	Minimum purity of Aluminum	%	99.50
b)	Maximum copper content	%	0.04
2.2	Steel wires/ rods		
a)	Carbon	%	0.50 to 0.85
b)	Manganese	%	0.50 to 1.10
c)	Phosphorous	%	Not more than 0.035
d)	Sulphur	%	Not more than 0.045
e)	Silicon	%	0.10 to 0.35 (Max.)
2.3	Zinc		
a)	Minimum purity of Zinc	%	99.95
3.0	**Aluminum strands after stranding**		
3.1	Diameter		
a)	Nominal	mm	3.53
b)	Maximum	mm	3.55
c)	Minimum	mm	3.51
3.2	Minimum Breaking load of strand		
a)	Before stranding	KN	1.57
b)	After stranding	KN	1.49
c)	*Maximum D.C. resistance of strand at 20 deg. Centigrade*	*Ohm/ KM*	*2.921*
3.3	Maximum resistance of 1 m length of strand at 20 deg. C	Ohm	0.002921

ANNEXURE-B

Sl.	Description	Unit	ACSR MOOSE
1.0	**Applicable Standard**	IEC-61089	
2.0	**Raw Materials**		
2.1	Aluminum		
4.0	**Steel strand after stranding**		
4.1	Diameter		
a)	Nominal	mm	3.53
b)	Maximum	mm	3.60
c)	Minimum	mm	3.46
4.2	Minimum Breaking load of strand		
a)	Before stranding	KN	12.86
b)	After stranding	KN	12.22
4.3	Galvanizing		
a)	Minimum weight of zinc coating per sq.m.	gm	260
b)	Minimum number of dips that the galvanized strand can withstand in the standard preece test	Nos.	2 dips of one minute & 1 dip of half minute
c)	Min. No. of twists in gauge length equal 100 times the dia. of wire which the strand can withstand in the torsion test (after stranding)	Nos	16 (After stranding) 18 (Before stranding)
5.0	ACSR Conductor		
5.1.a)	Stranding		Al -54/3.53 mm+ Steel-7/3.53 mm
b)	Number of Strands		
i.	Steel center	Nos.	1
ii.	1st Steel Layer	Nos.	6
iii.	1st Aluminum Layer	Nos.	12
iv.	2nd Aluminum Layer	Nos.	18
v.	3rd Aluminum Layer	Nos.	24
5.2	Sectional Area of aluminum	Sq. mm	528.50
5.3	Total sectional area	Sq. mm	597.00
5.4	Approximate Weight	Kg/m	2.004
5.5	Diameter of the conductor	mm	31.77
5.6	UTS of the conductor	kN	161.20 (Min.)
5.7	Lay ratio of the conductor	mm	Max Min
a)	Outer Steel layer	mm	18 16

ANNEXURE-B

Sl.	Description	Unit	ACSR MOOSE
1.0	**Applicable Standard**	IEC-61089	
2.0	**Raw Materials**		
2.1	Aluminum		
b)	8/12 wire Aluminum layer	mm	14 12
c)	14/ 18 wire Aluminum layer	mm	13 11
d)	20/24 wire Aluminum layer	mm	12 10
5.8	DC resistance of the conductor at 20°C	ohm/ km	0.05552
5.9	Standard length of the conductor	m	1800
5.10	Tolerance on Standard length	%	(+/-) 5
5.11	Direction of lay of outer layer	-	Right Hand
5.12	Linear mass of the conductor		
a)	Standard	kg/ km	2004
b)	Minimum	kg/ km	1965
c)	Maximum	kg/ km	2045
5.13	Modulus of Elasticity (Final State)	Kg/sq.mm	6860
5.14	Co-efficient of Linear Expansion	Per Deg. C	$19.3x10^{-6}$
5.15	Minimum Corona Extinction Voltage	KV (rms)	320
5.16	RIV at 1 MHz under dry condition	Micro volts	Max. 1000 at 320 kV (rms)
6.0	**Drum Dimensions**		
a)	Flange Diameter	mm	1800
b)	Traverse width	mm	950
c)	Barrel Diameter	mm	650
d)	Flange thickness	mm	50x50

1.2 Guaranteed technical particulars of Galvanized Steel Earth wire

	Description	Unit	Standard Values
1.0	**Raw Materials**		
1.1	**Steel wires / rods**		
a)	Carbon	%	Not more than 0.55
b)	Manganese	%	0.40 to 0.90
c)	Phosphorous	%	Not more than 0.04

d)	Sulphur	%	Not more than 0.04
e)	Silicon	%	0.15 to 0.35
1.2	**Zinc**		
a)	Minimum purity of Zinc	%	99.95
2.0	**Steel strands**		
2.1	**Diameter**		
a)	Nominal	mm	3.66
b)	Maximum	mm	3.74
c)	Minimum	mm	3.58
2.2.	**Minimum breaking load of strand**		
a)	After stranding	KN	10.58
2.3	**Galvanizing**		
a)	Minimum weight of zinc coating per sq. after stranding	gms.	275
b)	Minimum number of dips that the galvanized strand can withstand in the standard preece test	Nos.	3 dips of 1 minute and one dip of ½ minute
c)	Minimum number of twists in a gauge length equal to 100 times diameter of wire which the strand can withstand in the torsion test, after stranding	Nos.	18
3.0	**Stranded Earth wire**		
3.1	**UTS of Earth wire**	KN	68.4 (min.)
3.2	**Lay length of outer steel layer**		
a)	Standard	mm	181
b)	Maximum	mm	198
c)	Minimum	mm	165
3.3	**Maximum DC resistance of earth wire at 20^0 C**	Ohm/km	3.375
3.4	**Standard length of earth wire**	M	2000 or actual quantity whichever is less.
3.5	**Tolerance on standard length**	%	±5
3.6	**Direction of lay for outside layer**		Right hand
3.7	**Linear mass**		
a)	Standard	Kg/km	583
b)	Maximum	Kg/km	552
c)	Minimum	Kg/km	600

3.8	**Overall diameter**	mm	10.98

1.3 Guaranteed Technical Parameters of Aluminum Tube

A. GTP for 3" IPS & 4" IPS AL. TUBE

Sl. No.	Description	3" AL. TUBE	4" AL. TUBE
1.	Size	3" IPS (EH Type)	4" IPS (EH Type)
2.	Material	Aluminum Alloy 6101 T6 confirms to 63401 WP (range 2) of IS 5082 : 1998/Equivalent BS standard	
3.	Chemical Composition		
i)	Cu	0.05 Max	
ii)	Mg	0.4 to 0.9	
iii)	Si	0.3 to 0.7	
iv)	Fe	0.5 Max	
v)	Mn	0.03 Max	
Vi)	Al	Remainder	
4.	Outer diameter	88.90 mm	114.2 mm
5.	Tolerance on outer diameter	*+2.2 mm, - 0.0 mm*	*+2.2 mm, - 0.0 mm*
6.	Thickness	7.62 mm	8.51 mm
7.	Tolerance on thickness	*+2.2 mm, - 0.0 mm*	*+2.2 mm, - 0.0 mm*
8.	Cross-sectional area	1945.76 sq.mm	2825.61 sq.mm
9.	Weight	5.25 kg/m	7.7 kg/m
10.	Moment of Inertia	*1621589.99 mm^4*	*3972577.97 mm^4*
11.	Section Modulus	*36481.21 mm^3*	*69572.29 mm^3*
12.	Minimum Ultimate Tensile Strength	20.5 Kg/sq.mm	
13.	Temperature co-efficient of resistance	0.00364 per Deg.C	
14.	Minimum Electrical Conductivity at 20 deg.C	55% of IACS	
15.	Linear Temperature Co-efficient of Expansion (20 Deg.C -200 Deg.C)	0.000023	
16.	Modulus of Elasticity	6700 Kg/sq.mm	
17.	Minimum Elongation on 50 mm	10%	
18.	Thermal Conductivity at 100 Deg.C	0.43 Calories/sec/sq.mm/cm/deg.C	
19.	Minimum 0.2% proof stress	17.34 Kg/sq.mm	
20	Minimum Yield point	17.50 Kg/sq.mm	17.50 Kg/sq.mm
21	Minimum Breaking Strength	20.42 Kg/sq.mm	20.42 Kg/sq.mm

ANNEXURE-C

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

Unless otherwise stipulated, all 220kV & 132kV equipment 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% and 110% 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 noisel meter.

4. 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 110% of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 110%, 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%, and 110%. 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 be 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.

In case corona inception does not take place at 110%, voltage shall not be increased further and corona extinction voltage shall be considered adequate.

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 energization 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) Back earth 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 of 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

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SECTION-XVI
STRUCTURE

1.0 GENERAL

The scope of specification covers design, fabrication, trial assembly, supply and erection of galvanized steel structures for towers, girders, lightning masts and equipment support structures. Structures shall be lattice or Pipe type structure fabricated from structural steel conforming to relevant Indian standard Codes (IS Codes)/ equivalent International Standards.

Line diagrams of Towers, girders, Lightning mast, equipment support structures for 220kV structures enclosed with the tender document are for information only. However, **the line diagram of all structures of 220 kV, 132kV and 33 kV for new switch yards shall be prepared by the contractor based on their design during detailed engineering stage**. The fabrication drawing/line diagram of structures for extension of existing switch yards shall be furnished by Employer to the successful bidder progressively during detailed engineering stage. The bidder shall mention in their bid for the type of proposed structure i.e. Pipe or lattice type structure. The fabrication drawings, proto corrected drawings along with Bill of Material (BOM) for all the structures (Both Gantry and Equipment support structures) shall be prepared by the contractor during detailed engineering for submission to Employer for their approval. Support structure for circuit breaker shall also be designed by the Manufacturer/Contractor.

It is the intent of the Employer to provide structures which allow interchangeability of equipment's at a later stage. Accordingly, Contractor is expected to design the equipment support structures with the provision of stool. Stools shall be provided by the Contractor between the equipment and its support structure to match the bus bar height. The top of stool shall be connected to the equipment and the bottom of the stool shall be connected to the Base support structure.

The scope shall include supply and erection of all types of structures including bolts, nuts, washers, 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 with base plates and embedded anchor/foundation bolts. All steel structures and anchor/foundation bolts, fasteners (Nuts, bolts, washers) shall be fully galvanized as per relevant Indian standard Codes (IS Codes) / equivalent International Standards. The weight of the zinc coating shall be at least 610 grams /sq. m 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.

Contractor shall provide suitable arrangement on the equipment support structures wherever required to suit fixation of accessories such as marshalling boxes, MOM boxes, Control Cabinets, Junction box, surge counter, etc. in the equipment structure fabrication drawings.

2.0 DESIGN REQUIREMENTS FOR STRUCTURES

2.1 For design of steel structures loads such as dead loads, live loads, wind loads etc. shall be based on relevant Indian standard Codes (IS Codes) / equivalent International Standards.

2.2 For materials and permissible stresses, relevant Indian standard Codes (IS Codes) / equivalent International Standards. Shall be followed in general. However, additional requirements given in following paragraphs shall be also considered.

2.3 Minimum thickness of galvanized lattice structure member shall be as follows:

Members	Min Thickness (mm)
Leg members, Ground wire	5
Peak members\/Main members	5
Other members	4
Redundant members	4

2.4 Maximum slenderness ratios for leg members, other stressed members and redundant members for compression force shall be as per relevant Indian standard Codes (IS Codes) / equivalent International Standards.

2.5 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.

2.6 All bolts shall be M16 or higher as per design requirement.

2.7 **Step Bolts**

In order to facilitate inspection and maintenance, the tower structures shall be provided with climbing devices. Each tower shall be provided with M16 step bolts 175mm long spaced not more than 450mm apart, staggered on faces on diagonally opposite legs extending from about 0.5 meters above plinth level to the top of the tower. The step bolt shall conform to relevant Indian standard Codes (IS Codes) / equivalent International Standards. Ladders along with safety guard shall be provided for the Lightning Mast Tower.

2.8 **Design Criteria**

a) All gantry structures shall be designed for the worst combination of dead loads, live loads, wind loads and Seismic forces as per relevant Indian standard Codes (IS Codes) / equivalent International Standards. (latest), 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 for 220kV, 31.5KA for 132kV and 25KA for 33kV or as applicable. Relevant Indian standard Codes (IS Codes) / equivalent International Standards. 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.

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 gantries shall be designed for a minimum conductor tension of 2 metric tons per phase for 220 kV, 1 Metric tons per phase for 132 kV and 0.50 Metric Ton for 33 kV or as per requirements whichever is higher. The distance between terminal gantry and dead-end tower shall be taken as 200 meters for 220kV, 150m for 132kV and 80 m for 33 kV switch yard. The design of these terminal gantries shall also be checked considering +/- 30 deg deviation of conductor in both vertical and horizontal planes. For other gantries the structural layout requirements shall be adopted in design.

e) The girders / beams shall be connected with lattice/Tower columns by bolted joints.

f). All equipment support structures 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 relevant Indian standard Codes (IS Codes) / equivalent International Standards.

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.

i) The height of Lightning Mast shall be as per approved structural layout and designed for diagonal wind condition. . The lightning mast shall be provided with platform for mounting of lighting fixtures and a structural steel ladder within its base up to the level of platform. The ladder shall be provided with protection rings The platforms shall also have protection railing. The details of lighting fixtures would be as per approved drawings of electrical fixtures.

3.0 DESIGN, DRAWINGS, BILL OF MATETRIALS AND DOCUMENTS

3.1 The Contractor shall submit design and line diagram of each structure for approval of Employer. Fabrication drawing based on approved line diagram shall be prepared by the contractor for approval of Employer. The BOM (Bill Of Material) shall be prepared by the contractor based on approved fabrication drawing. The Line diagram should indicate not only profile, but section, numbers and sizes of bolts and details of typical joints. In case Employer feels that any design or drawings are to be modified even after its approval, Contractor shall modify the designs & drawings and resubmit the same for approval.

3.2 The 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. The fabrication drawing and bill of material based on design/line diagram shall be submitted to Employer for approval. Approved bill of materials prepared on the basis of fabrication drawing shall be the basis for payment.

3.3 Such approvals shall, however, not relieve the contractor of his responsibility for safety and durability of the structure and good connection and any loss occurring due to defective fabrication, design or workmanship shall be borne by the contractor.

3.4 The contractor shall submit editable soft copy of all designs preferably in Stead / excel form and drawings in AutoCAD to Employer`. The list of Indian standard codes relevant to steel structures have been given in Section-Civil Work section of technical specification This list is illustrative but not exhaustive. The contractor shall submit the copy of relevant portion of IS codes/equivalent International standard referred to Employer for reference if necessary during detailed engineering stage.

4.0 FABRICATION AND ERECTION

4.1 The fabrication and erection works shall be carried out generally in accordance with relevant Indian standard Codes (IS Codes) / equivalent International Standards. All materials shall be completely shop fabricated and finished with proper connection material and erection marks for ready assembly in the field.

4.2 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.

4.3 Sample towers, beams and lightning masts and equipment support structures may be trial assembled in the fabrication shop to ensure fitment of various members and to avoid problems during erection.

4.4 For all structures, BOM along with fabrication drawings in hard and editable soft copies shall be submitted to Employer `as document for information. The responsibility of correctness of such fabrication drawing and BOM shall be fully with the contractor.

4.5 Approval of fabrication drawings and BOM shall, however, not relieve the Contractor of his responsibility for the safety and durability 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.

4.6 The Contractor should arrange on his own all plant and equipment, welding set, tools and tackles, scaffolding, trestles equipment's 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. Minor modification if any, required during erection shall be done at site with the approval of Employer.

5.0 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) In case of fasteners, the galvanizing shall confirm to relevant Indian standard Codes (IS Codes) / equivalent International Standards. The spring washer shall be electro galvanized as per relevant Indian standard Codes (IS Codes) / equivalent International Standards.

6.0 WELDING

The work shall be done as per approved fabrication drawings which shall clearly indicate various details of joints to be welded, type of weld, length and size of weld, Symbols for welding on erection and shop drawings shall be according to relevant Indian standard Codes (IS Codes) / equivalent International Standards. Welding shall be carried out in accordance to relevant Indian standard Codes (IS Codes) / equivalent International Standards.

7.0 FOUNDATION BOLTS

7.1 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.

7.2 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.

7.3 All foundation bolts for lattice structure, pipe structure are to be supplied by the Contractor.

7.4 All foundation bolts shall be fully galvanized so as to achieve minimum 610 grams Per Sq. of Zinc Coating as per relevant Indian standard Codes (IS Codes) / equivalent International Standards.

7.5 All foundation bolts and its material shall conform to relevant Indian standard Codes (IS Codes) / equivalent International Standards. All foundation bolts shall be provided with two number standard nuts, one check nut, one plain washer and MS plate at the bottom of foundation bolt.

8.0 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.

9.0 GROUTING

The method of grouting the column bases shall be subject to approval of Employer and shall be such as to ensure a complete uniformity of contact over the whole area of the steel base. No additional payment for grouting shall be admissible.

10.0 GALVANISING

10.1 All structural steel works (Gantry structures, Equipment support structures) and foundation bolts shall be galvanized after fabrication. The galvanization shall be done as per requirement relevant Indian standard Codes (IS Codes) / equivalent International Standards.

10.2 Zinc required for galvanizing shall have to be arranged by the Contractor/manufacturer. Purity of zinc to be used shall be 99.95% as per relevant Indian standard Codes (IS Codes) / equivalent International Standards.

10.3 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.

11.0 TOUCH-UP PAINTING

Minor defects in hot dip galvanized members shall be repaired by applying zinc rich primer and two coats of enamel paint to the satisfaction of Employer before erection.

12.0 INSPECTION BEFORE DISPATCH

Each part of the fabricated steel work shall be inspected as per approved quality plans and certified by Employer 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.

13.0 TEST CERTIFICATE

Copies of all test certificates relating to material procured by the Contractor for the works shall be submitted to Employer.

14.0 MODE OF MEASUREMENT

The measurement of the structure, fasteners (Nuts, Bolts, and Washers) and foundation bolts including its nuts washers and MS Plate at bottom shall be done as per Bid price schedule (BPS). The weight of all structural members, fasteners, step bolts and foundation bolts (Bolt, Nuts, washer and MS steel plates welded at bottom of bolt) shall be measured under one head in Metric ton.

15.0 SAFETY PRECAUTIONS

The Contractor shall strictly follow all precautions at all stages of fabrication, transportation and erection of steel structures. The stipulations contained in relevant Indian standard Codes (IS Codes) / equivalent International Standards.

for Safety during erection of structural steel work shall also be adhered to.

16.0 MANUFACTURING QUALITY PLAN

The material specification shall also be as per relevant Indian standard Codes (IS Codes) / equivalent International Standards.

The Contractor shall prepare the manufacturing quality plan to accept/check the material, galvanization and welding as per relevant international standards/IS codes within 1 month after award of work and submit the same to Employer for approval.

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SECTION-XVII
CIVIL WORKS

1.0 GENERAL

The intent of specification covers the following:

Design, engineering, drawing and construction of all civil works at sub-station. All civil works shall also satisfy the general technical requirements specified in other Sections of Specification and as detailed below. They shall be designed to the required service conditions/loads as specified elsewhere in this Specification or implied as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

All civil works shall be carried out as per applicable Standards and Codes. All materials shall be of best quality conforming to relevant national/International Standards and Codes. In case of any conflict between Standards/ Code and Technical Specification, the provisions of Technical Specification shall prevail. In case any item is not covered under specification then same shall be carried out as per CPWD specification and applicable standards and codes.

The Contractor shall furnish all design, drawings, labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with approved drawings, specifications and direction of Employer.

The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the Employer. For all buildings, structures, foundations etc. necessary layout and details shall be developed by the Contractor keeping in view the functional requirement of the substation facilities and providing enough space and access for operation, use and maintenance. Certain minimum requirements are indicated in this specification for guidance purposes only. However, the Contractor shall quote according to the complete requirements.

2.0 GEOTECHNICAL INVESTIGATION

2.1 The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate, general as well as specific information about the soil profile and the necessary soil parameters of the Site in order that the foundation of the various structures can be designed and constructed safely and rationally.
A detailed soil report including field data duly certified by site engineers of Employer will be submitted by the Contractor for specific approval of Employer**.** The report shall contain all soil parameters along with recommendation of soil consultant for type of foundation i.e. pile or open type, soil treatment if any etc. to be used for the design of civil foundations.

2.2 The Contractor may visit the site to ascertain the soil parameters. Any variation in soil data shall not constitute a valid reason for any additional cost & shall not affect the terms & conditions of the contract. Field tests must be conducted covering entire substation area including all the critical locations i.e. Control Room and GIS Building, Lightning Mast. Towers, transformer/Reactor etc.

2.3 **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 Employer.

All the work shall be carried out as per latest edition of the corresponding relevant Indian standard codes (I S Codes)/ equivalent International Standards. The Agency carrying out the soil investigation work must have the experience of carrying out soil investigation successfully in the relevant field. /RECTPCL/PDD, J&K shall assess the capability of the agency for soil investigation before commencement of soil investigation work.

2.3.1 **Bore Holes**

Bore holes of Minimum 150 mm diameter in accordance with the provisions of relevant international standards/Indian standards(IS) at the rate of minimum one number bore hole per hectare up to 25meter depth(Minimum) or to refusal which ever occur earlier shall be drilled for new areas (220 kV Yards and 220/132/33 kV yards wherever applicable). In any case number of boreholes shall not be less than five. 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 are 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 30 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. Standard Penetration Test shall be performed as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

Undisturbed samples shall be collected in accordance with the recommendation of relevant Indian standard codes (I S Codes)/ equivalent International Standards. Or an alternative recognize method as agreed by Employer. Undisturbed samples shall be taken in cohesive material or weak cemented granular material where ever possible at 1.0 m interval or at each change in stratum.

The depth of Water Table, if encountered, shall be recorded in each borehole. In case the soil investigation is carried out in winter/summer, the water table for rainy season shall be collected from reliable sources and recorded in the report.

All samples, both disturbed and undisturbed, shall be identified properly with the borehole number and depth from which they have been taken.

The sample shall be sealed at both ends of the sampling tubes with wax immediately after the sampling and shall be packed properly and transported to the Contractor's laboratory without any damage or loss.

The logging of the boreholes shall be compiled immediately after the boring is completed and a copy of the bore log shall be handed over to the Executive Engineer-in-charge.

2.3.2 **Trial Pits**

The Contractor shall excavate two number trial pits per substation (New) as and where directed by Employer, of Plan area 2x2 sq.m. and not exceeding 4 m depth. Undisturbed samples shall be taken from the trial pits as per the direction of the Employer. All Trial Pits shall be re-filled with approved material after the tests are complete and shall be compacted in layers of not more than 500mm.

2.3.3 **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 equipment's and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall confirm to relevant Indian standard codes (I S: 3043)/ equivalent International Standards. The test shall be conducted using Wagner's four electrode method as specified in relevant Indian standard codes (IS: 1892)/ equivalent International Standards. Unless otherwise specified at each test location, the test shall be conducted along two perpendicular lines parallel to the coordinate axis. On each line a minimum of 8 to 10 readings shall be taken by changing the spacing of the electrodes from an initial small value of 0.2 m up to a distance of 50.0 m.

2.3.4 **Plate load test**

Two number of Plate load tests shall be conducted each at the location of control room / GIS building and Substation area as applicable only to determine the bearing capacity, modulus of

sub grade reaction and load/settlement characteristics of soil at shallow depths by loading a plane and level steel plate kept at the desired depth and measuring the settlement under different loads, until a desired settlement takes place or failure occurs. The specification for the equipment and accessories required for conducting the test, the test procedure, field observations and reporting of results shall conform to relevant IS:1888. Plate load test shall be performed at the proposed foundation depth below finished ground level for bearing capacity.

Undisturbed tube samples shall also be collected from the pit at 1.0 m depth and bottom of pit from natural ground level for carrying out laboratory tests.

The size of the pit in plate load test shall not be less than five times the plate size and shall be taken up to the specified depth. All provisions regarding excavation and visual examination of pit shall apply here.

Unless otherwise specified the reaction method of loading shall be adopted. Settlement shall be recorded from dial gauges placed at four diametrically opposite ends of the test plate.

The load shall be increased in stages. Under each loading stage, record of Time vs. Settlement shall be kept as specified in relevant Indian standard codes (I S: 1888)/ equivalent International Standards.
Backfilling of the pit shall be carried out as per the directions of the Employer**.** 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.

2.3.5 **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.

2.3.6 **Back Filling of Bore Holes**

On completion of each hole, the Contractor shall backfill all bore holes as directed by the Employer. The backfill material can be the excavated material.

2.3.7 **Laboratory Test**

1. The laboratory tests shall be carried out progressively during the field work after sufficient number of samples has reached the laboratory in order that the test results of the initial bore holes can be made use of in planning the later stages of the field investigation and quantum of laboratory tests.

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 Indian standard codes (I S Codes)/ equivalent International Standards.

The following laboratory tests shall be carried out

a) Visual and Engineering Classification

b) Liquid limit, plastic limit and Shrinkage limits for C-Φ soils.

c) Natural moisture content, bulk density and specific gravity.
d) Grain size distribution analysis.
e) Swell pressure and free swell index determination.
f) California bearing ratio.
g) Consolidated drained test with pore pressure measurement.

h) Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, Ph value, and organic matter and any other chemical harmful to the concrete foundation.

i) In case rock is encountered, the soil test required for rock as per relevant Indian standard codes (I S Codes)/ equivalent International Standards including following tests shall also be conducted.
(i) UCC test.
(ii) Point load index test.

2.3.8 **Test Results and Reports**

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. The contractor shall also submit the bearing capacity calculation in editable soft copy to Employer. 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 field and laboratory test data shall bear the signatures of the Investigation Agency, Contractor and also site representative of Employer.

The report shall include, but not limited to the following: -

a) A plan showing the locations of the exploration work i.e. bore holes, trial pits. Plate load test, electrical resistivity test, CBR sample location etc.

b) Bore Logs: Bore logs of each bore holes clearly identifying the stratification and the type of soil stratum with depth. The values of Standard Penetration Test (SPT) at the

depths where the tests were conducted on the samples collected at various depths shall be clearly shown against that particular stratum.

Test results of field and laboratory tests shall be summarised strata wise as well in combined tabular form. All relevant graphs, charts tables, diagrams and photographs, if any, shall be submitted along with report. Sample illustrative reference calculations for settlement, bearing capacity, pile capacity shall be enclosed.

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 Employer. The observations and recommendations shall include but not limited to the following:

a) Geological formation of the area, past observations or historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table etc.

b) Recommended type of foundations for various structures. If piles are recommended the type, size and capacity of pile and groups of piles shall be given after comparing different types and sizes of piles and pile groups.

c) Allowable bearing pressure on the soil at various depths for different sizes of the foundations based on shear strength and settlement characteristics of soil with supporting calculations. Minimum factor of safety for calculating net safe bearing capacity shall be taken as 3.0 (three). Recommendation of liquefaction characteristics of soil if applicable shall be provided.

d) Recommendations regarding slope of excavations and dewatering schemes, if required.

e) Comments on the Chemical nature of soil and ground water with due regard to deleterious effects of the same on concrete and steel and recommendations for protective measures.

f) If expansive soil is met with, recommendations on removal or detainment of the same under the structure, road, drains, etc. and thickness of treatment shall be given. In the latter case detailed specification of any special treatment required including specification or materials to be used, construction method, equipment's to be deployed etc. shall be furnished. Illustrative diagram of a symbolic foundation showing details shall be furnished.

g) Recommendations for additional investigations beyond the scope of the present work, if considered such investigation as necessary.

f) In case of foundation in rocky strata, type of foundation and recommendation regarding rock anchoring etc. should also be given.

3.0 CONTOUR SURVEY, SITE LEVELLING

3.1 CONTOUR SURVEY & SITE LEVELLING:

The land for construction of substation will be handed over to the successful bidder as on where basis progressively after award of work. The contractor shall carry out survey work by taking spot level at 05 m x 05 m grid interval with respect to temporary bench mark transferred from permanent bench mark in the locality if available either on bridge, government buildings of local authorities or any other permanent structure. The contractor shall submit the spot levels (in grid format) in editable soft copy in excel format and contour map with contour interval of 0.5 m in editable auto cad soft drawing.

The contractor will level the area required for construction of substation work either at single level, multi-level or gradual slope with the finished ground level as approved by Employer during detailed engineering based on highest flood level. The levelling area shall be decided by Employer during detailed Engineering stage.

The layout and levels of all structure etc. shall be made by the Contractor at his own cost from the general grids of the plot and benchmarks set by the Contractor and approved by Employer. The Contractor shall provide all assistance in instruments, materials and personnel to Employer for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels.

3.2 SCOPE

This clause covers clearance of site, contour survey, site levelling, maintaining finished ground level by cutting/filling in all types of soil and soft/ disintegrated rock, supplying and compaction of fill material if required. Cutting/felling of trees and their disposal has not been envisaged under the present scope.

3.3 GENERAL

Site shall be cleared, surveyed and levelled/sloped by the contractor as per approved general arrangement drawing or levelling area decided during detailed engineering after award of work.

Work covered under this clause comprises the site clearance, survey work/setting out and making profiles (preparation of plot plan, setting up Bench Mark and taking spot levels at 05m x 05 m interval, preparation of contour plan with contour interval of 0.50 m), Earth work in Excavation & filling in specified area with all lifts and leads and earth work in filling with borrowed earth with all leads and lifts (Borrow areas including payment of royalty for borrowed earth shall be arranged by the contractor at his own cost). During detailed engineering stage, the contractor will prepare the levelling proposal for optimum levelling and submit to Employer for approval. Contractor shall submit the hard copy and editable soft

copy of levelling proposal (levelling quantity calculation in Excel form and levelling drawing in Auto CAD) to Employer for approval.

3.4 Filling material shall conform to relevant Indian standard codes (IS Codes)/ equivalent International Standards. Unsuitable filling material if any shall be removed and replaced by suitable fill material. The filling shall be compacted in layers to achieve 95% of standard Proctor's density at Optimum moisture contents (OMC). Cohesion less material shall be compacted to 70% relative density (minimum). Levelling/Filling shall be carried out as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

3.5 All materials involved in excavation shall be classified by Employer in the following groups:

3.5.1 **All kinds of soils and soft/disintegrated rocks (Not requiring blasting):** The material which can be quaried/excavated with pick, shovel, jumpers, scarifiers, crowbars and mechanical implements and will include various types of soils, plain cement concrete, shingle, river/nallah boulders, soling of road/foot path, stone masonary, soft conglomerate and laterite stone, lime stone and hard conglomerate etc.

3.5.2 **Hard Rocks**: All kinds of rocks which can only be excavated by machines and requires blasting, chiselling in edging or in another agreed method and will also include reinforcement cement concrete.

3.6 The quantity of excavation in all types of soils and soft/disintegrated rock shall be worked out by using initial and final level and no void deduction shall be made to calculate net quantity of earth work with 95% compaction.

3.7 The volume of hard rock shall be computed on the basis of stack of excavated rubble after making 50 % deduction for voids.

3.8 The surface of excavation or filling shall be neatly dressed to the required formation level with tolerance of (±) 100 mm.

4.0 SITE PREPERATION, EXCAVATION, BACKFILL & DISPOSAL OF SURPLUS EARTH.

4.1 SITE PREPERATION

The layout and levels of all structure etc. shall be made by the Contractor at his own cost from the general grids of the plot and benchmarks set by the Contractor and approved by the Employer. The Contractor shall give all help in instruments, materials and personnel to the Employer for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels.

4.2 SCOPE

This clause covers clearing of the site, maintaining the finished ground level with available surplus excavated suitable back fill material generated from foundation works etc.

4.3 GENERAL

1) The Contractor shall develop the site area to meet the requirement of the intended purpose. The site preparation shall conform to the requirements of relevant sections

of this specification or as per stipulations of relevant Indian standard codes (I S Codes)/ equivalent International Standards.

2) The fill material shall be suitable for the above requirement. The fill shall be with such a material that the site so designed shall not be affected by erosion from wind and water 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 to be approved by the Employer.

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 purchaser up to a maximum lead of 2 km.

4.4 EXCAVATION AND BACKFILL

SCOPE

This clause covers excavation for foundation works of Towers, Equipment support structures, Transformer/Reactor foundations, External Lighting poles, Cable trenches, Buildings, Car parking shed, Fire Wall, DG set, Water tanks, etc. backfilling of Foundations Works.

1. Excavation and backfill for foundations shall be in accordance with the relevant Indian standard codes (I S Codes)/ equivalent International Standards.

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 Purchaser. 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.

4.5 COMPACTION

1. The density to which fill materials shall be compacted shall be as per relevant IS and as per direction of Employer. 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 centre 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.

4.6 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 Employer.

4.7 DISPOSAL OF SURPLUS EARTH

The surplus earth generated from foundation work shall be disposed away from levelling area boundary at low lying areas within 2Km lead. The surplus earth if disposed within substation main boundary, the same shall be spread in uniform layers and compacted with suitable compacting equipment to achieve 95% compaction at O.M.C.

5.0 ANTIWEED TREATMENT & STONE SPREADING

5.1 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.

Stone spreading along with cement concrete layer shall be done in the areas of the switchyard under present scope of work within fenced area. However the stone spreading along with cement concrete layer in future areas within fenced area shall also to be provided in case step potential without stone layer is not well within safe limits.

5.2 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 Employer.

The material to be used for stone filling/site surfacing shall be uncrushed/crushed/broken stone of 40mm nominal size (ungraded single size) conforming to relevant IS. Hardness, flakiness shall be as required for wearing courses shall be as are per relevant IS.

(a) Hardness
Abrasion value as per relevant IS.
Impact value as per relevant IS.

(b) Flakiness Index
One test shall be conducted as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

After all the structures/equipment's are erected, anti-weed 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 of chemical to be used. The anti-weed 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 (appx.) and shall be sprinkled with water at least once in the afternoon every day 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 Employer. The final approval shall be given by Employer based on the results.

Employer 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.

After anti weed treatment is complete, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by Employer. 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.

In areas that are considered by the Employer to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipment's, 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.

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.

Over the prepared sub grade, 75mm thick base layer of cement concrete in 1:5:10 (1 cement :5 sand : 10 Stone aggregates) 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 centre of the area between the nearest drains. The above slope shall be provided at the top of base layer of cement concrete in 1:5:10. A layer of cement slurry of mix 1:6 (1 cement: 6 sand) shall be laid uniformly over cement concrete layer. The cement consumption for cement slurry shall not be less than 150 kg. per 100 sq.m.

A final layer of 100mm thickness of uncrushed/crushed/broken stone of 40mm nominal size (ungraded size) shall be spread uniformly over cement concrete layer after curing is complete.

6.0 SITE DRAINAGE

Preparation of overall drainage layout, design, drawing and providing rain water drainage system within the substation 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 metre drain outside the boundary wall is in the scope of contractor. Outfall point shall be got approved from Employer before commencement of construction. While designing the drainage system following points shall be taken care of:

(a) The surface of the switchyard shall be sloped to prevent accumulation of water.
(b) Drain shall be constructed at suitable locations in such a way that substation is not flooded and roads are not affected with ponding of surface water. In the switchyard

maximum spacing between two drains shall not be more than 100 meter. It will be ensured that no area is left undrained.

(c) Open surface drains having 300mm bottom width and 300mm depth at starting point of drain shall be provided. The depth of drain shall be measured with respect to finished ground level of switch yard i.e. from bottom of switch yard stone filling.

(d) Longitudinal slope shall not be less than 1 in 1000.

(e) Open surface drains shall be constructed with brick masonry or concrete blocks. As per design of contractor. PCC (1:2:4) shall be laid over 40mm thick layer of PCC 1:4:8 (1 cement: 4coarse sand: 8 stone aggregate 20mm nominal size.)

(f) The side wall of the drains shall be 25 mm above the gravel level to prevent falling of gravel into drain. Groove of 125 mm width shall be provided at 2000 mm spacing with suitable mild steel grating.

(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, relevant Indian standard codes (I S Codes)/ equivalent International Standards. shall be followed.

(j) Two Nos. of portable pumps of 3 / 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 max. 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 Employer before commencement of construction.

6.1 RAINWATER HARVESTING:

In addition to drainage of rainwater in accordance with above clause 6.0, the contractor shall design, prepare drawings and provide rainwater harvesting system also. Rainwater harvesting shall not be done if the depth of underground water table is within 8.0m from finished ground level or as per provision of relevant Indian standard codes (I S Codes)/ equivalent International Standards. While designing the rain water harvesting system, following points may be taken care of:

Rainwater harvesting shall be done by providing two numbers recharge structures with bore wells. The recharge structures 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 structures.

The internal diameter of recharge shafts shall be 4.5 meter with 230mm thick lining of brick work up to a depth of 2.0 meter from ground level and 345mm thick brickwork below 2.0 meter depth. The brick/concrete block work shall be constructed with cement mortar 1:6 (1 cement: 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 sq.m. Two openings of size 0.7 x 0.7 meter shall be provided in the RCC cover slab as shown in the drawing. 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.

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.

A 100 mm dia. medium duty MS pipe conforming to relevant IS 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 dia. shall be provided for a length of 2.0 meter starting from the bottom level of coarse sand and down wards. The overall length of pipe shall be equal to total depth of bore well plus depth of shaft.

Gravel of size 3mm to 6mm shall be filled around 100 dia. MS pipe in the borewell. 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.

7.0 ROADS

a). All the roads as required for the Substation as per approved General Arrangement drawing for the substation are in the present scope. Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. Road to the Transformer /Reactor shall be as short and straight as possible.

b) All concrete roads within substation boundary wall shall be with 3.75 m or 5.5m (as indicated in drawing) RCC concrete pavement of suitable thickness and 1.3 m wide earthen shoulder on either side of the road. Below RCC concrete pavement, water bound macadam of adequate thickness as per design (WBM) shall be laid.

c) All black top (Bituminous/Asphalt) roads within substation boundary wall if any shall be with 3.75 m asphaltic pavement of suitable thickness and 1.3 m wide earthen shoulder on either side of the road. Below black top pavement, water bound macadam of adequate thickness as per design (WBM) shall be laid.

d) Strengthening of existing roads as applicable shall be carried out with 2.5 cm thick premix carpet and 100 mm thick compacted layer of WBM (Water Bound Macadum) after filling the pot holes of existing roads with WBM material.

e) All roads shall be designed as per relevant Indian standard codes (I S Codes)/ equivalent International Standards. All drawings of road and culverts shall be prepared by the contractor.

f) All the culverts and allied structures (required for road/rail, drain, trench crossings etc.) shall be designed as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

8.0 TRANSFORMERS/REACTOR FOUNDATION, RAIL TRACK/ RAIL CUM ROAD TRACK

The Contractor shall design, prepare drawing and provide a RCC Rail cum road system integrated with the Transformer/Reactor 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 nearest road. If trench/drain crossings are required then suitable R.C.C. culverts shall be provided in accordance with relevant IS.

The Contractor shall provide a pylon support system for supporting the fire fighting system.

Each Transformer / Reactor 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/Reactor shall be 20% of the Transformer /Reactor height or 0.8m whichever is more. The oil collection pit thus formed shall have a void volume equal to 200% volume for 220 kV & above and 130% for 132 kV & below of total oil in the Transformer / Reactor. The minimum height of the retaining walls shall be 15 cm above the finished level of the ground to avoid outside water pouring inside the pit. The bottom of the pit shall have uniform slope towards the sump pit. While designing the oil collection pit, the movement of the Transformer must be taken into account.

The grating shall be made of MS flat of size 40mmx 5mm placed at 30mm center to center and 25mmx5mm MS flat at spacing of 150mm at right angle to each other. Maximum length of grating shall be 2000mm 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. All steel works used for grating and support in transformer foundation shall be painted with Zinc phosphate primer (two packs) conforming to relevant Indian standard codes (I S Codes)/ equivalent International Standards.

Each oil collection pit shall be drained towards a sump pit within the collection pit whose role is to drain water and oil due to leakage within the collection pit so that collection pit remains dry.

8.1 MATERIALS

Complete foundation shall be made of reinforced cement concrete and shall be designed as per guidelines for design of foundations given in clause 10.0 in the specification.

8.2 DRAINAGE

One 0.5/1.0 H.P pump for each pit shall be supplied and installed by the Contractor to evacuate the fire fighting & rain water from the sump pit in to the nearest drain.

9.0 FIRE PROTECTION WALLS

9.1 GENERAL

Fire protection walls shall be provided, if required, in accordance with Local Advisory Committee (LAC) recommendations. The scope of works covers design, preparation of drawing and construction of RCC fire protection walls. While designing the wall, following points may be taken care of:

9.1.1 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.

9.1.2 DIMENSIONS

The firewall shall extend 600 mm on each side of the Transformer /Reactors and 600 mm above the conservator tank or safety vent.

These dimensions might be reduced in special cases, as per the approval of owner where there is lack of space. A minimum of 2.0meter clearance shall be provided between the equipment's e.g. Transformer /Reactors and firewalls.

The building walls, which act as firewalls, shall extend at least 1 m above the roof in order to protect it.

9.1.3 MATERIALS

The firewall will be made of reinforced cement concrete as per the relevant Indian standard codes (I S Codes)/ equivalent International Standards.

10.0 CABLE TRENCHES AND CABLE TRENCH CROSSINGS

The work covered under this clause comprises of design, drawing and construction of cable trenches and cable trench crossings. While designing, following points may be taken care of:

a). The cable trenches and pre-cast removable RCC cover (with lifting arrangement) shall be constructed using RCC of M25 (Minimum) grade as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

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 centre of span on each panel.

d). Necessary sumps shall be provided and each sump shall be provided with pumps of 5 / 3 HP capacity, shall be supplied for pumping out water collected in cable trench. Cable trenches shall not be used as storm water drains.

e). The top of trenches shall be kept at least 100 mm above the finished ground level. 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 and plaster with 12mm thick 1:6 cement sand mortar.

J) Cable trench crossings shall be designed for critical load likely to be passed over the crossing. The cable trench crossing may be of either RCC box culvert type or RCC hume pipes embedded in plain concrete as per design of contractor.

11.0 FOUNDATION / RCC CONSTRUCTION

11.1 GENERAL

1. Work covered under this Clause of the Specification comprises the design ,drawing and construction of foundations and other RCC constructions for switchyard tower structures, bus supports, equipment supports, cable trenches, Transformer /Reactors, jacking pad, pulling blocks, fire protection walls, control cubicles, marshalling kiosks, auxiliary equipment's, Control Room Cum Administrative building, GIS hall, Fire fighting Pump house, fire fighting water tanks, Auxiliary Building, Panel room, ,Security room, Parking shed ,RCC retaining wall, or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to the other RCC constructions.

2. Concrete shall conform to the requirements mentioned in relevant Indian standard codes (I S Codes)/ equivalent International Standards. And all the tests shall be conducted as per relevant Indian standard codes (I S Codes)/ equivalent International Standards. However, a minimum grade of M25 (design Mix) concrete shall be used for all foundations and structural/load bearing members as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

3. If the site is sloppy, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate such slopes.

4. The switchyard foundation's plinths and building plinths shall be minimum 300mm and 500 mm above finished ground level respectively.

5. Minimum 75mm thick lean concrete (1:4:8) shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.

6. Concrete made with Portland slag cement shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering.

7. The design and detailing of foundations shall be done based on the approved soil data and sub-soil conditions as well as for all possible critical loads and the combinations thereof. The Spread footings foundation or pile foundation as may be required based on soil/sub-soil conditions and superimposed loads shall be provided.

8. If pile foundations are adopted, the same shall be cast-in-situ driven/bored or pre-cast or under reamed type as per relevant parts of relevant Indian standard codes (I S Codes)/ equivalent International Standards. Only RCC piles shall be provided. Suitability of the adopted pile foundations shall be justified by way of full design calculations. Detailed design calculations shall be submitted by the contractor showing complete details of piles/pile groups proposed to be used. Necessary initial load test shall also be carried out by the bidder at their cost to establish the piles design capacity. Only after the design capacity of piles has been established, the Contractor shall take up the job of piling. Routine tests for the piles shall also be conducted. All the work (design & testing) shall be planned in such a way that these shall not cause any delay in project completion.

11.2 **DESIGN**

While designing foundations, following may be taken care of:

11.2.1. All foundations except for external lighting poles shall be of reinforced cement concrete. The external lighting pole shall be embedded in plain cement concrete (1:2:4) foundation. The design and construction of RCC structures shall be carried out as per relevant IS: 456 and minimum grade of concrete shall be M-25 (design Mix). Higher grade of concrete than

specified above may be used at the discretion of Contractor without any additional financial implication to the Employer.

11.2.2. Limit state method or any other method as per relevant Indian standard codes (I S Codes)/ equivalent International Standards of design shall be adopted unless specified otherwise in the specification.

11.2.3. For detailing of reinforcement IS: 2502 and SP 34 shall be followed. Cold twisted deformed bars (Fe=500N/mm^2) conforming to relevant Indian standard codes (I S Codes)/ equivalent International Standards shall be used as reinforcement. 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 relevant Indian standard codes (I S: 456)/ equivalent International Standards.

11.2.4. RCC water retaining structures like storage tanks, etc. shall be designed as uncracked section in accordance with relevant Indian standard codes (I S: 3370 Part I to IV)/ equivalent International Standards. However, water channels shall be designed as cracked section with limited steel stresses as per relevant IS.

11.2.5. The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and or equipment and/or superstructure and other conditions which produces the maximum stresses in the foundation or the foundation component and as per the relevant Indian standard codes (I S Codes)/ equivalent International Standards of foundation design. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used.

11.2.6. Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.

11.2.7. Necessary protection to the foundation work, if required shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental/harmful to the concrete foundations.

11.2.8. RCC columns shall be provided with rigid connection at the base.

11.2.9. All sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be taken as mentioned in relevant Indian standard codes (I S Codes)/ equivalent International Standards 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.

11.2.10. Earth pressure for all underground structures shall be calculated using co-efficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable).

However, for the design of substructures of any underground enclosures, earth pressure at rest shall be considered.

11.2.11. 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.

11.2.12. Following conditions shall be considered for the design of water tank in pumps house, channels, sumps, trenches and other underground structures:

a) 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).

b) Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

c) 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.

11.2.13. 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.

11.2.14. 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.

11.2.15. 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.

11.2.16. The foundations of transformer/reactor and circuit breaker shall be of lock type foundation. Minimum reinforcement shall be governed by relevant Indian standard codes (I S Codes)/ equivalent International Standards.

11.2.17. The tower and equipment foundations shall be checked for a factor of safety as per relevant Indian standard codes (I S Codes)/ equivalent International Standards for two conditions i.e. Normal condition and short circuit condition against sliding, overturning and pull-out. The same factors shall be used as partial safety factor over loads in limit state design also.

11.3 **ADMIXTURES & ADDITIVES**

11.3.1. Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own batch and added to the mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labelled containers to enable identification.

11.3.2. Admixtures in concrete shall conform to relevant Indian standard codes (I S Codes)/ equivalent International Standards. The water proofing cement additives shall conform to relevant IS. Concrete Admixtures/ Additives shall be approved by Employer.

11.3.3. The Contractor may propose and the Employer 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.

11.3.4. The water-reducing setting-retarding admixture shall be an approved brand as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

11.3.5 The water proofing cement additives shall be used as required/advised by Employer.

12.0 CHAINLINK FENCING AND GATE

12.1 **General**

Work covered under this clause comprises of design, drawing, supply, fabrication, erection, painting or galvanisation as specified etc. of switch yard Fencing and gate, construction of foundation of steel posts and toe wall. While providing switch yard fencing and gate, Following points may be taken care of:

12.2 **Areas requiring Fencing**

12.2.1 Fencing shall be provided for complete switchyard as per drawing. Separate gate shall be provided for men and equipment.

12.2.2 Internal fence surrounding the various equipment's (if) mounted on ground or a height lower than 2.5m. Necessary gates shall be provided for each area so surrounded.

12.3 **Product materials**

The minimum requirements are as follows:

Chain link fence fabric (galvanization) in accordance to relevant Indian standard codes (I S: 2721)/ equivalent International Standards.

12.4 **Posts**

The posts shall be of medium M.S. tubes of 50mm diameter conforming to grade as per relevant international /IS Standard. The tubes shall also conform to relevant Indian standard codes (I S: 1161 / IS 806)/ equivalent International Standards. 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 at suitable locations. 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 relevant IS.

12.5 **Fence Fabric & Fence Panel**

Chain link fencing shall be made of 3.15 mm diameter wire with 75 X 75 mm mesh size. Fence fabric shall be galvanised. 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 Zinc paint over approved standard steel primer.

12.6 **Installation**

1. Fence shall be installed along the switchyard line as shown in the approved drawings.
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 1:2:4 Plain Cement Concrete block of minimum 0.40x0.40x1.2m depth. 75mm 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 (12mm diameter) on each flat.

12.7 **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 40mm dia. pipe and vertical pipes of 15mm dia. @ 125mm spacing (maximum) shall be welded with the main frame. Two number of 1.25 mm thick and 125 mm wide MS plates (Horizontal) @ 500 mm centre to centre distance shall be welded on each gate leaf. Gate leaves shall be fixed with a vertical post of 2700 mm long two steel channels-150 welded together. A 8 mm thick 200X 200 mm size MS plate shall be welded at the bottom of channel frame.
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 welded on 4 mm thick MS plate on the gate leaf.
4. The main gate shall be 5.0m wide and shall be of double leaf type (as shown in the drawing). Next to the main gate, a men gate (1.25m wide single leaf) shall also be provided.
5. Steel roller shall be provided with the gate.
6. Gate shall be installed in location as shown in approved G.A. drawing.
7. The vertical post of gate shall be embedded in PCC foundation of 500 X500X1250 mm deep size.

13.0 BUILDINGS

13.1 GENERAL

The scope includes the design, drawing, engineering and construction including anti-termite treatment, plinth protection, DPC of Building including sanitary, water supply, electrification, false ceiling etc. as applicable ,complete of control room building, fire fighting building, Auxiliary building, Store and Security room. Electrification and air conditioning of building shall be provided as detailed in other sections of electrical portion.

13.2 CONTROL ROOM CUM ADMINISTRATIVE BUILDING

GENERAL

The scope includes design, engineering and construction, including anti-termite treatment, plinth protection, DPC, peripheral drains, water supply, plumbing, sanitation, fire-fighting, electrification etc. of Control Room Building.

The Control Room Building shall be of size 20 m X 25 m approximately. It will be a double storeyed RCC Framed structure if constructed separately away from GIS hall. It shall be so designed that most of the area of switchyard is visible from the Control Room.

The building auxiliary services like air conditioning systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements as specified in relevant section or elsewhere in this Specification. The building shall be constructed as per the design and drawings to be developed by the contractor. **Roof with slopes to be provided in case the substation is in snow bound terrain**. Tentative carpet area requirement for different rooms of control room cum administrative building is given as below for guidance to the contractor:

AREA REQUIREMENTS

Control Room	75 sq.m. approx.
ACDB & DCDB Room	145 Sq.M or As per requirement.
Battery Room	45 Sq. M or As per requirement.
Electrical Lab	23 sq.m.
• Conference Room with attached Toilet	33 sq.m.
• Telecom Room	As per requirement
• S/S-In-charge office with attached Toilet	24 sq.m.
• Room for executives	40 sq.m.
• Room for non-executives	30 sq.m.
• Lobby -Reception	25 sq.m.
• Corridor width	Minimum width of corridor shall be 1800 mm.
• Portico	25 sq.m. (approx.).
• Common Toilet-Men	07 sq.m.
• Toilet for Women	4 sq.m.
• Janitor Room	3 sq.m.
Pantry	7 sq.m.
Provision of shaft for electrical, sanitary, water supply facilities shall also be kept.	

13.3 **DESIGN CRITERIA**

The Building shall be designed:

1. To the requirements of the International standards/Indian Standards.
2. for the specified climatic and loading conditions.
3. To adequately suit the requirements of the equipment's 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. To be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design, as far as possible.

6. To allow for easy access to the equipment's as well as maintenance of the equipment's.

7. Wherever access to the roof is required, RCC stair case shall be provided.

8. Fire retarding materials for walls, ceilings doors etc., which would prevent supporting or spreading of fire and wherever required, shall be decided by the bidder.

9. Suitable Expansion joints, wherever required, shall be provided as per Codal Provisions.

10. All the members of the buildings frame shall be designed for the worst combination of loads as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

11. Permissible stresses for different load combinations shall be taken as per relevant Indian standard codes (I S Codes) / equivalent International Standards.

12. Seismic coefficient Method or Response spectrum method shall be used for seismic analysis of the building for Earthquake forces, as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

13.4 **DESIGN LOADS**

1. Building structure shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, erection loads, wind loads, seismic loads, snow loading, if required etc. Any other incidental load, if anticipated, shall be duly accounted for in the design, and shall be clearly mentioned by the bidder.

2. Dead loads shall include the weight of structures complete with finishes, fixtures and partitions, and shall be taken as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

3. 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, wherever these loads are expected. Equipment loads shall constitute, if applicable, all load of equipment's to be supported on the building frame.

AREA	**Load**
1. For Offices.	5.0 kN/m2
If higher than 5.0 kN/m2.	As per actual Requirement.
2. For Equipment Floors.	10.0 kN/m2
If higher than 10 kN/m2 (Based on Equipment weight and layout plans).	As per actual Requirement.
3. Staircases & Balconies.	5.0 kN/m2
4. Toilets.	2.0 kN/m2
5. Chequered Plate.	4.0 kN/m2
6. Corridors/Walkways.	3.0 kN/m2

7. Accessible Roofs.	1.5 kN/m2
8. Non-accessible Roofs.	0.75 kN/m2

4. Wind loads shall be calculated as per relevant Indian standard codes (I S Codes)/ equivalent International Standards. The Factors affecting the wind speed shall be taken based on the site conditions.

5. Earthquake loads shall be calculated as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

6. Wind forces and Seismic forces shall not be considered to act simultaneously.

7. Snow load shall be computed as per IS:875 part 4 (latest). When snow load is present in roofs, replace imposed load by snow loads in respective load combinations

7. All the load combinations to create worst combinations of loads shall be as per relevant International standards/Indian Standards.

8. Floors/ Slabs shall be designed to carry loads imposed by equipment's, cables, piping, movement of maintenance trucks (if required) and any other load associated with the building. In general, floors shall be designed for live loads as per relevant Indian standard codes (I S Codes)/ equivalent International Standards. Cable and piping loads shall also be considered in addition to the live loads for floors where these loads are expected.

13.5 **FLOORS, WALLS & ROOFS**

1. All walls shall be non-load bearing in filled panel walls, in brickwork as per the specification. Minimum thickness of external walls shall be 230 mm (one brick) with 1:6 cement sand mortar. Partition walls if any shall be of 115 mm thick brick masonary in cement sand mortar (1:4).
2. All Floor/Roof slabs shall be regular beam slab construction. However, sunken RCC slab shall be provided in toilet areas as per the requirement.
3. False ceiling as per requirement shall be provided as detailed in Table-1 (Detailed Finish Schedule).
4. Minimum height of skirting above finished floor level shall be 150 mm. The skirting material shall match with the floor finish.
5. Minimum height of the parapet walls shall be 750 mm.
6. Ground floor finish shall be laid over 20 mm thick cement sand mortar,100 mm thick plain cement concrete (PCC) 1:4:8 (1 cement: 4 sand : 8 stone aggregates),100 mm thick local sand filling. The earth below ground floor shall be well rammed before laying sand filling.
7. First floor details shall comprise of finish as per schedule, 20 mm cement sand mortar and 50 mm thick PCC(1:4:8) over RCC slab.

13.6 **DETAILS OF ROOF**

Roof of the Building shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be an integral cement based treatment conforming to relevant Indian standard codes (I S Codes)/ equivalent International Standards. The water proofing treatment shall be of following operations:

(a) Applying and grouting a slurry coat of neat cement using 2.75 kg/m2 of cement admixed with proprietary water proofing compounds conforming to relevant Indian standard codes (I S Codes)/ equivalent International Standards. Over the RCC slab including cleaning the surface before treatment.
(b) Laying cement concrete using broken stone of size from 25mm to 100mm size with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to relevant Indian standard codes (I S Codes)/ equivalent International Standards over 20mm thick layer of cement mortar of min 1:5 (Cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to relevant Indian standard codes (I S Codes)/ equivalent International Standards to required slope and treating similarly the adjoining walls up to 300mm height including rounding of junctions of walls and slabs.
(c) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming relevant Indian standard codes (I S Codes)/ equivalent International Standards.
(d) 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 relevant Indian standard codes (I S Codes)/ equivalent International Standards and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.
(e) 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 Executive Engineer In charge.

(f) Average thickness of water proofing shall be 120 mm and minimum thickness at khurra shall be 65 mm.

13.7 PARTITIONS

Partitions wherever provided, shall be made of powder coated aluminium frame provided with 5.5 mm thick clear glass or pre-laminated board depending upon the location of partition.

13.8 PLASTERING

External surfaces of buildings shall have 18 mm thick plaster in two layers, with the under layer 12mm thick 1:5 cement sand plaster and the top layer 6 mm thick 1:6 cement sand plaster. Inside wall surfaces shall have 12/15 mm thick 1:6 cement sand plaster. Rough surfaces shall have 15mm and smooth surface shall have 12 mm thick cement sand plaster.

All RCC ceilings shall be provided with 6 mm thick cement sand (fine) plaster (1:3) except for areas with false ceiling.

13.9 EXTERNAL PAINTING

External surfaces of the Control Room Building shall be painted with acrylic exterior flat paint as per manufacturer's specification and approval of Employer.

13.10 DOORS, WINDOWS AND VENTILATORS

The schedule of doors, windows and ventilators of the Control Room Building shall be as per the detailed finish schedule given in Table-1 (Detailed Finish Schedule), and shall conform to the relevant Indian standard codes (I S Codes)/ equivalent International Standards. Rolling Steel shutters shall be provided as per the layout and requirements of the building. Main entrance door to control room building shall be made of powder coated aluminium frame with 5.5 mm thick glazing.

13.11 **CABLE TRENCH INSIDE CONTROL ROOM BUILDING**

All cable trenches inside the Control Room Building shall be covered with minimum 6mm thick steel chequered plate with suitable stiffeners.

13.12 **PLINTH PROTECTION**

750 mm wide and 50 mm thick plain cement concrete 1:2:4 (1 cement:2 sand:4 graded 20 mm nominal size stone aggregate) shall be laid over 75 mm thick dry stone aggregates well rammed and consolidated with interstices filled with local sand including smooth finishing top.

13.13 **PLUMBING & SANITATION**

1. All plumbing and sanitation works 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 with regards to the inspection, testing, obtaining approval and giving notices etc.

2. 'SINTEX' or an equivalent make PVC Roof water tank(s) of adequate capacity depending on the number of users for 24 hours storage shall be provided. However, a minimum of 2 nos. 1500 litre capacity shall be provided.

3. Chlorinated Polyvinyl chloride (CPVC) pipes having thermal stability for hot and cold water supply including all CPVC plain and brass threading conforming to relevant Indian standard codes (I S Codes)/ equivalent International Standards shall be used for internal piping works for water supply.

4. Sand C.I. pipes with lead joints conforming to relevant Indian standard codes (I S Codes)/ equivalent International Standards shall be used for sanitary works above ground level and RCC pipes shall be used for sanitary works below ground.

5. Each toilet shall have the following minimum fittings:

(i) WC (Western type) 390 mm high along with toilet paper roll holder and all other fittings, in toilets attached to conference room and S/S In-charge office; and WC (Indian Type) Orissa Pattern (580 x 440 mm) with all fittings shall be provided in common toilets.

(ii) Urinal (430 x 260 x 350 mm size) with all fittings and built-in-sensor for automatic flush after use.

(iii) Wash basin (550 x 400 mm) with all fittings.

(iv) Bathroom mirror (600 x 450 x 6 mm thick) with hard board backing.

(v) CP brass towel rail (600 x 20 mm) with CP brass brackets.

(vi) Soap holder and liquid soap dispenser.

(vii) Automatic Hand Dryer.

6. Water cooler for drinking water with adequate water storage facility shall be provided which shall preferably be located near pantry and away from the toilet block.

7. One no. stainless steel kitchen sink with Drain board (510 x 1040 x 178 mm bowl depth) for pantry shall be provided.

8. All fittings, fasteners, gratings shall be chromium plated.

9. All sanitary fixtures and fittings shall be of approved quality and type, manufactured by reputed manufacturers. All items brought to site must bear identification marks of the Manufacturer.

10. Contractor shall provide necessary nos. of septic tank and soak pit of adequate capacity to treat the sewage/sullage from the buildings.

11. Contractor shall undertake all other activities required to complete and commission the building.

13.14 **BUILDING STORM WATER DRAINAGE**

1. The building design shall provide for the collection of storm water from the roof. This water shall be drained to the main drainage system of the Sub-station.
2. Cast Iron Rainwater down comer pipes conforming to relevant International standards/Indian Standards with water tight lead joints or medium class galvanized mild steel pipes conforms to relevant Indian standard codes (I S Codes)/ equivalent International Standards shall be provided to drain off the rain water from the roofs. These pipes shall be suitably concealed with masonry work or cement concrete or cladding material. The number and size of down comer pipes shall be governed by relevant Indian standard codes (I S Codes)/ equivalent International Standards.
3. All drains inside the buildings shall have minimum 40 mm thick grating covers; and in areas where heavy equipment loads are envisaged, Pre-Cast RCC covers shall be provided in place of steel grating.
4. Suitable arrangements for draining out water collected from equipment blow downs, leakages, floor washings, fire fighting etc. shall be provided for each floor.

13.15 **DETAILED FINISH SCHEDULE**

The detailed finish schedule for Control Room Building Cum Administrative building is given below:

Table- 1: DETAILED FINISH SCHEDULE

Sl. No.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL(INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
1.	Control Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of 10mm thick toughened glass by using suitable patch fittings/spider fittings. The glass shall extend horizontally from column to column and vertically from sill level of 0.75 m to bottom of lintel/roof beam. All doors shall be glazed powder coated aluminium doors with 5.5.mm Thk. Glazing.
2.	Conference Room	Vitrified tiles 8mm thick size	Premium acrylic emulsion paint	White wash above False Ceiling*	Windows shall be of powder coated aluminium with 5.5mm thick glazing.

Sl. No.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL(INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
		600 x 600mm	on smooth surface applied with plaster of paris (2 mm thick)		All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing
3.	S/S In-charge Room.	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
4	Office Rooms	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
5.	Electrical/ Electronics Test Lab./Telecom Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
6.	ACDB & DCDB Room	62mm thick cement concrete flooring with metallic hardener topping. Skirting shall be of	Oil bound washable distemper on smooth surface applied with plaster of paris putty	Oil bound washable distemper on smooth surface applied with plaster of paris putty	Steel door 45mm thick double sheet 18 gauge MS steel suitably reinforced and filled with mineral wool. Windows/ventilator shall be of powder coated aluminium with 4mm glazing.

Sl. No.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL(INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
		cement sand plaster.			
7.	Battery Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	White wash above False Ceiling*	Steel door 45mm thick double sheet 18 gauge MS steel suitably reinforced and filled with mineral wool. Windows/ventilator shall be of powder coated aluminium with 4mm glazing.
8.	Reception /Lobby	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	Oil bound washable distemper on smooth surface applied with plaster of paris putty	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
9.	Corridor	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	Oil bound washable distemper on smooth surface applied with plaster of paris putty	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
10.	Portico	Cast-in-situ 52mm thk. Cement concrete with metallic hardener.	Granite cladding	Oil bound washable distemper on smooth surface applied with plaster of paris putty	All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.

Sl. No.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL(INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
11.	Toilet	Ceramic tiles	DADO glazed tile 2100mm high, oil bound washable distemper above DADO	Oil bound washable distemper	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters made of pre-laminated particle board with powder coated aluminium frame.
12.	Janitor room	Ceramic tiles with white cement	Vitrified tiles 8mm thick size 600 x 600mm	Oil bound washable distemper	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters made of pre-laminated particle board with powder coated aluminium frame.

*Providing and fixing 15mm thick approximately 600 X 600mm Mineral fiber board panel false ceiling and making cut-outs for electrical fixtures, AC diffusers, open able access etc. complete with silhouette profile system with 15mm wide flange incorporating 6mm central recess white / black main runners at 1200mm centre-centre and not greater than 600mm from the adjacent wall. The cross tees shall be provided to make a module of approximately 600mm X 600mm by fitting 600 mm long cross tees centrally placed between 1200 mm long cross tees. Cross tees also have 15mm wide flange incorporating 6mm central recess white/black. The module formed above shall be anchored to the slab with channels or angles, suspenders as per manufacturer's specifications.

13.16 **SUBMISSIONS**

The following information/documents/drawings shall be submitted for review and approval:

1. Structural design calculations, Structural drawings (including construction/ fabrication), both in hard and soft copies, for all reinforced concrete and structural steel structures.

2. Fully dimensioned and detailed floor plans, cross-sections, longitudinal sections and elevations identifying the major building components.

3. Product information of building components and materials, including walls, partitions, flooring, ceilings, roofing, doors, wall panelling and windows and building finishes along with BOQ.

5. A detailed schedule of building finishes including colours schemes along with item description.

6. A door & window schedule showing door & window types and locations, lock sets and latch sets and other door hardware along with item details.

Approval of the above information shall be obtained before ordering materials or starting construction/fabrication, as applicable.

13.17 **FALSE CEILING**

Providing and fixing seamless ceiling with Gypsum board of 12mm thick fixed to the underside of GI frame work. The GI is fixed to the roof Slab with metal expansion fastener. The joint shall be finished with joint paper tape by using jointing Compound recommended by manufacturer with the approval of Employer. The rate includes for all necessary cutting of ceiling for the fixing of complete fixtures.

13.18 **Under deck Insulation**

The method of fixing shall consist of slotted M.S. angles of appropriate size (minimum 65x50x2mm) fixed to soffit of RCC roof slab at 600mm centres in both directions by Rawl plugs of adequate strength. The slots shall have 14g G.I. tie wire drawn through them.
50mm thick insulation mat Fibreglass Crown - 100 or equivalent shall, be made out of fibre-glass or approved equivalent conforming to IS: 8183, backed with 34g aluminium foil and 22g x 12mm mesh wire netting. The net shall be stretched tightly across the slotted angles or slotted plates holding it in place by means of wires. The joints of the wire netting shall be butted and tightly laced down with 14g G.I. wire. The system shall be got approved from Employer.

13.19 **ELECTRIFICATION**

All electrification shall be executed as per details specified elsewhere in the technical specification. All details shall be as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

14.0 FIRE FIGHTING PUMP HOUSE BUILDING

GENERAL

The scope includes design, engineering and construction, including anti-termite treatment, plinth protection, DPC, peripheral drains, fire-fighting, electrification etc. of fire fighting pump house building.

The fire fighting pump house building shall be essentially single storied reinforced cement concrete (RCC) framed Building. The building auxiliary services like internal electrification, fire protection systems shall be designed in accordance with the requirements as specified in relevant section of technical Specification. The design and layout of foundation of various pumps and cable trenches inside building shall be prepared by the contractor as per requirement of proposed fire fighting system.

AREA REQUIREMENTS

Dimensions of the Building shall be decided by the bidder depending upon the requirement. The approximate size of building is 12.3m X 7.9mX 4.3 m high. The height of building shall be measured from finished floor level to top of roof slab.

DESIGN CRITERIA

The Building shall be designed:

1. To the requirements of the relevant /Indian standards/ equivalent International standards quoted therein, and as specified in this specification.

2. for the specified climatic and loading conditions.

3. To adequately suit the requirements of the pumps and fire fighting system 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. To be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design, as far as possible.

6. To allow for easy access to the equipment's as well as maintenance of the equipment's.

7. G.I. ladder with cage shall be provided for access to the roof.

8. With, wherever required, fire retarding materials for walls, ceilings doors etc., which would prevent supporting or spreading of fire and shall be decided by the bidder.

9. Suitable Expansion joints, wherever required, shall be provided as per Codal Provisions.

10. All the members of the buildings frame shall be designed for the worst combination of Loads as per relevant International standards/Indian Standards.

11. Permissible stresses for different load combinations shall be taken as per relevant International standards/Indian Standards.

12. Seismic analysis of the building for Earthquake forces shall be carried out as per relevant International standards/Indian Standards.

DESIGN LOADS

1. Building structure shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, wind loads, seismic loads etc. Any other incidental load, if anticipated, shall be duly accounted for in the design, and shall be clearly mentioned by the bidder.

2. Dead loads shall include the weight of structures complete with finishes, fixtures and partitions, and shall be taken as per relevant International standards/Indian Standards.

3. Super-imposed loads in different areas shall include live loads, cable trays, and small pipe racks/hangers, piping system and erection, operation and maintenance loads wherever these loads are expected.

1) Non-accessible Roof – 0.75 kN/m2.

2) Accessible Roof – 1.50 kN/m2

4. Wind loads shall be calculated as per relevant International standards/Indian Standards. The Factors affecting the wind speed shall be taken based on the site conditions.

5. Earthquake loads shall be calculated as per relevant International standards/Indian Standards.

6. Wind forces and Seismic forces shall not be considered to act simultaneously.

7. All the load combinations to create worst combinations of loads shall be as per relevant International standards/Indian Standards.

7. Floors shall be designed to carry loads imposed by Pumps, cables, piping, movement of maintenance trucks (if required) and any other load associated with the building. In general, floors shall be designed for live loads as per relevant International standards/Indian Standards. Cable and piping loads shall also be considered in addition to the live loads for floors where these loads are expected.

FLOORS, WALLS & ROOFS

The floor shall be constructed with 52 mm thick cement concrete finished with metallic hardener topping. 150 mm thick base plain cement concrete layer,100 mm thick compacted local sand filling and 200 mm thick hard core of stone ballast with interstices filled with local sand shall be laid below cement concrete flooring top. The earth filling below floor shall be well rammed.

PLASTERING

External surfaces of building shall have 18 mm thick plaster in two layers, with the under layer 12mm thick 1:5 cement sand (coarse) plaster and the top layer 6 mm thick 1:6 cement sand (coarse) plaster. Inside wall surfaces shall have 12/15 mm thick 1:6 cement sand (coarse) plaster. Rough surfaces shall have 15mm and smooth surface shall have 12 mm thick cement sand plaster. Ceiling shall be plastered with 6 mm thick cement sand plaster (1 Cement : 3 Sand).

EXTERNAL PAINTING

External surfaces of the Building shall be painted with acrylic exterior flat paint as per manufacturer's specification and approval of Employer.

DOORS, WINDOWS AND VENTILATORS

The schedule of doors, roller shutter, windows and ventilators of the Building shall be of steel as per relevant International standards/Indian Standards. Rolling Steel shutters shall be provided as per the layout and requirements of the building. Main entrance door to the Building shall be MS door frame with M.S. sheet double shutter. Windows and ventilators shall be of steel made of hot rolled sections windows and ventilators shall be provided with 5.5 mm thick glazing.

CABLE TRENCH INSIDE FIRE FIGHTING PUMP HOUSE BUILDING

All cable trenches inside the building shall be covered with minimum 6 mm thick steel chequered plate with suitable stiffeners. The structural steel used for cable tray support, earthing cleat, chequered plates for internal cable trenches of fire fighting pump house building shall be measured and paid under miscellaneous steel item of BPS

PLINTH PROTECTION

750 mm wide plinth protection all-around the building shall be provided. Plinth protection shall comprise of 50 mm thick PCC (1:2:4) laid over 75 mm thick well compacted stone aggregates with interstices filled with local sand including smooth finishing top.

PARAPET

230 mm thick and 500 mm high brick parapet shall be provided. The parapet shall be plastered with cement sand plaster (1:6).

BUILDING STORM WATER DRAINAGE

1. The building design shall provide for the collection of storm water from the roof. This water shall be drained to the main drainage system of the Sub-station.
2. Cast Iron Rainwater down comers pipes conforming to relevant International standards/Indian Standards with water tight lead joints or medium class galvanized mild steel pipes conforms to relevant International standards/Indian Standards shall be provided to drain off the rain water from the roofs. These pipes shall be suitably concealed with masonry work or cement concrete or cladding material.
3. Suitable arrangements for draining out water collected from equipment blow downs, leakages, floor washings, fire fighting etc. shall be provided, if found necessary.

DETAILS OF ROOF

Roof of the Building shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be an integral cement based treatment conforming to relevant International standards/Indian Standards. The water proofing treatment shall be of following operations:
(a) Applying and grouting a slurry coat of neat cement using 2.75 kg/m2 of cement admixed with proprietary water proofing compounds conforming to relevant International standards/Indian Standards over the RCC slab including cleaning the surface before treatment.
(b) Laying cement concrete using broken stones 25mm to 100mm size with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to relevant International standards/Indian Standards over 20mm thick layer of cement mortar of min 1:5 (Cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to relevant International standards/Indian Standards to required slope and treating similarly the adjoining walls up to 300mm height including rounding of junctions of walls and slabs.
(c) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to relevant Indian standard codes (I S Codes) / equivalent International Standards.
(d) 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 relevant International standards/Indian Standards and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.
(e) 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 Executive Engineer In charge.

(f) Average thickness of water proofing shall be 120 mm and minimum thickness at khurra shall be 65 mm.

DETAILED FINISH SCHEDULE

The detailed finish schedule for Fire Fighting Pump House Building is given below:

Table- 2 : DETAILED FINISH SCHEDULE

S.N	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL(INTERNAL)	CEILING	LLER SHUTTER,DOOR, WINDOWS & VENTILATOR
1.	Fire Fighting Pump House	62mm thick cement concrete flooring with metallic hardener topping .skirting shall be of cement sand plaster.	Oil bound washable distemper on masonry portion.	As per Manufacturer details.	Windows/ ventilator shall be hot rolled steel section with 5.5mm thick glazing. Entry door shall be of M.S. Sheet double shutter and rolling shutter shall be of steel.

ELECTRIFICATION

All electrification shall be executed as per details specified elsewhere in the technical specification. All details shall be as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

15.0 AUXILLIARY BUILDING

Auxilliary building shall be single storeyed reinforced cement concrete framed structure building. The size of building shall be about 15 m X 20 m approximately. However, bidder may suggest suitable size as per his requirement. The building shall house 11 kV indoor switchgear.

The details like floor details, door, windows, ventilator, internal finish details etc. shall match with respective room of RCC control room building. External finish shall also match with control room building.

1. Contractor shall develop the layout in such a way that its aesthetic look is pleasant. The design of Auxiliary building shall be carried out as per relevant International standard/Indian Standards.
2. The internal cable trenches, panel etc. shall be designed by the contractor as per requirement. Layout of these cable trenches, panel layout shall also be prepared by the contractor as per requirement.

CABLE TRENCH INSIDE AUXILLIARY BUILDING

All cable trenches inside the building shall be covered with minimum 6 mm thick steel chequered plate with suitable stiffeners. The structural steel used for cable tray support, earthing cleat, chequered plates for internal cable trenches shall be measured and paid under miscellaneous steel item of BPS.

ELECTRIFICATION

All electrification shall be executed as per details specified elsewhere in the technical specification. All details shall be as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

16.0 FIRE FIGHTING WATER TANK

1. Reinforced cement concrete water tank with two compartments each of size 9.31 m X 9.31 m and capacity of 317 Cubic Meter shall be constructed. A sump of size 2.5 m X 2.5 m x 0.5 m deep shall be provided at one corner in each compartment. Finished floor level of water tank shall be about 200 mm above finished ground level of switch yard. Base slab of water tank shall rest on 75 mm thick plain cement concrete (1:3:6) laid over 800 mm thick well compacted stone packing (Stone Size from 25 mm to 150 mm) with interstices filled with local sand.
2. The roof of Water tank shall be of Asbestos Corrugated sheet. The sheet shall be supported on suitable steel purlins etc. Suitable gutter shall be provided to drain off rain water.
3. A steel door of size 900 mm X 1850 mm with single shutter made of hot rolled steel section and MS steel door frame shall be provided at about (+) 4.5 m level for access inside water tank.
4. Suitable MS rungs of 20 mm diameter rod @ 300 mm centre to centre staggered on both faces (External and internal) of wall at suitable location shall be provided to act as ladder.
5. Integral water proofing compound of reputed brand shall be added to the concrete and plaster of water tank. Quantity of compound shall be as per manufacturer's recommendation.
6. All inserts, nozzles, pipe sleeves etc. shall be provided during concreting at suitable locations as per fire fighting system. The size is to be decided by the contractor to meet the requirement.
7. Inside surfaces of water tank shall be plastered with cement sand plaster (1 Cement: 6 sand).
8. The outer surface of water tank shall be painted with the paint matching with Fire fighting pump house building.
9. P.V.C. water stopper shall be provided at all construction joints of water tank.
10. The design of water tank shall be carried out as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

17.0 SWITCH YARD PANEL ROOM

RCC switchyard panel room with the size as mentioned in bid price schedule shall be constructed. RCC sloped roof shall be provided. The sloped roof shall be covered with suitable tiles to enhance aesthetic look. The floor details (sand, PCC, cement mortar) shall match with that of other buildings. The floor finish shall be provided with vitrified tiles. Plinth protection as per other buildings. The finish details like painting, plaster shall match with other buildings. Doors shall be aluminium glazed . All walls, floor and roof shall be provided with suitable chicken wire mesh which shall be connected with earthing system through 75 x 12 mm MS flat. Air conditioning and internal electrification of panel room shall be done as mentioned in respective technical specification and BPS in Electrical portion. The size and layout of internal cable trenches of panel room shall be decided by the contractor as per requirement. All cable trenches inside the panel room shall be covered with minimum 6 mm thick steel chequered plate with suitable stiffeners. The structural steel used for cable tray support, earthing cleat, chequerred plates for internal cable trenches shall be measured and paid under miscellaneous steel item of BPS

The design shall conform to relevant Indian standard codes (I S Codes)/ equivalent International Standards.

18.0 CAR PARKING SHED

Aesthetically pleasant RCC car parking shed as per design and drawings as developed by the contractor and suitable to park 10 cars shall be constructed at suitable location to be decided during detailed engineering stage

19.0 WATER SUPPLY

(i) Water shall be made available by Employer at any feasible point within substation boundary at single point to the contractor. Contractor shall state the total water requirement both in terms of quantity and head to Employer.

(ii) The contractor shall carry out all the plumbing/erection works required for supply of water in control room cum administrative building beyond the single point as at (i) above.

(iii) The contractor shall carry out all the plumbing/erection works required for supply of water to Fire Fighting pump house, Security room beyond the single point as at (i) above.

(iv) The details of tanks, pipes, fittings, fixtures etc. for water supply are given elsewhere in the specification under respective sections.

(v) A scheme shall be prepared by the contractor indicating the layout and details of water supply which shall be got approved by Employer 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. All drawings shall be prepared by the contractor for approval of Employer.

(vi) Bore wells and pumps for water supply is not in the scope of contractor.

20.0 SEWERAGE SYSTEM

(i) Sewerage system shall be provided for all buildings wherever applicable.

(ii) The Contractor shall construct septic tank and soak pit suitable for 50 users each for control room building and transit camp, if constructed. If septic and soak pit system is not acceptable by local Authority, contractor will have to install suitable sewerage system as per local statutory requirement.

(iii) The system shall be designed as per relevant Indian standard codes (I S Codes)/ equivalent International Standards. All drawings shall be prepared by the contractor for approval of Employer.

All shop connections shall be welded with appropriate arc welding process and welding shall be in accordance with relevant standard, AWSD 1.1. as

appropriate. The Webs should be welded on to the flanges at both the faces at top and bottom for columns, beams and crane girders. Weld material should have strength more than the parent metal.

21.0 GIS HALL CUM CONTROL ROOM BUILDING

21.1 Control Room and GIS Hall

The GIS building shall be of pre-engineered steel structure. Control room building, if attached to GIS hall, shall be of pre-engineered steel structure similar to GIS hall and shall be RCC framed structure, if it is not connected with GIS hall. In case of steel control room building all walls shall be of brick masonry and roof of ground floor shall be of RCC. Internal access to the GIS hall from control room building shall be provided.

Material specification and other details for construction of Pre-engineered steel building shall be as described in subsequent paragraphs. The base plate of steel columns shall be mounted on the RCC foundation by means of hot dip galvanised foundation bolts (Galvanisation of 610 gms/Sq. M). In order to facilitate inspection and maintenance, the structures shall be provided with climbing devices. Separate fire escape doors shall also be provided in the GIS Building.

Panels shall be kept in an air-conditioned enclosure. A glazed partition made of aluminium frame and 5.5mm thick glass shall be provided between GIS hall and panel room. The glazing shall be kept at a sill level of 0.9 m above floor level. The height of glazing shall be minimum 2.1 m above sill level.

Walkway of width not less than 1.0m shall be provided at gantry girder level on the two longer side of GIS hall along with climbing arrangement to facilitate maintenance of crane.

All the material required for Pre-engineered (steel) building shall be procured from reputed manufacturer for which prior approval shall be obtained. Manufacturing of various parts of the building shall start only after approval of "Manufacturing Quality Plan to be prepared by the bidder during detailed engineering stage". Complete material shall be offered for inspection to RECTPCL/PDD, J&K before dispatch. Inspection shall be carried out based on assembly (fabrication) drawings approved by Employer and "BILL OF MATERIAL" & Shop drawing prepared by the Manufacturer and certified by the Contractor for its correctness. Approval of BOM and shop drawing from employer is not required.

21.1A Design Criteria and Design Loads

Design criteria and design loads shall be same as defined for Control room cum administrative building at clause no. 13.3 and 13.4 respectively except in case of design loads for GIS building wherein an impact factor of 30% and lateral crane surge of 10% (lifted weight + trolley) shall be considered in the analysis of frame according to provision of IS:

875. The horizontal surge shall be 5% of static wheel load. Crane load shall be applied as per requirement of building.

21.2 **Material Specification**

21.2.1 Primary members fabricated from plates and sections with minimum yield strength of 345 Mpa or to suit design by continuous welding.

21.2.2 Secondary members for Purlins and Grits shall conform to the physical specification of ASTM A570 (Grade 50) or equivalent IS/equivalent international standards having a minimum yield strength of 345 MPa. The minimum thickness of secondary members shall be 2.5mm.

21.2.3 Rod / ANGLE/pipe bracing shall conform to the physical specification of relevant IS/equivalent international standards of minimum 245Mpa Yield Strength

21.2.4 All hot rolled sections shall conform to the physical specifications of IS/equivalent international standards. All other miscellaneous secondary members shall have minimum yield strength of 250 MPa.

21.3 **DESCRIPTION**

21.3.1 **PRIMARY MEMBERS:**

Primary structural framing shall include the transverse rigid frames, columns, corner columns, end wall wind columns and crane gantry girders and Frames at Door openings.

21.3.2 **SECONDARY MEMBERS:**

Secondary structural framing shall include the purlins, girts, eave struts, wind bracing, flange bracing, base angles, clips, flashings and other miscellaneous structural parts. Suitable wind bracings sag rods to be reckoned while designing the structure.

21.3.3 **PURLINS, GIRTS, CLIPS:**

Purlins, girts and clips should be of Pre Galvanised steel of 345 Mpa having a coating thickness of 275 gms/sq. M inclusive of both sides.

21.3.4 ROOF SHEETING

Factory assembled 50mm thick puff (density 40kg/cu.m. +2 Kg/cu m as per IS/equivalent International Standards) sandwiched panels shall be provided. These panels shall be made of puff insulation sandwiched between two high tensile steel sheets each of 0.5 mm thickness. The material of sheets shall confirm to ASTM 792 M Grade 345B with minimum yield strength of 345 Mpa. The steel sheets shall be provided with hot dip coating of Zinc aluminium alloy (approximately 55% Al , 43.5% Zn and 1.5 % silicon) . Total mass of zinc aluminium alloy coating shall be minimum 200 gm/Sq. m inclusive of both sides. The

tolerance of base metal thickness (BMT) of steel sheet shall be as per IS/equivalent International Standards . After hot dip coating of Zinc aluminium alloy , the sheet shall be provided with steel primer and silicon modified polyester (SMP) paint. The total thickness of primer and paint shall be 40 microns inclusive of both sides (TCT) comprising of 20 microns of SMP paint on top surface and 10 microns of backer coat (polyester coat) on back surface over 5 microns thick primer each on both surfaces with inorganic pigments coated free from heavy metals. Painting shall conform to IS/equivalent International Standards. In case SMP paint is not available, Super Durable Polyester paint (SDP) can also be used by the bidder without cost implication to Employer.

21.3.5 **Wall Panels**

Wall panel material specifications shall be same as roof panels.

21.3.6 **SHEETING FASTENERS:**

Standard fasteners shall be self-tapping zinc plated metal screws with EPDM bonded zinc plated washers. All screws shall be colour coated to match roof and wall sheeting.

21.3.7 **SEALER**:

This is to be applied at all side laps and end laps of roof panels and around self-flashing windows. Sealer shall be pressure sensitive elastomeric Butyl tapes. The sealer shall be non-asphaltic, non-shrinking and nontoxic and shall be superior adhesive metals, plastics and painted at temperatures from 51°C to +104°C.

21.3.8 **CLOSURES**:

Solid or closed cell closures matching the profiles of the panel shall be installed along the eaves, rake and other locations specified on drawings.

21.3.9 **FLASHING AND TRIM:**

Flashing and / or trim shall be furnished at the rake, corners, eaves, and framed openings and wherever necessary to provide weather tightness and finished appearance. Colour shall be matching with the colour of wall. Material shall be 26 gauge thick conforming to the physical specifications of sheeting.

21.3.10 **WALL LIGHTS:**

For day lighting purpose of GIS hall, minimum 2 mm thick approved translucent polycarbonate sheet shall be provided for wall lighting in addition to windows for at least 10% of wall area on upper portion of both long walls. The polycarbonate sheet shall be fixed with necessary EPDM, rubber gasket, Silicon Sealant, cold forged fastener, aluminum profile

etc. including MS supporting structural steel (conforming to relevant IS/equivalent International Standards) frame to ensure water tight arrangement.

21.3.11 **GUTTERS AND DOWN SPOUTS:**

Gutters and downspouts shall be adequately designed to ensure proper roof drainage system. Material shall be same as that of sheeting with matching colour.

21.3.12 PAINTING OF BUILT UP STEEL FRAMES, CRANE GANTRY GIRDERS, FRAMES AT DOOR OPENINGS, WALK WAY STEEL AND LADDER:

The built up frame ,Crane gantry girders, frames for door openings and steel for walk way shall be applied with a priming coat of standard steel primmer followed by one coat coating of epoxy paint and final coating of PU (Minimum 100 Micron) . The steel work for aforesaid members shall be provided with suitable treatment of shot blasting before application of steel primer. The steel material of ladder shall be galvanized.

21.3.13 COLOUR SCHEME:

Colour Scheme matching with local aesthetic and best industry practices shall be submitted by vendors for approval of Employer. Three alternatives of coloured isometric views with colour codes shall be submitted for approval. The monotony of external colour of sheet shall be avoided by providing vertical bands of different coloured sheet. The colour of roof sheet shall be light coloured to minimize heat absorption. External and internal masonry walls shall be painted with suitable colour matching with colour of steel sheet.

21.4 **CONNECTIONS:**

21.4.1 **SITE CONNECTIONS**

a) All primary bolted connections shall be provided with galvanized high strength bolts, washers, nuts conforming to specifications of relevant standard.

b) All secondary bolted connections shall be furnished with bolts, nuts, washers conforming to the specifications of grade 4.6 of relevant standard or ASTM-A307.

21.4.2 **SHOP CONNECTIONS**

All shop connections shall be welded with appropriate arc welding process and welding shall be in accordance with relevant standard, AWSD 1.1. as appropriate. The Webs should be welded on to the flanges at both the faces at top and bottom for columns, beams and crane girders. Weld material should have strength more than the parent metal.

21.4.3 **ROOF & WALL BRACINGS**

Roof and wall bracings shall have minimum yield strength of 250 Mpa and shall conform to the specifications of relevant standard.

21.5 INTERNAL FINISH SCHEDULE

The finishing schedule is given in subsequent clauses and table-1. Areas not specified in finish schedule shall be provided with vitrified tile flooring, and Premium Acrylic emulsion paint oil bound washable distemper over two mm thick putty. Paints used in the work shall be of best quality specified in relevant standard.

21.5.1 FLOORING

Flooring in various rooms of control room building and GIS hall shall be as per detailed schedule given in Table -1.

21.5.2 WALLS

All walls of control room building shall be non-load bearing walls. Min. thickness of walls shall be 230 mm (one brick) with 1:6 cement sand mortar. Partition walls (115mm thick) in toilets and pantry can be half brick walls with 1:4 cement sand mortar and two nos. 6mm dia. MS bars at every third course.

In GIS building and the attached relay room 230mm thick brick wall shall be provided up to roof level of relay room attached to GIS hall. 50mm thick puff sandwiched panels as described above shall be provided above brick wall.

21.5.3 ROOF

(A) GIS Building and Control Room (if steel structure)

Roofing Panel: 50mm thick puff (density 40kg/cu.m.) sandwiched panels shall be provided as described in previous clauses.

21.6 CABLE TRENCH IN GIS HALL

All cable trenches in GIS hall shall be covered with minimum 6mm thick steel chequered plate with suitable stiffeners. Chequered plate shall be painted with two or more coats of Epoxy paint as per relevant standards.

21.7 EXTERNAL PLASTER AND PAINTING

External plaster 18mm thick shall be of 1:6 cement sand plaster in two layers. External surface of the control room building and GIS building (brick wall portion) shall be painted with Premium acrylic smooth exterior paint with silicon additives over and including priming coat of exterior primer as per relevant standards.

21.8 INTERNAL FINISH SCHEDULE

Internal finish Schedule for control room building and GIS hall is given in Table - 1 below:

Table -1

S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
1.	Control Room	Vitrified tiles size 600 x	Premium Acrylic	False ceiling and White	Windows shall be of 10mm thick

S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
		600mm	emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	wash above False Ceiling	toughened glass by using suitable patch fittings/spider fittings. The glass shall extend horizontally from column to column and vertically from sill level of 0.75 m to bottom of lintel/roof beam. All doors shall be glazed powder coated aluminium doors with 5.5.mm Thk. Glazing.
2.	Conference	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
3.	In-charge Room	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
4	Other Office Rooms	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be

S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
			surface applied with plaster of paris (2 mm thick)		glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
5.	Electronics Test Lab.	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
6.	ACDB & DCDB Room	62mm thick cement concrete flooring with metallic hardener topping	Oil bound washable distemper on smooth surface applied with plaster of paris putty as per relevant standards	Oil bound washable distemper on smooth surface applied with plaster of paris putty	Steel door 45mm thick double sheet 18 gauge MS steel suitably reinforced and filled with mineral wool. Windows/ventilator shall be of powder coated aluminium with 4mm glazing.
7.	Battery room	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Steel door 45mm thick double sheet 18 gauge MS steel suitably reinforced and filled with mineral wool. Windows/ventilator shall be of powder coated aluminium with 4mm glazing.
8.	Lobby	18mm thick granite flooring	Premium Acrylic emulsion	False ceiling and White wash above	Windows shall be of powder coated aluminium with

S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
			paint on smooth surface applied with plaster of paris (2 mm thick)	False Ceiling	5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
9.	Corridor	Vitrified tiles size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
10.	Portico	18mm thick granite flooring	Granite cladding	Acrylic emulsion paint over a coat of cement primer on smooth surface applied with readymade putty 1 mm thick as per relevant standards	All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
11.	Toilet	Ceramic tiles	DADO glazed tile 2100mm high, oil bound washable distemper above DADO	Acrylic emulsion paint over a coat of cement primer on smooth surface applied with	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters made of pre-laminated particle board (with

S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
				readymade putty 1 mm thick as per relevant standards	powder coated aluminium frame.
12.	Janitor room	Ceramic tiles	DADO glazed tile 2100mm high, oil bound washable distemper above DADO	Acrylic emulsion paint over a coat of cement primer on smooth surface applied with readymade putty 1 mm thick as per relevant standards	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters made of pre-laminated particle board with powder coated aluminium frame.
13.	GIS Hall	62mm thick cement concrete flooring with metallic hardener topping (DSR item code 11.5). Two coats of PU coating over the metallic hardener shall be provided. The final coat of PU shall be applied after Installation of equipments. Total thickness of PU coats	Premium Acrylic emulsion paint having Volatile Organic Compound (VOC) content less than 50 gms per liter of approved brand and manufacture r on smooth surface applied with plaster of paris (2 mm thick) over approved	In case of RCC roof, ceiling shall be finished with Premium Acrylic emulsion paint having Volatile Organic Compound (VOC) content less than 50 gms per liter of approved brand and manufacture r over approved primer coat	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters with powder coated aluminium frame.

S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
		shall be minimum 300 microns.	primer coat .		
14.	Panel/Relay Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False ceiling and White wash above False Ceiling	Windows shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be glazed powder coated aluminium doors with 5.5.mm thk. Glazing.
15.	AHU Room	62mm thick cement concrete flooring with metallic hardener topping	Premium Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	Acrylic emulsion paint over a coat of cement primer on smooth surface applied with readymade putty 1 mm thick as per relevant standards	Windows/ ventilator shall be of powder coated aluminium with 5.5mm thick glazing. All doors shall be flush door shutters with powder coated aluminium frame.

21.9 Staircase shall be provided with stainless steel railing and 18mm thick granite slab in risers and treads.

21.10 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/equivalent International Standards. Rolling steel shutters shall be provided as per layout and requirement of buildings. Main entrance door to control room building shall be made of powder coated aluminium frame with 5.5 mm thick glazing.

21.11 PARTITION

Partitions, if required, shall be made of powder coated aluminium frame provided with 5.5 mm thick clear glass or pre- laminated board depending upon the location of partition.

21.12 FALSE CEILING

Fifteen millimeter thick densified regular edged ecofriendly light weight calcium silicate false ceiling as per relevant standards shall be provided in the areas specified in Finish Schedule.

21.13 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 litre capacity shall be provided.

(iii) Galvanized MS pipe of medium class conforming to relevant standards shall be used for internal & external piping work for potable water supply.

(iv) Sand CI pipes with lead joints conforming to relevant standards shall be used for sanitary works above ground level and RCC pipe shall be used for works below ground.

(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) CP Soap holder and CP liquid soap dispenser.

(g) All urinals and washbasins shall be provided with built in sensors.

(vi) Water cooler for drinking water with adequate water storage facility shall be provided and located near control room and not near toilet block.

(viii) 1 no. stainless steel kitchen sink with Drain board (510 x 1040 x 178 mm bowl depth) for pantry shall be provided.

(ix) All fittings, fastener, grating shall be chromium plated.

(x) 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.

(xi) Stoneware pipes may be used for soil, waste and drain pipes in the areas not subjected to heavy loads otherwise Heavy duty cast iron pipes may be used.

(xii) Contractor shall provide septic tank and soak pit of adequate capacity to treat the sewage / sullage from the building.

(xiii) Contractor shall implement all other jobs required to complete and commission the building.

22.0 Boundary wall, Main Gate, Security Room and septic tank and soak pit

22.1 Boundary Wall :

RCC framed with brick masonary/concrete block/stone masonay in fill between columns shall be provided along periphery of substation. The brief description of boundary wall is given below:

(a) Height of boundary wall (Masonay portion) above ground = 2.5 m

(b) 0.5 m High of Y shaped angle supports (50x50x6 mm) above each column with about 0.5 m deep grouted in column shall be provided as grill on the boundary wall

(c) C/c distance of RCC Column (230 X 230 mm size) = 2.5 m

(d) 8 rows of galvanised barbed wire with concertina coil a top of boundary wall shall be provided. 4 rows of barbed wire on each arm of Y-shaped angle are to be provided.

(e) Grade of Concrete for RCC works = M25

(f) Mix of masonary works = 1 Cement: 6 Sand

(g) 12 mm thick Cement sand plaster (1 cement: 6 Sand) over exposed portion of boundary wall along with 50mm thk. CC(1:2:4) coping on the top of wall.

(h) Two coats of oil bound distemper with one coat of cement primer of approved make shall be applied over exposed portion of boundary wall.

(i) A RCC plinth beam (230 X 300 mm deep) shall be provided at ground level. A lintel beam of 230 X 230 mm shall be provided over gratings.

(j) Suitable steel grating made of 20 mm square bars shall be provided at suitable locations preferably @ 100 m to allow the flow of surface water.

(k) Suitable foundation of about 1.5 depth shall be provided for each RCC column. 75 mm thick PCC (1:4:8) layer shall be provided below all RCC works.

(l) All steel works shall be provided with two coats of synthetic enamel paint over a coat of steel primer of approved make.

(m) Twin columns with 25 mm expansion gap at every 45 meter length shall be provided.

(n) Suitable design of boundary wall shall be developed by the contractor.

The boundary wall shall be measured and paid on running meter length basis.

22.2 Main Gate

A steel gate of 2.1 m high and 6 m wide along with 1.5 m wide man gate shall be provided at entry location of substation. The gate shall be supported on steel columns. The steel support columns shall be encased with suitable RCC foundations. Suitable wheel mounting arrangement shall be provided at the bottom of gate for smooth opening of gate. All steel works shall be provided with two coats of synthetic enamel paint over a coat of steel primer of approved make.

The item shall be measured and paid on Lump sum basis.

22.3 Security Room:

A RCC framed room of size 3 m X 3m and 3 m high with 1.5 m wide veranda shall be provided near gate. An attached toilet of 1.5 m x 1.5 m size shall be provided. Suitable septic tank and soak pit for 10 users with cleaning interval of 3 years shall also be provided. A RCC platform (600 mm wide) at window sill level along with wardrobe shall be provided. All sanitary works and a PVC water tank of 1000 litre capacity shall also be provided. All finish details shall match with other buildings mentioned elsewhere in the technical specification.

The item shall be measured and paid on square meter area basis.

23.0 MODE OF MEASUREMENT

23.1 Geotechnical investigation

This shall include carrying out field tests, laboratory tests, compilation of results and preparation of soil report with recommendations for type of foundations shallow or pile type, suitability of soil for construction of substation etc. The geotechnical investigation work shall be measured on lump sum basis.

23.2 Contour survey and site leveling.

The Contour survey work shall not be measured and paid separately and shall be deemed to be included in the item of site leveling work.
Measurement of Earth work in all kind of soil including soft/disintegrated rock in the item of cutting and filling and item of earth work in the filling with borrowed earth shall be made in Cubic meters. No void deduction for 95% compaction.

23.3 Earthwork

This shall include excavation in all kinds of soil including rock, all leads and lifts including back filling with suitable earth, compacting, dewatering (if required) and disposal of surplus earth or rock to a suitable location within a lead up to 2 km. The surplus earth if disposed within substation boundary shall be spread in uniform layers each compacted with two passes of suitable compacting equipment. The quantity of excavation for foundations of towers, equipment support structures, all transformers/Reactors, DG Set, firewall, cable trenches, fire fighting water tank, buildings and underground water tanks, covered car parking, External lighting poles, control cubicles, marshalling box as well as quantity of excavation for roads, rail cum road, drains, culverts, rainwater harvesting,

septic tank, soak pit, external water supply system, site surfacing, chain link fencing (including gate) shall not be measured separately and shall be deemed to be included in the composite rates quoted by the bidder for the respective works. All other excavation required for the completion of the work including plinth protection, flooring, sewerage system, manholes, pipes, earth mat etc. shall also not be paid for.

23.4 **PCC**

Providing and laying Plain Cement Concrete of all types and at all locations including all leads and lifts. All PCC required for

i) PCC 1:2:4 (1 cement : 2 sand : 4 coarse aggregate 20 mm nominal size) - Flooring of buildings, plinth protection, fencing, transformer/reactor foundation, rail track, drain, culverts, septic tank, chain link fencing, fencing gate ,external lighting poles etc.

ii) PCC 1:4:8 (1 cement : 4 coarse sand : 8 stone aggregate, 40mm nominal size) - All foundations of towers, equipment support structures, buildings, fire fighting water tanks, covered car parking, cable trench, roads, under flooring, rail-cum-road, transformer foundation, reactor foundation, drain, cable trench crossings, culverts, fence, gate etc.

iii) PCC 1:5:10 (1 Cement: 5 sand: 10 Stone aggregate, 40mm nominal size) for site surfacing in switchyard, roof water proofing etc.

and for the completion of the work including hold fasts of doors/windows/rolling shutters, fixing of plumbing pipes, bedding concrete for sewer lines, embedment of electrical conduits etc. shall not be measured and deemed included in the composite rates quoted by the bidder for respective works. Water proofing compound wherever specified shall be added without any extra cost.

23.5 **RCC**

Reinforced cement concrete shall include all leads, lifts, formwork, grouting of pockets and underpinning, (but shall exclude reinforcement & miscellaneous structural steel like inserts etc.), of M25 design mix (Minimum). This shall also include pre-cast RCC work and addition of water proofing compound wherever required for which no additional payment shall be made. RCC quantity shall not be measured separately in cubic meters as this shall be deemed to be covered in respective items of BPS.

23.6 **Steel Reinforcement**

Reinforcement steel shall not be measured separately as this shall be deemed to be covered in respective items of BPS.

23.7 **Stone filling over grating in Transformer/Reactor foundation**

Measurement of stone (40mm nominal size) filling over gratings of transformer/reactor foundations shall **not** be made as per theoretical volume of the space to be filled in the transformer foundation as per approved drawings as this shall be deemed to be covered in item no. 3 (i) of Civil works in BPS.

23.8 **Miscellaneous structural steel**

Measurement for Supply, fabrication, transportation and erection of all miscellaneous structural steel work for rails alongwith rail fixing details and gratings with supports for transformers/reactors, Cable trenches with covers (Chequered plate covers, cable supports, earthing cleats and edge protection angles etc.), all other steel fittings and fixtures, inserts and embedment in concrete of transformer/reactor foundation and cable trenches shall be made as per approved drawings. The unit rate for this item shall be inclusive of cutting, grinding, drilling, bolting, welding, pre- heating of the welded joints, applying a priming coat of steel primer and anti-corrosive bitumastic paint/ synthetic enamel paint in general but with Zinc Phosphate Primer (Two packs) for grating and support for grating in Transformer foundation. (Wherever specified), setting of all types of embedment in concrete, etc. Steel required for foundation bolts, nuts and bolt, doors, windows, ventilators, louvers, rolling shutters, chain link fencing, gratings in drains, soil pipes, plumbing pipes, floor traps, embedment's required for rainwater harvesting, septic tank, soak pit, roof truss and purlins required for fire water tank, etc. shall not be considered for payment and measurements. Quantity shall be measured in metric tonnes.

23.9 **Roads**

A). The measurement for the concrete road shall be made on the basis of area in square meter (M2) of top concrete completed surface of the road and shall be deemed to include all items such as excavation, Concreting, reinforcement, compaction, rolling, watering, WBM, shoulder, etc. complete as per approved drawing.

B) The measurement of bituminous road shall be made on the basis of area in square meter (M2), of the top bituminous completed surface of the road and shall include all items such as excavation, compaction, rolling, watering, sub base course, WBM, shoulder, premix carpet etc. complete as per approved drawing.

23.10 Anti-weed Treatment, 75mm thick PCC and Stone Spreading

The measurement shall be done for the actual area in square metres of stone spreading provided in the switchyard .It includes providing and spreading of 100mm thickness of uncrushed/crushed/broken stone of 40mm nominal size as per relevant IS codes/equivalent International standards for the specified area. Application of anti-weed treatment including material shall be measured in Square meter based on actual area and it will be same area as of stone spreading in switchyard. The measurement of 75mm thick PCC shall also be done in Sq. meter based on actual area of PCC.

23.11 Chain Link Fencing and gate

The measurement shall be made in running metres of the fence provided as per approved drawing. The rate shall be including the post, fencing, MS Flat, painting, brick work, concrete and plaster of toe wall etc. complete. The Fencing gate shall also be measured as part of chain link fencing.

23.12 **Cable Trenches and Cable trench Crossings**

All items like Excavation, earthwork, PCC, RCC, reinforcement steel except RCC hume pipes and miscellaneous steel required for construction of Cable Trenches of various sizes and cable trench crossings shall be measured in route meter. . However, RCC hume pipes used in culverts and miscellaneous steel required for cable trench shall be measured under respective item of Bid price schedule (BPS) as described in clause of hume pipes and Miscellaneous steel. Please note that No additional payment for brick work, plaster and PVC pipes used for cable trench crossings and sealing of trench mouth shall be admissible.

23.13 **Drains & Culverts**

All items like excavation, PCC, brick work, plaster and stone pitching except RCC hume pipes required for completion of drains and culverts shall be deemed to be included in the quoted rate of drain. The quantity for drain section shall be measured in running meters irrespective of size. However, RCC hume pipes used in culverts shall be measured under respective item of Bid price schedule (BPS) as described in clause of hume pipes.

23.14 **External Finishing of RCC Framed Buildings/structures:**

The item shall be measured per square meter area basis. Contractor has to assess the quantity as per requirement of Control room cum administrative building, Fire Fighting Pump House, fire fighting water tank, switchyard panel room, other buildings, covered car parking and quote for the same separately. This shall include following items.

1) External plastering/cement wash : 18mm Cement plaster in two coats under layer 12 mm thick cement plaster 1:5 (1 cement: 5 coarse Sand) finished with a top layer of 6 mm thick cement plaster 1:6 (1 cement: 6 fine Sand) for all buildings and fire fighting water tank .

2) Providing and applying two or more coats of Acrylic smooth exterior paint over an under coat of suitable primer on new cement plaster surfaces of the control room building, auxiliary building, fire fighting pump house building, fire fighting water tank, panel room , other buildings and covered car parking. It shall be inclusive of required tools, scaffolding, materials and other painting accessories etc. as per recommendations of manufacturer.

23.15 Hume Pipe

Hume pipe shall be measured diameter-wise and laid as per approved drawings and shall be measured in running meters. The item shall be inclusive of excavation, concreting, reinforcement, laying, back filling, jointing etc.

23.16 Building

The measurement of all items of each type of buildings shall be made on area in Square Meter basis. The structural steel used for cable tray support, earthing cleat, chequered plates for internal cable trenches of building and panel room wherever applicable shall be measured and paid under miscellaneous steel item of BPS and described above paras. The structural steel and foundation bolts for fixing equipments with foundations/raft within buildings shall not be measured separately which shall be deemed to be included in the quoted rates per square meter of buildings. External Finishing shall not be measured separately as it shall be deemed to be included in the item No. 6 of Civil works in BPS i.e. Design, Engineering and Construction of Buildings. The rest of the entire work required to complete the building in all respect as per drawings prepared by contractor and approved by Employer shall be deemed to be included in this item rate per square meter area basis.

23.17 Rain Water Harvesting

This is a lump sum item. The contractor shall be required to complete the work in all respect as per drawings prepared by contractor and approved by Employer. All the items including excavation, miscellaneous steel, brick work, fillings of boulders, gravel, sand, pipes etc. shall be deemed to be included in this lump sum rate.

23.18 Rail cum Road

The rail cum road shall include all items such as excavation, compaction, rolling, watering, WBM, concrete, reinforcement, structural steel and rails with rail fixing details etc. complete as per approved drawing. This work shall not be measured separately as it is covered under respective item of BPS and described in above paras.

23.19 Septic Tank and Soak Pit

The contractor shall be required to complete the work in all respect as per drawings furnished by the contractor and approved by Employer. All the items including excavation, masonry work, all types of fillings, all types of pipes including plumbing and vent pipes, all type of fittings etc. shall be deemed to be included in the item No. 6 of Civil works in BPS i.e. Design, Engineering and Construction of Buildings.

23.20 Fire Water Tank

This is a lump sum item. The contractor shall be required to complete the work in all respect as per approved drawings. The items including brick work if any, and miscellaneous steel including steel embedment Rungs, roof truss, corrugated AC Sheet roofing, door, pipe sleeves, internal finish, etc. shall be deemed to be included in this lump sum cost against item No. 7 of Civil works in BPS .

23.21 External water supply from Bore-well/ other source of water supply arrangement to Fire water tank, Control Room building, Security Room etc.

The external water supply from Bore-well shall be measured diameter-wise in running meters. It shall include all the items such as excavation, piping, pipe fittings, painting, brickwork, sand filling, concrete, valves, chambers cutting chases in walls, openings in RCC and repairs, etc. required to complete the job.

23.22 External Sewage System of Control Room Building and other Buildings.

All the items such as excavation, piping, pipe fittings, manholes, gali trap, gali chamber casing in concrete and repairs etc. required to complete the job shall be deemed to be included in the item No. 6 of Civil works in BPS i.e. Design, Engineering and Construction of Buildings. Any modification in the existing sewage system, if required, shall be done by the Contractor without any extra cost implication to Employer.

24.0 MISCELLANEOUS GENERAL REQUIREMENTS

24.1 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.

24.2 All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops shall be used for the base slab and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm.

24.3 All steel sections and fabricated structures which are required to be transported on sea shall be provided with anti-corrosive paint to take care of sea worthiness.

24.4 All mild steel parts used in the water retaining structures shall be hot-double dip galvanised. The minimum coating of the zinc shall be 750 gm/sq. m. for galvanised structures and shall comply with relevant IS. Galvanizing shall be checked and tested in accordance with relevant IS. The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS: 3416.

24.5 A screed concrete layer not less than 100 mm thick and of grade not weaker than M10 conforming to relevant IS 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.

24.6 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 75 kg/cm2 compressive strength before submitting his offer. The contractor may use concrete blocks of equivalent compressive strength in place of brick work.

24.7 Doors and windows on external walls of the buildings (other than areas provided, with insulated metal claddings) shall be provided with RCC sun-shade 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.

24.8 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. Service ladder shall be provided for access to all roofs. RCC fire escape staircase if required as per local bye laws, shall be provided in control buildings.

24.9 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.

24.10 Anti termite chemical treatment for buildings shall be given to all column pits, wall trenches, foundations, filling below the floors etc. as per relevant International/IS .

24.11 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 galvanised (medium-class as per relevant BS). All rungs for ladder shall also be galvanised as per relevant BS.

For RCC stairs, hand railing with 20 mm square MS bars, balustrades with suitable MS flats & aluminium handrails shall be provided.

24.12 For all civil works covered under this specification, design Mix of Minimum M25 grade as per relevant International /IS shall be used. Reinforcement steel shall be of minimum Fe 500 grade.

The material specification, workmanship and acceptance criteria shall be as per relevant clauses of applicable International/IS standard.

24.13 Items/components of buildings not explicitly covered in the specification and BPS but required for completion of the project shall be deemed to be included in the scope.

24.14 Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the International/IS Standards based on the findings of the detailed soil investigation to be carried out by the Bidder.

24.15 Foundation system adopted by Bidder shall ensure that relative settlement and other criteria shall be as per provision in relevant IS and other International Standards.

24.16 All water retaining structures designed as uncracked section shall also be tested for water tightness at full water level in accordance with relevant international/ IS standards.

24.17 Construction joints shall be as per International/IS standard.

24.18 All underground concrete structures like basements, pumps houses, water retaining structures etc. shall have plasticizer cum water proofing cement additive conforming to relevant IS. 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, The Method shall be applied as per relevant international standard/IS standard for repairing the leakage.

24.19 All building/construction materials shall conform to the best quality specified in relevant International /IS standard.

25.0 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's, 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.

26.0 STATUTORY RULES

26.1 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 and Water and sewerage Act for pollution control etc.

26.2 Provisions for fire proof doors, no. of staircases, fire escape stairs ,fire separation wall, plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Local Advisory Committee.

26.3 Statutory clearance and norms of Local Pollution Control Board shall be followed as per Water Act for effluent quality from plant.

27.0 FIELD QUALITY PLAN

All tests as required in accordance to IS codes or equivalent International standards have to be carried out. The contractor shall prepare field quality plan for civil works as per relevant IS codes/equivalent International Standards during detailed engineering stage and submit to Employer for approval within ONE month after award of work.

28.0 INDIAN STANDARD CODES

For design and engineering relevant IS codes or equivalent International standards shall be referred by the contractor. Relevant portion of IS codes or equivalent international standards referred by the contractor for the design shall be made available to Employer if necessary during detailed engineering stage.

TECHNICAL SPECIFICATION
VOL-II, SEC-XVIII
CONTROL & RELAY PANELS

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APPENDIX-A TEST PROGRAMME FOR DISTANCE RELAYS

SECTION XVIII

CONTROL, RELAY & PROTECTION PANELS

1. TYPE OF PANELS

1.1 Simplex Panel

Simplex panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from rear for control panels &-front-for relay/protection 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 Duplex Panel

Duplex panel shall be walk-in tunnel type comprising two vertical front and rear panel sections connected back-on-back by formed sheet steel roof tie members and a central corridor in between. The corridor shall facilitate access to internal wiring and external cable connections. In case of number of duplex panels located in a row side by side, the central corridor shall be aligned to form a continuous passage. Both ends of the corridor shall be provided with double leaf doors with lift off hinges. Doors shall have handles either with built-in locking facility or shall be provided with pad-locks. Separate cable entries shall be provided for the front and rear panels. However, inter-connections between front and back panels shall be by means of inter panel wiring at the top of the panel.

2. CONSTRUCTIONAL FEATURES

2.1. Control and Relay Board shall be of panels of simplex or duplex type design as indicated in bill of quantity. It is the responsibility of the Contractor to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control schemes be properly accommodated in the panels without congestion and if necessary, **either add more number of panels or** provide panels with larger dimensions. No price increase at a later date on this account shall be allowed. However, the width of panels that are being offered to be placed in existing switchyard control rooms, should be in conformity with the space availability in the control room.

2.2. Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-31 in accordance with IEC 60529 (Part-1).

2.3. Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation.

2.4. All doors, removable covers of panels shall be gasketed all around with synthetic gaskets Neoprene/EPDM. However, XLPE gaskets can also be used for fixing protective glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh

2.5. Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces tune and smooth.

2.6. Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Anti-vibration strips made of shock absorbing materials that shall be supplied by the contractor, which shall be placed between panel & base frame.

2.7. Cable entries to the panels shall be from the bottom. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the panel/station through a flexible braided copper conductor rigidly.

2.8. Relay/protection panels of modern modular construction would also be acceptable.

3. MOUNTING

3.1. All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panel shall be mounted flush.

3.2. Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible.

3.3. The Contractor shall carry out cut out, mounting and wiring of the free issue items supplied by others which are to be mounted in his panel in accordance with the corresponding equipment manufacturer's drawings. Cut outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.

3.4. The centre lines of switches, push buttons and indicating lamps shall not be less than 750mm from the bottom of the panel. The centre lines of relays, meters and recorders shall not be less than 450mm from the bottom of the panel.

3.5. The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise, the top lines of all meters, relays and recorders etc. shall be matched.

3.6. No equipment shall be mounted on the doors.

3.7. At existing station, panels shall be matched with other panels in the control room in respect of dimensions, colour, appearance and arrangement of equipment (centre lines of switches, push buttons and other equipment) on the front of the panel.

4. PANEL INTERNAL WIRING

4.1. Panels shall be supplied complete with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be carried out internally

4.2. All wiring shall be carried out with 650V grade, single core, stranded copper conductor wires with PVC insulation. The minimum size of the multi-stranded copper conductor used for internal wiring shall be as follows:

- All circuits except current transformer circuits and voltage transfer circuits meant for energy metering - one 1.5mm sq. per lead.
- All current transformer circuits - one 2.5 sq.mm per lead.
- Voltage transformer circuit (for energy meters): Two 2.5 mm sq. per lead.

4.3. 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.

4.4. 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.

4.5. 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.

4.6. 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.

4.7. Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment's.

5. TERMINAL BLOCKS

5.1. All internal wiring to be connected to external equipment shall terminate on terminal blocks. Terminal blocks shall be 650 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.

5.2. 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.

5.3. At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

5.4. 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. Aluminium.
- All other circuits: minimum of one of 2.5mm Sq. Copper.

5.5. 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.

5.6. Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side of the wiring-duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.

5.7. The number and sizes of the Owner's multi core incoming external cables will be furnished to the Contractor after placement of the order. All necessary cable terminating accessories such as gland plates, supporting clamps & brackets, wiring troughs and gutters etc. (except glands & lugs) for external cables shall be included in the scope of supply.

6. PAINTING

The painting shall be carried out as detailed in Section–GTR.

7. MIMIC DIAGRAM

7.1. Coloured mimic diagram and symbols showing the exact representation of the system

shall be provided in the front of control panels.

7.2. Mimic diagram shall be made preferably of anodised aluminium or plastic of approved fast colour material, which shall be screwed on to the panel and can be easily cleaned. The mimic bus shall be 2mm thick. The width of the mimic bus shall be 10mm for bus bars and 7mm for other connections. Painted overlaid mimic is also acceptable.

7.3. Mimic bus colour will be decided **during detailed Engineering.**

7.4. When semaphore indicators are used for equipment position, they shall be so mounted in the mimic that the equipment in close position shall complete the continuity of mimic.

7.5. Indicating lamp, one for each phase, for each bus shall be provided on the mimic to indicate bus charged condition.

8. NAME PLATES AND MARKINGS

8.1. All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. Also on the top of each panel on front as well as rear side, large and bold nameplates shall be provided for circuit/feeder designation.

8.2. All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.

8.3. Each instrument and meter shall be prominently marked with the quantity measured e.g. KV, A, MW, etc. All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.

8.4. Name Plates shall be made of non-rusting metal or 3 ply limacodid. Name plates shall be black with white engraving lettering.

8.5. Each switch shall bear clear inscription identifying its function e.g. 'BREAKER' '52A', "SYNCHRONISING" etc. Similar inscription shall also be provided on each device whose function is not other-wise identified. If any switch device does not bear this inscription separate name plate giving its function shall be provided for it. Switch shall also have clear inscription for each position indication e.g. "Trip- Neutral-Close", "ON-OFF", "R-Y-B-OFF" etc.

8.6. All the panels shall be provided with name plate mounted inside the panel bearing LOA No & Date, Name of the Substation & feeder and reference drawing number.

9. MISCELLANEOUS ACCESSORIES

9.1. **Plug Point**: 230V, 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.

9.2. **Interior Lighting**: Each panel shall be provided with a fluorescent lighting fixture rated for 230 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch. Adequate lighting shall also be provided for the corridor in Duplex panels.

9.3. **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 Fuses. Selection of the main and sub-circuit Fuses rating shall be such as to ensure selective clearance of sub-circuit faults. Voltage transformer circuits for relaying and metering shall be protected by fuses. All fuses shall be HRC cartridge type conforming to IS: 13703 mounted on plug-in type fuse bases. The short time fuse rating of Fuses shall be not less than 9 KA. Fuse carrier base shall have imprints of the fuse 'rating' and 'voltage'.

9.4. **Space Heater**: Each panel shall be provided with a thermostatically connected space heater rated for 230V, single phase, 50 Hz AC supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit.

10. EARTHING

10.1. All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference from earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq.mm copper with threaded holes at a gap of 50 mm with provision of bolts and nuts for connection with cable armours and mounted equipment etc. for effective earthing. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of Contractor. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

10.2. Provision shall be made on each bus bar of the end panels for connecting Substation earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of Contractor.

10.3. All metallic cases of relays, instruments and other panel mounted equipment including gland plate, shall be connected to the earth bus by copper wires of size not less than 2.5 sq. mm. The colour code of earthing wires shall be green.

10.4. Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided.

10.5. VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

10.6. An electrostatic discharge **arrangement** shall be provided in each panel **so as to discharge human body before he handles the equipment's inside the panels**.

11. INDICATING INSTRUMENTS & TRANSDUCERS FOR CONTROL PANEL:

All instruments, meters and transducers shall be enclosed in dust proof, moisture resistant, black finished cases and shall be suitable for tropical use. All megawatt , megabar, Bus voltage and frequency indicating instruments shall be provided with individual transducers and these shall be calibrated along with transducers to read directly the primary quantities. They shall be accurately adjusted and calibrated at works and shall have means of calibration check and adjustment at site. The supplier shall submit calibration certificates at the time of delivery. However no separate transducers are envisaged for digital bus voltmeters and digital frequency meters and the indicating meters provided in the synchronising equipment.

11.1. Indicating Instruments

11.1.1. Unless otherwise specified, all electrical indicating instruments shall be of digital type suitable for flush mounting.

11.1.2. Instruments shall have 4-digit display; display height being not less than 25 mm

11.1.3. Instrument shall confirm to relevant IEC and shall have an accuracy class of 1.5 or better. Watt and Var meters shall have an indication of (+) and (-) to indicate EXPORT and IMPORT respectively.

11.1.4. Digital voltage and frequency meters shall be of class: 0.5 and shall have digital display of 5 and 4 digits respectively, with display size, not less than 25mm (height).

11.2. Transducers

11.2.1. Transducers (for use with Indicating Instruments and Telemetry/Data Communication application) shall in general conform to IEC:688-1

11.2.2. The transducers shall be suitable for measurement of active power, reactive power, voltage, current and frequency in three phases four wire unbalanced system.

11.2.3. The input to the transducers will be from sub-station current & potential transformers. The output shall be in mill ampere D.C. proportional to the input & it shall be possible to feed the output current directly to the telemetry terminal or indicating instruments.

11.2.4. The transducer characteristic shall be linear throughout the measuring range.

11.2.5. The transducer output shall be load independent.

11.2.6. The input & output of the transducer shall be galvanically isolated.

11.2.7. Each transducer shall be housed in a separate compact case and have suitable terminals for inputs & outputs.

11.2.8. The transducers shall be suitably protected against transient high peaks of voltage & current.

11.2.9. The transducer shall withstand indefinitely without damage and work satisfactorily at 120% of the rated voltage and 120% of the rated input current as applicable.

11.2.10. All the transducers shall have an output of 4-20 mA.

11.2.11. The response time of the transducers shall be less than 1 second.

11.2.12. The accuracy class of transducers shall be 1.0 or better for voltage/current transducer, 0.5 or better for watt/VAR transducer and 0.2 or better for frequency transducer.

11.2.13. The transducers shall have a low AC ripple on output less than 1%.

11.2.14. The transducer shall have dual output.

12. ANNUNCIATION SYSTEM for Control Panel

12.1. Alarm annunciation system shall be provided in the control board by means of visual and audible alarm in order to draw the attention of the operator to the abnormal operating conditions or the operation of some protective devices. The annunciation equipment shall be suitable for operation on the voltages specified in this specification.

12.2. The visual annunciation shall be provided by annunciation facia, mounted flush on the top of the control panels.

12.3. The annunciation facia shall be provided with translucent plastic window for alarm point with approximate size of 35mm x 50mm. The facia plates shall be engraved in black lettering with respective inscriptions. Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall not be less than 5 mm.

12.4. Each annunciation window shall be provided with two white lamps in parallel to provide safety against lamp failure. Long life lamps shall be used. The transparency of cover plates and wattage of the lamps provided in the facia windows shall be adequate to ensure clear visibility of the inscriptions in the control room having high illumination intensity (350 Lux), from the location of the operator's desk.

12.5. All Trip facia shall have red colour and all Non-trip facia shall have white colour.

12.6. The audible alarm shall be provided by Buzzer/ Hooter /Bell having different sounds and shall be used as follows.

Hooter Alarm Annunciation

Bell	Annunciation DC failure
Buzzer	AC supply failure

12.7. Sequence of operation of the annunciator shall be as follows:

Sl. NO.	Alarm Condition	Fault Contact	Visual Annunciation	Audible Annunciation
1.	Normal	Open	OFF	OFF
2.	Abnormal	Close	Flashing	ON
3.	Accept Push Button Pressed	Close	Steady On	OFF
		Open	Steady On	OFF
4.	Reset Push Button Pressed	Close	On	OFF
		Open	Off	OFF
5.	Lamp Test Push Button Pressed	Open	Steady On	OFF

12.8. Audible annunciation for the failure of DC supply to the annunciation system shall be provided and this annunciation shall operate on 230 Volts AC supply. On failure of the DC to the annunciation system for more than 2 or 3 seconds (adjustable setting), a bell shall sound. A separate push button shall be provided for the cancellation of this audible alarm alone but the facia window shall remain steadily lighted till the supply to annunciation system is restored.

12.9. A separate voltage check relay shall be provided to monitor the failure of supply (230V AC) to the scheme mentioned in Clause above. If the failure of supply exists for more than 2 to 3 seconds, this relay shall initiate visual and audible annunciation. Visual and audible annunciation for the failure of AC supply to the annunciation system shall be provided and this annunciation shall operate on Annunciation DC and buzzer shall sound.

12.10. The annunciation system described above shall meet the following additional requirements:

a) The annunciation system shall be capable of catering to at least 20 simultaneous signals at a time.

b) One set of the following push buttons shall be provided on each control panel:

- Reset push button for annunciation system
- Accept push button for annunciation system
- Lamp test push button for testing the facia windows

c) One set of the following items shall be provided common for all the control panel (not applicable for extension of substation):

- Flasher relay for annunciation system
- Push button for Flasher test
- Three Push buttons for test of all audible alarm systems

d) These testing circuits shall be so connected that while testing is being done, it shall not prevent the registering of any new annunciation that may land during the test.

e) The annunciation shall be repetitive type and shall be capable of registering the fleeting signal. Minimum duration of the fleeting signal registered by the system

shall be 15 mill seconds.

f) In case of static annunciator scheme, special precaution shall be taken to ensure that spurious alarm condition does not appear due to influence of external electromagnetic/ electrostatic interference on the annunciator wiring and switching disturbances from the neighbouring circuits within the panels and the static annunciator shall meet the high voltage susceptibility test , impulse voltage withstand test , high frequency disturbance test– class III and fast transient disturbance test –level III as per IEC 60255.

12.11. The annunciation system to be supplied for existing sub-stations shall be engineered as an extension to the existing scheme.

13. SWITCHES

13.1. Control and instrument switches shall be rotary operated type with escutcheon plates clearly marked to show operating position and circuit designation plates and suitable for flush mounting with only switch front plate and operating handle projecting out.

13.2. The selection of operating handles for the different types of switches shall be as follows:

Breaker, Isolator control switches	:	Pistol grip, black
Synchronising switches	:	Oval, Black, Keyed handle (one common removable handle for a group of switches or locking facility having common key)
synchronising Selector switches	:	Oval or knob, black
Instrument switches	:	Round, knurled, black
Protection Transfer switch	:	Pistol grip, lockable and black.

13.3. The control switch of breaker and isolator shall be of spring return to neutral type. The switch shall have spring return from close and trip positions to "after close" and "after trip" positions respectively.

13.4. Instrument selection switches shall be of maintained contact (stay put) type. Ammeter selection switches shall have make-before-break type contacts so as to prevent open circuiting of CT secondary when changing the position of the switch. Voltmeter transfer switches for AC shall be suitable for reading all line- to-line and line-to-neutral voltages for non- effectively earthed systems and for reading all line to line voltages for effectively earthed systems.

13.5. Synchronising switches shall be of maintained contact (stay put) type having a common removable handle for a group of switches. The handle shall be removable only in the OFF position and it shall be co-ordinated to fit into all the synchronising switches. These switches shall be arranged to connect the synchronising equipment when turned to the 'ON' position. One contact of each switch shall be connected in the closing circuit of the respective breaker so that the breaker cannot be closed until the switch is turned to the 'ON' position.

13.6. Lockable type of switches which can be locked in particular positions shall be provided when specified. The key locks shall be fitted on the operating handles.

13.7. The contacts of all switches shall preferably open and close with snap action to minimise arcing. Contacts of switches shall be spring assisted and contact faces shall be with rivets of pure silver or silver alloy. Springs shall not be used as current carrying parts

13.8. The contact combination and their operation shall be such as to give completeness to the interlock and function of the scheme.

13.9. The contact rating of the switches shall be as follows:

Description	Contact Rating in Amps		
	220/110V DC	50V DC	230V AC
Make and carry Continuously	10	10	10
Make and carry for 0.5 sec.	30	30	30
Break for Resistive load	3	20	7
Break for Inductive load with L/R = 40m sec.	0.2	-	-

14. INDICATING LAMPS

14.1. Indicating lamps shall be of cluster LED type suitable for panel mounting with rear terminal connections. Lamps shall be provided with series connected resistors preferably built in the lamp assembly. Lamps shall have translucent lamp covers to diffuse lights coloured red, green, amber, clear white or blue as specified. The lamp cover shall be preferably of screwed type, unbreakable and moulded from heat resisting material.

14.2. The lamps shall be provided with suitable resistors.

14.3. Lamps and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if required for replacing the bulbs and lenses shall also be included in the scope of the supply.

14.4. The indicating lamps with resistors shall withstand 120% of rated voltage on a continuous basis.

15. POSITION INDICATORS (if Applicable)

15.1. Position indicators of "SEMAPHORE" type shall be provided when specified as part of the mimic diagrams on panels for indicating the position of circuit breakers, isolating/earthing switches etc. The indicator shall be suitable for semi-flush mounting with only the front disc projecting out and with terminal connection from the rear. Their strips shall be of the same colour as the associated mimic.

15.2. Position indicator shall be suitable for DC Voltage as specified. When the supervised object is in the closed position, the pointer of the indicator shall take up a position in line with the mimic bus bars, and at right angles to them when the object is in the open position. When the supply failure to the indicator occurs, the pointer shall take up an intermediate position to indicate the supply failure.

15.3. The rating of the indicator shall not exceed 2.5 W.

15.4. The position indicators shall withstand 120% of rated voltage on a continuous basis.

16. SYNCHRONISING EQUIPMENT

16.1. For sub-station equipped with sub-station Automation system, the requirement of synchronisation is specified in Section Sub-Station Automation System and the same shall prevail. For other sub-station which is not equipped with Sub-sub-station automation system following shall be applicable as per requirement.

1.1. The synchronising instruments shall be mounted either on a synchronising trolley or on a synchronising panel. The panel/ trolley shall be equipped with double analogy voltmeters and double analogy frequency meters, synchro scope and lamps fully wired. The size of voltmeters and frequency meters provided in the synchronising panel shall not be less than 144 X 144 sq.mm. Suitable auxiliary voltage transformers wherever necessary shall also be provided for synchronising condition. In case the synchro scope is not continuously rated, a synchro scope cut-off switch shall be provided and an indicating lamp to indicate that the synchro scope is energised, shall also be provided

1.2. Synchronising check relay with necessary ancillary equipment's shall be provided which shall permit breakers to close after checking the requirements of synchronising of incoming and running supply. The phase angle setting shall not exceed 35 degrees and have voltage difference setting not exceeding 10%. This relay shall have a response time of less than 200 milliseconds when the two system conditions are met within present limits and with the timer disconnected. The relay shall have a frequency difference setting not exceeding 0.45% at rated value and at the minimum time setting. The relay shall have an adjustable time setting range of 0.5-20 seconds. A guard relay shall be provided to prevent the closing attempt by means of synchronising check relay when control switch is kept in closed position long before the two systems are in synchronism

1.3. The synchronising panel shall be draw out and swing type which can be swivelled in left and right direction. The synchronising panel shall be placed along with control panels and the number of synchronising panel shall be as indicated in BPS. The incoming and running bus wires of VT secondary shall be connected and run as bus wires in the control panels and will be extended to synchronising panel for synchronisation of circuit breakers. The selector switch provided for each circuit breaker in respective control panels shall be lockable type with a common key so that only one selector switch is kept in synchronising mode at a time.

1.4. Alternatively, the trolley shall be of mobile type with four rubber-padding wheels capable of rotating in 360 degrees around the vertical axis. Suitable bumpers with rubber padding shall be provided all around the trolley to prevent any accidental damage to any panel in the control room while the trolley is in movement. The trolley shall have two-meter-long flexible cord fully wired to the instruments and terminated in a plug-in order to facilitate connecting the trolley to any of the panels. The receptacle to accept the plug shall be provided on the panel.

1.5. At existing sub-stations, the synchronising scheme shall be engineered to be compatible with the existing synchronising scheme and synchronising socket/switch on the panel. In substations, where synchronising panels are available, the bidder shall carry out the shifting of the above panels, if required, to facilitate the extension of control panel placement.

17. RELAYS

17.1. 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.

17.2. All protective relays shall be of numerical type and communication protocol shall be as per IEC 61850. Further, the test levels of EMI as indicated in IEC 61850 shall be applicable to these relays.

17.3. All protective relays shall be in draw out or plug-in type/modular cases with proper testing facilities. Necessary test plugs/test handles shall be supplied loose and shall be included in contractor's scope of supply.

17.4. All AC operated relays shall be suitable for operation at 50 Hz. AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 1-amp CT secondary. All DC operated relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

17.5. The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme; contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts.

17.6. Timers shall be of solid state type. Time delay in terms of milliseconds obtained by the external capacitor resistor combination is not preferred and shall be avoided.

17.7. No control relay, which shall trip the power circuit breaker when the relay is de-energised, shall be employed in the circuits.

17.8. Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

17.9. Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured:

(a) The operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.

(b) Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously.

(c) Impedance of the seal-in-unit shall be small enough to permit satisfactory operation of the trip coil on trip relays when the D.C. Supply Voltage is minimum.

(d) Trip-circuit seal-in is required for all trip outputs, irrespective of the magnitude of the interrupted current. The trip-circuit seal-in logic shall not only seal-in the trip output(s),but also the relevant initiation signals to other scheme functions, (e.g. initiate signals to the circuit-breaker failure function, reclosing function etc.), and the alarm output signals.

(e) Two methods of seal-in are required, one based on the measurement of AC current, catering for those circumstances for which the interrupted current is above a set threshold, and one based on a fixed time duration, catering for those circumstances for which the interrupted current is small (below the set threshold).

(f) For the current seal-in method, the seal-in shall be maintained until the circuit-breaker opens, at which time the seal-in shall reset and the seal-in method shall not now revert to the fixed time duration method. For this seal-in method, the seal-in shall be maintained for the set time duration. For the line protection schemes, this time duration shall be independently settable for single- and three-pole tripping.

(g) Seal-in by way of current or by way of the fixed duration timer shall occur irrespective of whether the trip command originates from within the main protection device itself (from any of the internal protection functions), or from an external device with its trip output routed through the main protection device for tripping. Trip-circuit seal-in shall not take place under sub-harmonic conditions (e.g. reactor ring down).

17.10. The setting ranges of the relays offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.

17.11. Any alternative/additional protections or relays considered necessary for providing complete effective and reliable protection shall also be offered separately. The acceptance of this alternative/ additional equipment shall lie with the OWNER.

17.12. All relays and their drawings shall have phase indications as R-Red, Y-yellow, B-blue

17.13. For numerical relays, the scope shall include the following:

a) Necessary software and hardware to up/down load the data to/from the relay from/to the personal computer installed in the substation. 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-61850 protocol.

c) In case of line protection and transformer/reactor protection, the features like fault recorder and event logging function as available including available as optional feature in these relays shall be supplied and activated at no extra cost to the owner. Also, necessary software/ hardware for automatic uploading to station HMI/DR work station (as applicable) shall be supplied. It is to be clearly understood that these shall be in addition to Fault recorder function as specified at clause no. 28.

18. TRANSMISSION LINE PROTECTION

18.1. All relays shall be suitable for series compensated line.

18.2. The line protection relays are required to protect the line and clear the faults on line within shortest possible time with reliability, selectivity and full sensitivity to all type of faults on lines. The general concept is to have two main protections having equal performance requirement specially in respect of time as called Main-I and Main-II for 220KV transmission lines and Main and back up protection for 132 KV transmission lines.

18.3. The Transmission system for which the line protection equipment are required is **indicated in Section – Project / General Technical Specification (GTS)**

18.4. The maximum fault current could be as high as 63kA 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.

18.5. The protective relays shall be suitable for use with capacitor voltage transformers having non-electronic damping and transient response as per IEC.

18.6. Fault Recorder, Distance to fault Locator and Over voltage relay (stage -1/2) functions if offered as an integral part of line protection relays, shall be acceptable provided these meet the technical requirements as specified in the respective clauses.

18.7. Auto reclose relay function if offered as an integral part of line distance protection relay, shall be acceptable **for 132 KV lines only** provided the auto reclose relay feature meets the technical requirements as specified in the respective clause.

18.8. The following protections shall be provided for each of the Transmission lines:

For 220KV

Main-I: Numerical distance protection scheme

Main-II: Numerical distance protection scheme of a make different from that of Main –I

For 132KV

Main: Numerical distance protection scheme

Back up: Directional Over Current and Earth fault Protection

The detailed description of line protections is given here under.

18.9. **Main-I and Main-II 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 lines:

For Source to Impedance ratio:	**4**	**15**
Relay setting (Ohms)	(10 or 20) and 2	2
Fault Locations (as % of relay setting)	50	50
Fault resistance (Ohms)	0	0
Maximum operating time (Milliseconds)	40 for all faults	45 for 3 ph. Faults & 60 for all other faults

(ii) for 132 KV lines:

A relaxation of 5 ms in above timings is allowed for 132 KV lines.

(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 facilities for offset features with adjustable 10-20% of Zone-3 setting

(j) shall have variable residual compensation

(k) 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

(l) shall have weak end in-feed feature

(m) shall be suitable for single & three phase tripping

(n) 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.

(o) 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 amps 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

(p) shall be suitable for use in permissive under reach/ over reach/ blocking communication mode

(q) shall have suitable number of potential free contacts for Carrier aided Tripping, Auto reclosing, CB failure, Disturbance recorder & Data acquisition system

(r) 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

(s) include fuse failure protection which shall monitor all the three fuses of C.V.T. and associated cable against open circuit

- inhibit trip circuits on operation and initiate annunciation
- have operating time less than 7 milliseconds
- remain inoperative for system earth faults

(t) 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 220KV transmission lines

(u) Must have a current reversal guard feature.

18.10. **Back-up Directional Over Current and Earth fault protection scheme**

(a) shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s)

(b) shall include necessary VT fuse failure relays for alarm purposes

(c) **over current elements** shall

- have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting
- have a variable setting range of 50-200% of rated current
- have a characteristic angle of 30/45 degree lead
- include hand reset flag indicators or LEDs

(d) **earth fault element** shall

- have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting
- have a variable setting range of 20-80% of rated current
- have a characteristic angle of 45/60 degree lag
- include hand reset flag indicators or LEDs

- include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay

18.11. **LINE OVER VOLTAGE PROTECTION RELAY** shall

(a) monitor all three phases

(b) have two independent stages

(c) stage- I & II as built-in with line distance relays Main I & II respectively are acceptable

(d) 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

(e) have an adjustable setting range of 100-170% of rated voltage with a time delay of 100-200 mill seconds for the second stage

(f) be tuned to power frequency

(g) provided with separate operation indicators (flag target) for each stage relays

(h) have a drop-off to pick-up ratio greater than 95%

(i) provide separate out-put contacts for each 'Phase' and stage for breaker trip relays, event logger and other scheme requirements

18.12. All trip relays used in transmission line protection scheme shall be of self/electrical reset type depending on application requirement.

19. CIRCUIT BREAKER PROTECTION:

This shall include following functions:

19.1. **Numerical AUTO RECLOSING** function shall

(a) have single phase reclosing facilities

(b) have a continuously variable single phase dead time range of 0.1-2 seconds

(c) have a continuously variable reclaim time range of 5-300 seconds

(d) Incorporate a **two-position** selector switch, from which single-phase auto-enclosure and non-auto reclosers mode can be selected. Alternatively, the mode of auto reclosing can be selected through programming.

(e) be of single shot type

(f) have priority circuit to closing of both circuit breakers in case one and half breaker arrangements to allow sequential closing of breakers

(g) However, Auto-reclose as in-built function of bay controller unit (BCU) (if supplied) provided for sub-station automation system is also acceptable.

19.2. **LOCAL BREAKER BACK-UP PROTECTION SCHEME** shall

(a) be triple pole type

(b) have an operating time of less than 15 milli seconds

(c) have a resetting time of less than 15 milli seconds

(d) have three over current elements

(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 initiations are acceptable for other protections and transformer /reactor 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

(j) be similar relays for complete scope of work as per specification

20. REACTOR PROTECTION

20.1. **Differential Protection Relay shall**

(a) be triple pole type

(b) have operation time less than 25 milli-seconds at 5 times setting

(c) be tuned to system frequency

(d) have current setting range of 10 to 40% of 1 Amp. or a suitable voltage setting range

(e) be high impedance / biased differential type

(f) be stable for all external faults

20.2. **Restricted Earth Fault Protection Relay** shall

(a) be single pole type

(b) be of current/voltage operated high impedance type

(c) have a current setting of 10-40% of 1 Amp. /have a suitable voltage setting range

(d) be tuned to system frequency

(e) have a suitable non-linear resistor to limit the peak voltage to 1000 Volts

20.3. **Back up impedance protection Relay** shall

(a) be triple pole type, with faulty phase identification/ indication

(b) be single step polarised 'mho' distance/ impedance relay suitable for measuring phase to ground and phase to phase faults

(c) have adequate ohmic setting range to cover at least 60% of the impedance of the reactor and shall be continuously variable

(d) have an adjustable characteristic angle of 30-80 degree

(e) have a definite time delay relay with a continuously adjustable setting range of 0.2-2.0 seconds

(f) include VT failure relay which shall block the tripping during VT fuse failure condition

Further, Reactor auxiliary protections contacts (Buchholz, PRV, Oil Temperature, Winding Temperature etc.) can be wired suitably in above protections or provide separate Flag relays/Auxiliary relays as per scheme requirements.

21. TRANSFORMER PROTECTION

All transformer protection functions may be grouped into Group-I and Group-II protections in the following manner:

Group-I Protection: Following protection functions may be provided in Group-I Transformer protection relay:

a) Differential Protection as per clause no. 21.1

b) Over fluxing Protection for HV side as per clause no. 21.2

c) Direction Over current and earth fault protection for HV side as per clause no. 21.4

d) Over Load Protection as per clause no. 21.5

Group-II Protection: Following protection functions may be provided in Group-II Transformer protection relay:

e) REF Protection as per clause no. 21.3

f) Over fluxing Protection for IV/LV side as per clause no. 21.2

g) Direction Over current and earth fault protection for IV/LV side as per clause no. 21.4

h) Neutral Current Relay for Single Phase Transformer Bank

The various protections as built-in function of Group I/II protections shall be accepted only if the functional requirements of corresponding protections as specified in clause no. 21.1 to 21.6 are met otherwise separate protection relay(s) shall be offered.

21.1 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 fault recording feature to record graphic form of instantaneous values of following analogue channels during faults and disturbances for the pre-fault and post fault period:

current in all three windings in nine analogue channels in case of 400kV class and above transformers or 6 analogue channels for lower voltage transformers and Voltage in one channel

The disturbance recorder shall have the facility to record the following external digital channel signals apart from the digital signals pertaining to differential relay:

1. REF protection operated
2. HV Breaker status (Main and tie)
3. IV Breaker status
4. Bucholz /OLTC Bucholz alarm / trip etc.
5. WTI/OTI/PRD alarm/trip of transformer etc.

Necessary hardware and software, for automatic up-loading the data captured by disturbance recorder to the personal computer (DR Work Station) available in the substation, shall be included in the scope.

21.2. **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 over fluxing 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

21.3. **Restricted Earth Fault Protection** shall

(a) be single pole type

(b) be of current/voltage operated type

(c) have a current setting range of 10-40% of 1 Amp. / have a suitable voltage setting range

(d) be tuned to the system frequency

21.4. **Back-up Over Current and Earth fault protection scheme with high set feature**

(a) Shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s).

(b) The scheme shall include necessary VT fuse failure relays for alarm purposes

(c) Over current relay shall

- have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current
- have low transient, over reach high set instantaneous unit of continuously variable setting range 500-2000 % of rated current
- have a characteristic angle of 30/45 degree lead
- include hand reset flag indicators or LEDs.

(d) Earth fault relay shall

- have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 20-80% of rated current
- have low transient, over reach high set instantaneous unit of continuously variable setting range 200-800 % of rated current
- have a characteristic angle of 45/60 degree lag

- include hand reset flag indicators or LEDs
- include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay

21.5. **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%.

21.6. **Transformer Neutral Current Protection relay** (for 1-Phase transformer bank neutral) shall

(a) 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

21.7. **Further, Transformer auxiliary protections contacts (Buchholz, PRV, Oil Temperature, Winding Temperature, OLTC Buchholz etc.) can be wired suitably in above protections or provide separate Flag relays/Auxiliary relays as per scheme requirements.**

22. TEE DIFFERENTIAL PROTECTION RELAYS

22.1. **TEE-1 Differential protection relay** shall

(a) be triple pole type

(b) have an operating time less than 30 milliseconds 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) have an operating current setting of 15% of 1 Amp or less

22.2. **TEE-2 Differential Protection relay** shall

(a) be triple pole type

(b) have operating time less than 25 milliseconds at 5 times setting

(c) be tuned to system frequency

(d) have current setting range of 20 to 80% of 1 Amp

(e) be voltage operated, high impedance type

(f) be stable for all external faults

(g) be provided with suitable nonlinear resistors across the relay to limit the peak voltage to 1000 volts

23. TRIP CIRCUIT SUPERVISION RELAY

(a) The relay shall be capable of monitoring the healthiness of each 'phase' trip-coil and associated circuit of circuit breaker during 'ON' and 'OFF' conditions.

(b) The relay shall have adequate contacts for providing connection to alarm and event logger.

(c) The relay shall have time delay on drop-off of not less than 200 milli seconds and be provided with operation indications for each phase

24. TRIPPING RELAY

High Speed Tripping Relay shall

(a) be instantaneous (operating time not to exceed 10 milli-seconds).

(b) reset within 20 milli seconds

(c) be D.C. operated

(d) have adequate contacts to meet the requirement of scheme, other functions like auto-reclose relay, LBB relay as well as cater to associated equipment like event logger, Disturbance recorder, fault Locator, etc.

(e) be provided with operation indicators for each element/coil.

25. DC SUPPLY SUPERIVISION RELAY

(a) The relay shall be capable of monitoring the failure of D.C. supply to which, it is connected.

(b) It shall have adequate potential free contacts to meet the scheme requirement.

(c) The relay shall have a 'time delay on drop-off' of not less than 100 milli seconds and be provided with operation indicator/flag.

26. BUS BAR PROTECTION

26.1. Single bus bar protection scheme shall be provided for each main bus and transfer bus (as applicable) for 220KV and 132 KV voltage levels

26.2. 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 milli seconds at 5 times setting value.

(b) operate selectively for each bus bar

(c) give hundred percent security up to 63 KA fault level for 220KV and 31.5 KA for 132 KV

(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 (including transfer bus if any). If the bus section is provided then each side of bus section shall have separate set of bus bar protection schemes

(i) include individual high speed electrically reset tripping relays for each feeder. However, in case of distributed Bus bar protection, individual trip relay shall not be required if bay unit is having trip duty contacts for breaker tripping.

(j) be transient free in operation

(k) include continuous D.C. supplies supervision

(l) not cause tripping for the differential current below the load current of heaviest

loaded feeder. Contractor shall submit application check for the same.

(m) shall include necessary C.T. switching relays wherever C.T. switching is involved and have 'CT' selection incomplete alarm

(n) include protection 'IN/OUT' switch for each zone

(o) shall include trip relays, CT switching relays (if applicable), auxiliary CTs (if applicable) as well as additional power supply modules, input modules etc. as may be required to provide a Bus-bar protection scheme for the complete bus arrangement i.e. for all the bays or breakers including future bays as per the Single line diagram for new substations. However, for extension of bus bar protection scheme in existing substations, scope shall be limited to the bay or breakers covered under this specification. Suitable panels (if required) to mount these are also included in the scope of the work.

(p) In case of distributed Bus Bar Protection, the bay units for future bays may be installed in a separate panel and the same shall be located in switchyard panel room where bus bar protection panel shall be installed.

26.3. Built-in Local Breaker Backup protection feature as a part of bus bar protection scheme shall also be acceptable.

26.4. 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.

26.5. 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.

27. **WEATHER PROOF RELAY PANELS** (If Applicable)

(a) This panel shall include necessary number of electrically reset relays each with at least eight contacts for isolator auxiliary contacts multiplication and for changing the CT and DC circuits to relevant zones of bus bar protection.

(b) The panel shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be at least 2.0 mm thick and properly braced to prevent wobbling.

(c) The enclosures of the panel shall provide a degree of protection of not less than IP-55 (as per IEC-60529).

(d) The panel shall be of free standing floor mounting type or pedestal mounting type as per requirement.

(e) The panel shall be provided with double hinged doors with padlocking arrangement.

(f) All doors, removable covers and panels shall be gasketed all around with synthetic gaskets Neoprene/EPDM. However, XLPE gaskets can also be used for fixing protective glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh

(g) Cable entries shall be from bottom. Suitable removable cable gland plate shall

be provided on the cabinet for this purpose.

(h) All sheet steel work shall be degreased, pickled, phosphate and then applied with two coats of zinc chromates primer and two coats of finishing synthetic enamel paint, both inside and outside. The colour of the finishing paint shall be light grey.

(i) Suitable heaters shall be mounted in the panel to prevent condensation. Heaters shall be controlled by thermostats so that the cubicle temperature does not exceed 30^{O}C. On-off switch and fuse shall be provided. Heater shall be suitable for 230V AC supply Voltage.

(j) The test terminal blocks (TTB) to be provided shall be fully enclosed with removable covers and made of moulded, non-inflammable plastic material with boxes and barriers moulded integrally. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring. Terminal block shall have shorting, disconnecting and testing facilities for CT circuits.

28. FAULT RECORDER

28.1. The fault recorder shall be provided for transmission line and the fault recorder as in-built feature of line distance relay is also acceptable provided the requirements of following clauses are met.

28.2. Fault recorder shall be microprocessor based and shall be used to record the graphic form of instantaneous values of voltage and current in all three phases, open delta voltage & neutral current, open or closed position of relay contacts and breakers during the system disturbances.

28.3. The Fault recorder shall consist of individual acquisition units, one for each feeder and an Evaluation unit which is common for the entire Substation. Whenever, more than one acquisition units are connected to an Evaluation unit, necessary hardware and software shall also be supplied for on line transfer of data from all acquisition units to Evaluation unit.

28.4. The acquisition unit is connected with evaluation unit being supplied as described in Section sub-station automation through bus conforming to IEC 61850. In case of extension sub-station which is equipped with Sub-Station Automation System based on IEC 61850, one set of evaluation software shall be supplied and loaded in existing fault recorder evaluation unit. Automatic uploading of disturbance files from acquisition unit to evaluation unit shall be done through existing station bus only conforming to IEC 61850. Necessary configuration/updating including hardware if any shall be in the scope of the contractor.

28.5. In case of extension of existing substation(s) which are without sub-station automation system, one set of Evaluation unit shall be supplied for each substation where ever disturbance recorders are required to be supplied along with necessary evaluation software as specified above. The Evaluation unit shall consist of a desktop personal computer (including at least 17" TFT colour monitor, mouse and keyboard) and printer. The desktop PC shall have Pentium - IV processor or better and having a clock speed 3.0GHz or better. The hard disk capacity of PC shall not be less than 300 GB and RAM capacity shall not be less than 3 GB

28.6. The evaluation unit hardware, for substations having SAS, shall be as described in clause no. 4.0 of Section sub-station automation system.

28.7. Fault recorder shall have at least 8 analogue and 16 digital channels for each feeder.

28.8. Acquisition units shall acquire the Disturbance data for the pre-fault and post fault period and transfer them to Evaluation unit automatically to store in the hard disk. The acquisition units shall be located in the protection panels of the respective feeders.

28.9. 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.

28.10. The equipment shall be carefully screened, shielded, earthed and protected as may be required for its safe functioning. Also, the Fault recorder shall have stable software, reliable hardware, simplicity of maintenance and immunity from the effects of the hostile environment of EHV switchyard which are prone to various interference signals typically from large switching transients.

28.11. Necessary software for transferring the data automatically from local evaluation unit to a remote station and receiving the same at the remote station through owner's PLCC/VSAT/LEASED LINE shall be provided.

28.12. Evaluation software shall be provided for the analysis and evaluation of the recorded data made available in the PC under WINDOWS environment. The Software features shall include repositioning of analogy and digital signals, selection and amplification of time and amplitude scales of each analogue and digital channel, calculation of MAX/MIN frequency, phase difference values, recording of MAX/MIN values etc. of analogue channel, group of signals to be drawn on the same axis etc. listing and numbering of all analogue 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 Disturbance records shall also be available in COMTRADE format (IEEE standard- Common Format for Transient data Exchange for Power System)

28.13. The Evaluation unit shall be connected to the printer to obtain the graphic form of disturbances whenever desired by the operator.

28.14. 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 normally 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. The inverter of adequate capacity shall be provided to cater the requirement specified in Section sub-station automation clause no. 8.0 and DR evaluation unit.

28.15. 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 fails etc. and same shall be wired to annunciation system.

(b) The frequency response shall be 5 Hz on lower side and 250 Hz or better on upper side.

(c) Scan rate shall be 1000 Hz/channel or better.

(d) Pre-fault time shall not be less than 100 milliseconds and the post fault time shall not be less than 2 seconds (adjustable). If another system fault occurs during one post-fault run time, the recorder shall also be able to record the same. However, the total memory of acquisition unit shall not be less than 5.0 seconds

(e) The open delta voltage and neutral current shall be derived either through software or externally by providing necessary auxiliary transformers.

(f) The acquisition unit shall be typically used to record the following digital channels:

1 Main CB R phase open

2 Main CB Y phase open

3 Main CB B phase open

4 Main-1 carrier received

5 Main-1 protection operated

6 Main/Tie /TBC Auto reclosed operated

7 Over Voltage -Stage-1 /2 operated

8 Reactor / Stub/TEE-1/2/UF protection operated

9 Direct Trip received

10 Main-2 carrier received

11 Main- 2/ Back Up protection operated

12 Bus bar protection operated

13 LBB operated of main /tie/TBC circuit breaker

14 Tie/TBC CB R phase open

15 Tie/TBC CB Y phase open

16 Tie/TBC CB B phase open

(g) In case the Fault recorder is in-built part of line distance protection, above digital channels may be interfaced either externally or internally.

(h) Any digital signal can be programmed to act as trigger for the acquisition unit. Analog channels should have programmable threshold levels for triggers and selection for over or under levels should be possible.

28.16. The **colour laser** printer shall be provided which 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 **A4 size** paper (500 sheets in each packet) suitable for printer shall be supplied.

28.17. Each Fault recorder shall have its own time generator and the clock of the time generator shall be such that the drift is limited to $\pm$0.5 seconds/day, if allowed to run without synchronisation. Further, Fault recorder shall have facility to synchronise its time generator from Time Synchronisation Equipment having output of following types

- Voltage signal: (0-5V continuously settable, with 50m Sec. minimum pulse duration)
- Potential free contact (Minimum pulse duration of 50 m Sec.)
- IRIG-B
- RS232C

The recorder shall give annunciation in case of absence of synchronising within a specified time.

28.18. Substations where Time Synchronisation Equipment is not available, time generator of any one of the Fault recorders can be taken as master and time generators of other Fault recorders and Event loggers in that station shall be synchronised to follow the master.

29. **DISTANCE TO FAULT LOCATOR** shall

a) be electronic or microprocessor based type

b) be 'On-line' type

c) be suitable for breaker operating time of 2 cycles

d) have built-in display unit

e) the display shall be directly in percent of line length or kilometres without requiring any further calculations

f) have an accuracy of 3% or better for the typical conditions defined for operating timings measurement of distance relays

g) The above accuracy should not be impaired under the following conditions:

- presence of remote end in feed
- predominant D.C. component in fault current
- high fault arc resistance
- severe CVT transients

h) shall have mutual zero sequence compensation unit if fault locator is to be used on double circuit transmission line

i) built in feature of line distance relay is acceptable provided the requirements of above clauses are met

30. TIME SYNCHRONISATION EQUPMENT

30.1. The Time synchronisation equipment shall receive the co-ordinated Universal Time (UTC) **transmitted** through Geo Positioning Satellite System (GPS) and synchronise equipment's to the Indian Standard Time in a substation.

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

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

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

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

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

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

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

30.9. The equipment offered shall have six (6) output ports. Various combinations of output ports shall be selected by the customer, during detailed engineering, from the following:

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

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

30.11. Time synchronisation equipment shall be suitable to operate from 220V DC or 110V DC as available at Substation.

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

31. RELAY TEST KIT

31.1. One relay test kit shall comprise of the following equipment as detailed here under

3 sets	Relay tools kits
2 nos.	Test plugs **for TTB**
2 nos.	Test plugs for using with modular type relays (if applicable)

32. TYPE TESTS

32.1. The reports for following type tests shall be submitted during detailed engineering for the Protective relays, Fault Recorder, Fault locator and Disturbance recorder:

a) Insulation tests as per IEC 60255-5

b) DC Voltage dips and interruptions/Variation as per IEC 6100-4-29.

c) High frequency disturbance test as per IEC 61000-4 16, Class IV (Not applicable for electromechanical relays)

d) Electrostatic discharges as per IEC 61000-4-2, level; 4 (not applicable for Electromechanical relays)

e) Fast transient test as per IEC 61000, Level I**V** (Not applicable for electromechanical relays)

f) Relay characteristics, performance and accuracy test as per IEC 60255

- Steady state Characteristics and operating time
- Dynamic Characteristics and operating time for distance protection relays and current differential protection relays
- Conformance test as per IEC 61850-10.

For Fault recorder, Disturbance recorder; only performance tests are intended under this item.

g) Tests for thermal and mechanical requirements as per IEC 60255-6

h) Tests for rated burden as per IEC 60255-6

i) Contact performance test as per IEC 60255-0-20 (not applicable for Distance to fault locator and Disturbance recorder)

In case there is a change either in version or in model (Except firmware) of the relay, the contractor has to submit the type test reports for the offered revision/model.

32.2. Steady state & Dynamic characteristics test reports on the distance protection relays, as type test, shall be based on test programme specified in Appendix A on simulator/network analyser/PTL. Alternatively, the files generated using Electromagnetic Transient Programme (EMTP) can also be used for carrying out the above tests. Single source dynamic tests on transformer differential relay shall be/ should have been conducted based on general guidelines specified in CIGRE committee 34 report on Evaluation of characteristics and performance of Power system protection relays and protective systems.

33. CONFIGURATION OF RELAY AND PROTECTION PANELS

The following is the general criteria for the selection of the equipment's to be provided

in each type of panel. However, contractor can optimise the requirement of panels by suitably clubbing the feeder protection and CB relay panels. It may be noted that Main-I and Main-II protections for line cannot be provided in single panel. Similarly, Group-I & Group-II protections for transformer cannot be provided in single panel.

CONTROL PANEL

Various types of control panels shall consist of the following

a	Ammeter	3 set	for each Line, BC, TBC Bus section, Bus Reactor and Transformer
b	Ammeter with Selector switch	1 set	for each line reactor
c	Wattmeter with transducer	1 set	for each line, transformer
d	Varmeter with transducer	1 set	for each line, transformer, Bus reactor
e	Varmeter with transducer	1 set	for each Line Reactor
f	CB Control switch	1 no.	for each Circuit breaker
g	Isolator Control switch	1 no.	for each isolator
h	Semaphore	1 no.	for each earth switch
i	Red indicating lamp	1 no.	for each Circuit breaker
j	Red indicating lamp	1 no.	for each isolator
k	Green indicating lamp	1 no.	for each Circuit breaker
l	Green indicating lamp	1 no.	for each isolator
m	White indicating lamp (DC healthy lamp)	2 nos.	for each feeder
n	Annunciation windows with associated annunciation relays	18 nos.	for each feeder
o	Push button for alarm	3 nos.	for each control panel

	Accept/reset/lamp test		
p	Synchronising Socket	1 no.	for each Circuit Breaker if required
q	Synchronising selector Switch	1no.	for each Circuit Breaker if required
r	Protection Transfer Switch	1 no.	for each breaker in case of DMT /DM*/SMT scheme (Excep And BC Breaker)-*with Bypass ISO
s	Mimic to represent SLD	Lot	in all control panels
t	Voltmeter with selector Switch	1no.	for each line, transformer, bus reactor
u	Cut out, mounting and wiring for RWTI and selector switch	Lot	for transformers/reactors

Notes:

1 For transformer feeders, all equipment's of control panel shall be provided separately for HV and MV sides.

2. In case of incomplete diameter (D and I type layouts), control panel shall be equipped fully as if the diameter is complete, unless otherwise specified. Annunciation relays shall also be provided for the same and if required, necessary panel shall be supplied to accommodate the same.

3. The above list of equipment's mentioned for control panel is generally applicable unless it is defined elsewhere and in case of bay extension in existing substations, necessary equipment's for matching the existing control panel shall be supplied.

4. Common synchronising switch is also acceptable in Synchronising trolley for new Substations. In this case. individual synchronising selector switch is not required for each Circuit Breaker in control panel

5. Each line /HV side of transformer/MV/LV side of transformer /Bus reactor /TBC /BC/ Bus Section shall be considered as one feeder for above purpose.

LINE PROTECTION PANEL (220 & 132kV)

The Line Protection panel for transmission lines shall consist of following protection features/schemes

Sl. No.	Description	220kV	132kV
1.	Main-1 Numerical Distance protection scheme	1 Set	1 Set

Sl. No.	Description	220kV	132kV
2.	Main-2 Numerical Distance protection scheme	1 Set	NIL
3.	Over Voltage Protection Scheme	NIL	NIL
4.	Fault Recorder	1 Set	NIL
5.	Distance to fault Locator	1 Set	1 Set
6.	3 Phase Trip Relays	2 Nos.	2 Nos.
7.	Flag relays, carrier receive relays, aux. Relays, timers etc. as per scheme requirements	As required	As required
8.	Under Voltage protection relay for isolator/earth switch	2 Nos.	2 Nos.
9. .	Cut-out and wiring with TTB for supplied energy meter	1 Set	1 Set
10.	Directional Back Up Over current and E/F protection scheme	1 Set	1 Set

In a substation where 220 KV lines are under the scope of the contract, bidder is required to give identical Main-1 and Main-2 distance protection schemes for all voltage levels.

a) 33 KV LINE CONTROL & PROTECTION PANEL (For Substation with Automation)

Sl No.	DESCRIPTION	QTY
1	Bay Control Unit/Bay Control & Protection Unit	1NO.
2	Numerical Non-Directional Over Current and Earth Fault Relay 1No.with High Set Feature and in built LBB protection (LBB function as part of BCU is acceptable)	1NO.
3	Electronic Trisector Meter with 0.2 Class Accuracy with RS 485, RS 232 & Front Optical port)	1NO.
4	Master Trip Relay with adequate no of contacts 1 No. and Electrical Resettable type	1NO.
5	CB Troubles and Alarm (Part of BCU)	1 SET
6	Metering (part of BCU)	1 SET

b) 132/33kV TRANSFORMER CONTROL & PROTECTION RELAY PANEL

I. The protection panel for 132/33kV Transformer shall consist of the following equipment's.

		132kV Side	33kV
1	Transformer Differential protection scheme	1 no	NIL
2	Restricted Earth fault protection scheme	1 no	1 no
3	Directional back up over current and E/F Relay With non-directional high set feature	1set	Nil

4	Non-Directional back up over current and E/F Relay with non-directional high set feature (Part of 33kV BCU is acceptable)	NIL	1 Set
5	Over fluxing protection scheme	Nil	1No.
6	Over load protection scheme	1No.	Nil
7	Three phase trip relays	2No.	2No.
8	Trip supervision relay	2No.	2No.
9	Scheme requirements including transformer Alarms and trip function	Lot	Lot
10	Disturbance Recorder	1No.	-------
11	Revenue Energy meter (As per T.S. Section)	1No.	1No.

$ BCU for 220kV&132kV Bays has been included in the BOQ details of SAS.

c) 33kV BREAKER RELAY PANEL
(Acceptable as Part of Line /transformer Relay panel)

The breaker relay panel for 33kV shall comprise of the following:

Without A/R

1. DC supply supervision relay 2 no.

2.Trip circuit supervision relays 2 nos.

3. Emergency CB TNC Switches 1 No.

4. Flag relays, aux. relays, timers, trip relays etc.
As per scheme requirements.
(Acceptable as part of BCU)

d) <u>TRANSFORMER PROTECTION PANEL (220/132kV) , 220/33kV</u>

The protection panel for Auto transformer/Transformer shall consists of the following features/schemes:

S. No.	Description	HV side	MV/LV side
1.	Transformer Differential Protection scheme	1 Nos.	Nil
2.	Restricted Earth fault protection scheme @ Not applicable for auto-transformer	1 no.	1 no
3.	Directional back up O/C and E/F relay with non-directional high set feature	1 set	1 set
4.	Over Fluxing Protection scheme	1 no.	--
5.	Overload protection scheme	1 nos.	NIL
6.	Three phase trip relays	2 nos.	2 nos.
7.	CVT selection relays as per scheme requirement	Lot	Lot
8.	Cut-out and wiring with TTB for supplied energy meter	1 set	1 set
9.	Transformer Neutral Current relay for 1-Phase transformer bank	1 Set	
10.	Flag Relays/Aux. Relays for wiring Transformer auxiliary protection contacts such as Buchholz, Oil Temperature, Winding Temperature, PRV, OLTC Buchholz etc. as per scheme requirements	As required	

The above protection schemes may be clubbed in Group-I/II as per clause no. 21 of technical specification.

e) **<u>REACTOR PROTECTION PANEL (220kV & 132kV)</u>**

The protection panel for Reactor shall consist of the following protection features/schemes:

Sl. No.	Description	Qty.
1.	Reactor Differential Protection scheme	1 no.
2.	Restricted Earth fault Protection scheme	1 no.
3.	Reactor back up impedance protection scheme	1 set
4.	Three phase trip relays	2 nos.
5.	CVT selection relay as per scheme requirement	Lot
6.	Flag Relays/Aux. Relays for wiring Reactor auxiliary protection contacts such as Buchholz, Oil Temperature, Winding Temperature, PRV etc. as per scheme requirements	As required

f) **<u>BREAKER RELAY PANEL (220kV & 132kV)</u>**

The breaker relay panel shall comprise of the following:

Sl. No.	Description	With A/R	Without A/R
1.	Breaker failure Protection Scheme	1 No.	1 No.
2.	DC supply Supervision relay	2 Nos.	2 Nos.
3.	Trip Circuit supervision relays#	6 Nos.	6 Nos.

4.	Auto-reclose scheme (if standalone)	1 Nos.	NIL
5.	Flag relays, aux relays, timers, trip relays as per scheme requirements	As required	As required

Trip supervision relays shall be 2 or 6 numbers as per no. of trip coils for each 132KV Circuit breaker

Note: Equipment/relays to be provided under CB Relay Panel may be accommodated in the Protection Panels to be provided for Transmission Line/Transformer/Reactor as applicable.

34. 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

35. TROPICALISATION

Control room will be normally air-cooled/air- conditioned. All equipment's 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.

General Comments:

1. These test cases are evolved from the report of working group 04 of study committee 34 (Protection) on evaluation of characteristics and performance of power system protection relays and protective systems. For any further guidelines required for carrying out the tests, reference may be made to the above document.
2. The test shall be carried out using network configuration and system parameters as shown in the figure-1
3. All denotations regarding fault location, breakers etc. are referred in figure –1
4. The fault inception angles are referred to R- N voltage for all types of faults
5. The fault inception angle is zero degree unless otherwise specified
6. Where not stated specifically, the fault resistance (Rf) shall be zero or minimum as possible in simulator
7. Single pole circuit breakers are to be used
8. The power flow in double source test is 500 MW

System parameters

System voltage =400KV

CTR= 1000/1

PTR = 400000/110 (with CVT, the parameters of CVT model are shown in figure –2)

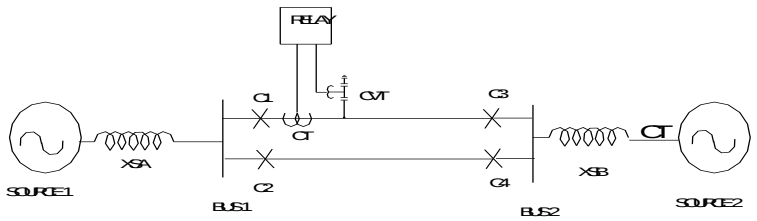

FIGURE 1

Line parameters/km

Positive Sequence Resistance, (r1)	= 0. 02897 Ω
Positive Sequence Reactance (x1)	= 0.3072 Ω
Zero Sequence Resistance (r0)	= 0.2597 Ω
Zero Sequence Reactance (x1)	= 1.0223 Ω
Zero Sequence Mutual Resistance (rm)	= 0.2281 Ω
Zero Sequence Mutual Reactance (xm)	= 0.6221 Ω

Zero Sequence succeptance (bo) **= 2.347 µ mho**
Positive Sequence succeptance (b1) =3.630 µ mho

Type of line	Short		Long
Secondary line impedance	2 Ω		20 Ω*
Length of line in Kms	23.57		235.7
SIR	4	15	4
Source impedance (pry) (at a time constant of 50 ms)	29.09 Ω (5500 MVA)	109.09 Ω (1467 MVA)	290.9 Ω (550 MVA)

* Alternatively, the tests can be done with 10 Ω secondary impedance and source impedance may accordingly be modified

CVT Model

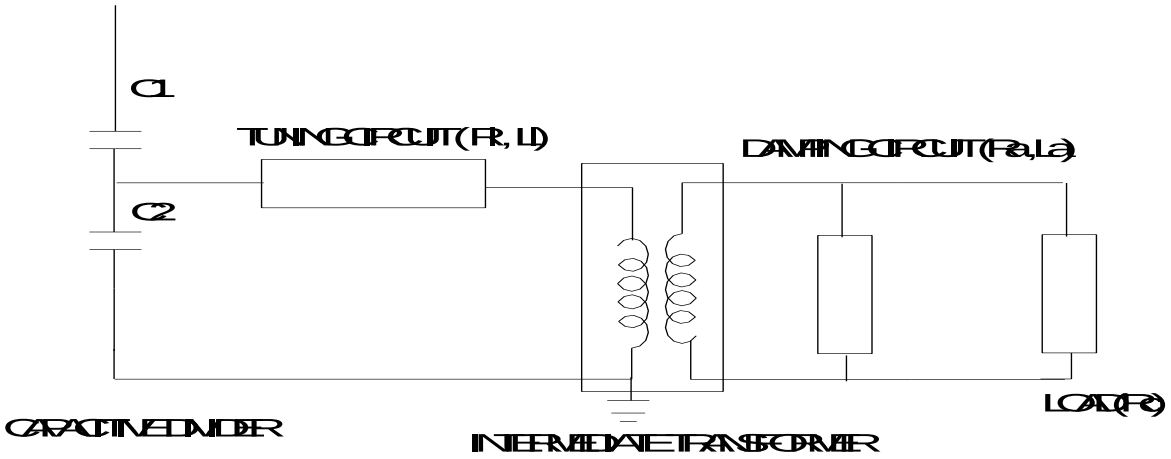

Figure2

XC1	1.455 µ mho
XC2	27.646 µ mho
Rl	320 Ω
XLl	34243 Ω
Ra	4.200 Ω
Xla	197.92 Ω
Rc	14.00 Ω
Transformation ratio of Intermediate	181.8

transformer

Details of fault cases to be done

S. no.	Description	Single source with short line (2)		Single source long line (20)	Double source with short double line (2)	Double source with long single line (20)
		CLOSE C1, OPEN C2, C3, C4		CLOSE C1, OPEN C2, C3, C4	CLOSE C1, C2, C3, C4	CLOSE C1, C3 OPEN C2, C4
		SIR=4	SIR=15	SIR =4	SIR = 4	SIR=4
	Dynamic accuracy for zone 1	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	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	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		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
2	Operating time for zone 1 at SIR =4	Tests to be done at 3 locations (0%, 40% and 64% of line length) X 4 faults (RN, YB, YBN, RYB) X 4 fault inception angle (0°, 30°,60° and 90°) = 48 cases	Tests to be done at 3 locations (0 %, 40 % and 64 % of line length) X 4 faults (RN, YB, YBN, RYB) X 4 fault inception angle (0°,30°,60°and 90°) = 48 cases	Tests to be done at 3 locations (0 %, 40 % and 64 % of line length) X 4 faults (RN, YB, YBN, RYB) X 4 fault inception angle (0°, 30°,60° and 90°) = 48 cases	Tests to be done at 1 location (40 % of line length) X 4 faults (RN, YB, YBN, RYB) X 4 fault inception angle (0°,30°,60° and 90 °) = 16 cases	Tests to be done at 1 location (40 % of line length) X 4 faults (RN, YB, YBN, RYB) X 4 fault inception angle (0°,30°,60° and 90°) = 16cases
3	Operating time for zone II and Zone III	Tests to be done at 1 location (100 % of line length) X 1 faults (RN, YB, YBN, RYB) X 2 zones (II and III) = 2 cases	Tests to be done at 1 location (100 % of line length) X 1 faults (RN, YB, YBN, RYB) X 2 zones (II and III) = 2 cases	Tests to be done at 1 location (100 % of line length) X 1 faults (RN, YB, YBN, RYB) X 2 Zones (II and III) = 2 cases		

S. no.	Description	Single source with short line (2)		Single source long line (20)	Double source with short double line (2)	Double source with long single line (20)
4	Switch on to fault feature			Tests to be done at 2 location (0 % and 32 %) X 1 faults (RYB) Any fault inception angle = 2 cases		
5	Operation during current reversal				Tests to be done at 2 location (0 % and 80 % of line length) X 1 faults (RN) X 1 fault inception angle (0 degrees) = 2 cases	
		CLOSE C1, OPEN C2,C3,C4		CLOSE C1, OPEN C2,C3,C4	CLOSE C1, C2,C3,C4	CLOSE C1,C3 OPEN C2,C4
		SIR=4	SIR=15	SIR =4	SIR = 4	SIR=4
6	Operation at simultaneous faults				Tests to be done at 2 location (8 % and 64 % of line length) X 2 faults (RN in circuit 1 to BN in circuit 2 and RN in circuit 1 to RYN in circuit 2 in 10 ms) X 1 fault inception angle (0 °) = 4 cases (*1)	
7	Directional sensitivity					Tests to be done at 1 location (0% reverse) X 6 faults (RN ,YB, YBN , RYB,RN with Rf=13.75

S. no.	Description	Single source with short line (2)		Single source long line (20)	Double source with short double line (2)	Double source with long single line (20)
						ohm(sec) and RYN with Rf= 13.75 Ohm (sec) X 2 fault inception angle (0° ,90°) = 12cases
8	Limit for fault resistance					Tests to be done at 2 location (0% and 68 % of line length) X 1 fault (RN with Rf=13.75 ohm(sec) X 2 fault inception angle (0°,90°) = 4 cases
9	Operation at evolving faults					Tests to be done at 2 location (32 % and 0% of line length) X 2 faults (RN to RYN) x in 2 timings (10 ms and 30 ms) X 2 load direction (from A to B and from B to A) = 16 cases
10	Fault locator function, in case the same is offered as built in feature	Measure fault location for all cases under 1 and 2	Measure fault location for all cases under 1 and 2	Measure fault location for all cases under 1 and 2	Measure fault location for all cases under 2 and 6	Measure fault location for all cases under 2, 7 and 9

TECHNICAL SPECIFICATION
VOL-II, SEC-XIX
SUBSTATION AUTOMATION SYSTEM

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ANNEXURE-I LIST OF ANALOGUE AND DIGITAL INPUT
ANNEXURE-II LIST OF IO POINTS TO BE TRANSMITTED TO RSCC

SECTION XIX
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 220kV system or higher for at least 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 remote control centre (RCC) as well as from local control centre.

The SAS shall contain the following main functional parts:

- Bay control Intelligence Electronic Devices (IEDs) for control and monitoring.
- Station Human Machine Interface (HMI)
- Redundant managed switched Ethernet Local Area Network communication infrastructure with hot standby.
- Gateway for remote control via industrial grade hardware (to RCC) through IEC60870-5-101 protocol.
- Gateway for remote supervisory control (to RSCC), the gateway should be able to communicate with RSCC on IEC 60870-5-101 protocol. The specific protocol to be implemented is enclosed as Appendix-I.. It shall be the bidder's responsibility to integrate his offered system with existing RSCC system for exchange of desired data. The requirement of IO point shall be worked out by the bidder as per criterion enclosed as Appendix-II for data exchange with RLDCs.
- Remote HMI.

1.3. Peripheral equipment like printers, display units, key boards, Mouse etc. 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. It shall include communication gateway, intelligent electronic devices (IED) for bay control and inter IED communication infrastructure. An architecture drawing for SAS is enclosed.

1.4. The communication gateway shall facilitate the information flow with remote control centres. 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.

2. **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 as given in GTS/ Section - 1 Project

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 centres via gateways.

The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.

The system shall incorporate the control, monitoring and protection functions specified, self-monitoring, signalling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

Maintenance, modification or extension of components may not cause a shutdown of the whole substation automation system. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

Bidder shall offer the Bay level unit (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer), bay mimic along with relay and protection panels and PLCC/Communication panels (described in other sections of technical specifications) housed in Control Room /air-conditioned *Switchyard Panel Room* suitably located in switchyard and Station HMI in Control Room building for overall optimisation 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 fibre-optic cables, thereby guaranteeing disturbance free communication. The fibre optic cables shall be run in G . I conduit pipes. Data exchange is to be realised using IEC 61850 protocol with a redundant managed switched Ethernet communication infrastructure

The communication shall be made in fault tolerant ring in redundant mode, excluding the links between individual bay IEDs to switch wherein the redundant connections are not envisaged, such that failure of one set of fiber shall not affect the normal operation of the SAS. However failure of fiber 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 centres.

The GPS time synchronising signal (as specified in the section relay & protection) for the synchronization of the entire system shall be provided.

The SAS shall contain the functional parts as described in para 1.2 above.

2.3 FUNCTIONAL REQUIREMENTS

The high-voltage apparatus within the station shall be operated from different places:

- Remote control centres
- 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.

2.3.1.1 Command supervision

Bay/station interlocking and blocking

Software Interlocking is to be provided to ensure that inadvertent incorrect operation of switchgear causing damage and accidents in case of false operation does not take place.

In addition to software interlocking hardwired interlocking are to be provided for:

(a) Bus Earth switch Interlocking

(b) Transfer Bus interlocking (if applicable)

It shall be a simple layout, easy to test and simple to handle when upgrading the station with future bays. For software interlocking the bidder shall describe the scenario while an IED of another bay is switched off or fails.

A software interlock override function shall be provided which can be enabled to bypass the interlocking function.

2.3.2 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.

2.3.3 Self-supervision

Continuous self-supervision function with self-diagnostic feature shall be included.

2.3.4 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). (Multi-activation 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 in bay control/protection unit.
- 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 (Raise and lower of tap) (for power transformer bays)
- Operation counters for circuit breakers and pumps
- Hydraulic pump/ Air compressor runtime supervision
- Operating pressure supervision through digital contacts only
- Breaker position indication per phase
- Alarm annunciation
- Measurement display
- Local HMI (local guided, emergency mode)
- Interface to the station HMI.
- Data storage for at least 200 events
- Extension possibilities with additional I/O's inside the unit or via fibre-optic communication and process bus

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 Synchro check functions are dependent on the station topology, i.e. on the positions of the circuit breakers and/or the isolators. The correct voltage for synchronizing and energizing is derived from the auxiliary switches of the circuit breakers, the isolator, and earthing switch and shall be selected automatically by the bay control and protection IEDs.

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. The disturbance recorder function shall be as per detailed in Section – Control, Relay & Protection Panels.

3.1.2.2. Bay Monitoring Function:

Analogue inputs for voltage and current measurements shall be connected directly to the voltage transformers (VT) and the current transformers (CT) without intermediate transducers. The values of active power (W), reactive power (VAR), frequency (Hz), and the rms values for voltage (U) and current (I) shall be calculated in the Bay control/protection unit.

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

The analogue values acquired/calculated in bay control/protection unit shall be displayed locally on the station HMI and in the control centre. The abnormal values must be discarded. The analogue values shall be updated every 2 seconds.

Threshold limit values shall be selectable for alarm indications.

3.2.3. Event and alarm handling

Events and alarms are generated either by the switchgear, by the control IEDs, or by the station level unit. They shall be recorded in an event list in the station HMI. Alarms shall be recorded in a separate alarm list and appear on the screen. All, or a freely selectable group of events and alarms shall also be printed out on an event printer. The alarms and events shall be time-tagged with a time resolution of 1 ms. The tentative list for various feeders and systems are enclosed as Annexure-I

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.

The HMI shall give the operator access to alarms and events displayed on the screen. Aside from these lists on the screen, there shall be a printout of alarms or events in an event log.

An acoustic alarm shall indicate abnormalities, and all unacknowledged alarms shall be accessible from any screen selected by the operator.

The following standard pictures shall be available from the HMI:

- Single-line diagram showing the switchgear status and measured values
- Control dialogues with interlocking or blocking information details. This control dialogue shall tell the operator whether the device operation is permitted or blocked**.**
- Measurement dialogues
- Alarm list, station / bay-oriented
- Event list, station / bay-oriented
- System status

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 (with1 ms resolution) of its occurrence has to be displayed for each event.

The operator shall be able to call up the chronological event list on the monitor at any time for the whole substation or sections of it.

A printout of each display shall be possible on the hard copy printer.

The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. It shall be possible to store all events in the computer for at least one month. The information shall be obtainable also from a printed event log.

The chronological event list shall contain:

- Position changes of circuit breakers, isolators and earthing devices
- Indication of protective relay operations
- Fault signals from the switchgear
- Indication when analogue measured values exceed upper and lower limits. Suitable provision shall be made in the system to define two level of alarm on either side of the value or which shall be user defined for each measurands.
- Loss of communication.

Filters for selection of a certain type or group of events shall be available. The filters shall be designed to enable viewing of events grouped per:

- Date and time
- Bay
- Device
- Function e.g. trips, protection operations etc.
- Alarm class

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
- Authority
- Local / remote control
- RSCC / SAS control
- Errors
- etc.,

shall be displayed.

3.2.4.9. Control dialogues

The operator shall give commands to the system by means of mouse click located on the single-line diagram. Data entry is performed with the keyboard. Dedicated control dialogues for controlling at least the following devices shall be available:

- Breaker and disconnector
- Transformer tap-changer

3.2.5. User-authority levels

It shall be possible to restrict activation of the process pictures of each object (bays, apparatus...) within a certain user authorisation group. Each user shall then be given access rights to each group of objects, e.g.:

- Display only
- Normal operation (e.g. open/close of switchgear)
- Restricted operation (e.g. by-passed interlocking)
- System administrator

For maintenance and engineering purposes of the station HMI, the following authorisation levels shall be available:

- No engineering allowed
- Engineering/configuration allowed
- Entire system management allowed

The access rights shall be defined by passwords assigned during the log-in 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 on-line. Scrolling between e.g. days shall be possible. Unsure values shall be indicated. It shall be possible to select the time period for which the specific data are kept in the memory.

Following printouts shall be available from the printer and shall be printed on demand:

i. Daily voltage and frequency curves depicting time on X-axis and the appropriate parameters on the Y-axis. The time duration of the curve is 24 hours.

ii. Weekly trend curves for real and derived analogue values.

iii. Printouts of the maximum and minimum values and frequency of occurrence and duration of maximum and minimum values for each analogue parameter for each circuit in 24 hr period.

iv. Provision shall be made for logging information about breaker status like number of operation with date and time indications along with the current value it interrupts (in both condition i.e. manual opening and fault tripping)

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. The bidder has to develop these reports. The reports are limited to the formats for which data is available in the SAS database.

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 Regional System Coordination Centre (RSCC)

The communication interface to the SAS shall allow scanning and control of defined points within the substation automation system independently for each control centre. The substation automation system shall simultaneously respond to independent scans and commands from employer's control centres (RCC & RSCC). 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 communication channels provided by Employer will consist either of power line carrier, microwave, optical fibre, VSAT or leased line, the details of which shall be provided during detailed Engineering.

3.3.3 Interface equipment:

The Contractor shall provide interface equipment for communicating between Substation Automation system and Remote control centre and between Substation Automation system and Regional System Coordination Centre (RSCC). However, the communication channels available for this purpose are specified in Section - GTS.

In case of PLCC 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 shall also be in the scope of bidder.

3.3.4 Communication Protocol

The communication protocol for gateway to control centre must be open protocol and shall support IEC 60870-5-101 and IEC 61850 for all levels of communication for sub-station automation such as Bay to station HMI, gateway to remote station etc.

4.0 System hardware:

4.1 Redundant Station HMI, Remote HMI and Disturbance Recorder Work station:

The contractor shall provide redundant station HMI in hot standby mode. The servers used in these work stations shall be of industrial grade**.**

It shall be capable to perform all functions for entire substation including future requirements as indicated in the SLD. It shall use industrial grade components. Processor and RAM shall be selected in such a manner that during normal operation not more than 30% capacity of processing and memory are used. Supplier shall demonstrate these features.

The capacity of hard disk shall be selected such that the following requirement should occupy less than 50% of disk space:

1. Storage of all analogue data (at 15 Minutes interval)and digital data including alarm , event and trend data for thirty(30) days,
2. Storage of all necessary software,
3. 20GB space for OWNER'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 display units shall have high resolution and reflection protected picture screen. High stability of the picture geometry shall be ensured. The screen shall be at least 21" diagonally in size and capable of colour graphic displays.

The display shall accommodate resolution of 1280 X 1024 pixels.

4.1.3 Printer

It shall be robust & suitable for operation with a minimum of 132 characters per line. The printing operation shall be quiet with a noise level of less than 45 dB suitable for location in the control room. Printer shall accept and print all ASCII characters via master control computer unit interface.

The printer shall have in built testing facility. Failure of the printer shall be indicated in the Station HMI. The printer shall have an off line mode selector switch to enable safe maintenance. The maintenance should be simple with provisions for ease of change of print head, ribbon changing, paper insertion etc.

All reports and graphics prints shall be printed on laser printer. One dot matrix printer shall be exclusively used for hourly log printing.

All printers shall be continuously online.

4.1.4 Mass Storage Unit

The mass storage unit shall be built-in to the Station HMI. All operational measured values, and indications shall be stored in a mass-storage unit **in form** of **DVD RW** The unit should support at least Read (48X), Write(24X), and Re-Write (10X) operations, with Multi-Session capability. It should support ISO9660, Rockridge and Joliet Filesystems. It should support formatting and use under the operating system provided for Station HMI. The monthly back up of data shall be taken on disc. The facility of back up of data shall be inherent in the software**.**

4.1.5 Switched Ethernet Communication Infrastructure:

The bidder shall provide the redundant switched optical Ethernet communication infrastructure for SAS. One switch shall be provided to connect all IEDs for two bays of 220kV yard to communication infrastructure. Each switch shall have at least two spare ports for connecting bay level IEDs and one spare port for connecting station bus.

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 number Bay level unit shall be provided for supervision and control of each ~~220/~~132 kV bay (a bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer). The Bay level unit shall be equipped with analogue and binary inputs/outputs for handling the control, status monitoring and analogue measurement functions. All bay level interlocks are to be incorporated in the Bay level unit so as to permit control from the Bay level unit/ local bay mimic panel, with all bay interlocks in place, during maintenance and

commissioning or in case of contingencies when the Station HMI is out of service.

The bay control unit to be provided for the bays shall be preferably installed in the CB relay panel/feeder protection panel for respective bay.

The bay control unit for future bay (if required as per Section – Project Specification Requirement) shall be installed in a separate panel.

The Bay level unit shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

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 Switchyard Panel Room:

The switchyard panel room shall be constructed to house Bay level units, bay mimic, relay and protection panels, PLCC panels etc. The layout of equipment/panel shall be subject to Owner's approval. The switchyard panel room shall be provided with necessray illuminations, fire alarm system with at least two detectors with necessary power supply if required and it shall be wired to SAS. The detailed constructional requirement of switchyard panel room is detailed in Section civil of technical specification and air conditioning requirement of switchyard panel room shall be as detailed in Section Air conditioning system of technical specification. The air conditioner provided in switchyard panel room shall be monitored from substation automation system.

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.

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 shut-down of the parts of the system which are not affected by the system adaptation.

5.1.1 Station level software

5.1.1.1 Human-machine interface (HMI)

The base HMI software package for the operator station shall include the main SAS functions and it shall be independent of project specific hardware version and operating system. It shall further include tools for picture editing, engineering and system configuration. The system shall be easy to use, to maintain, and to adapt according to specific user requirements. Systems shall contain a library with standard functions and applications.

5.1.2 Bay level software

5.1.1.1 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.

5.1.1.2 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.

5.1.1.3 Network Management System (NMS):

The contractor shall provide a network management system software for following management functions:

a. Configuration Management
b. Fault Management
c. Performance Monitoring

This system shall be used for management of communication devices and other IEDs in the system. This NMS can be loaded in DR work-station and shall be easy to use, user friendly and menu based. The NMS shall monitor all the devices in the SAS and report if there is any fault in the monitored devices. The NMS shall

(a) Maintain performance, resource usage, and error statistics for all managed links and devices and present this information via displays, periodic reports and on demand reports.
(b) Maintain a graphical display of SAS connectivity and device status.
(c) Issue alarms when error conditions occurs
(d) Provide facility to add and delete addresses and links

5.1.1.4 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 and specified ambient conditions:

6.1 Type Tests:

6.1.1 Control IEDs and Communication Equipment:

a. Power Input:
- i. Auxiliary Voltage
- ii. Current Circuits
- iii. Voltage Circuits
- iv. Indications

b. Accuracy Tests:
- i. Operational Measured Values
- ii. Currents
- iii. Voltages
- iv. Time resolution

c. Insulation Tests:
- i. Dielectric Tests
- ii. Impulse Voltage withstand Test

d. Influencing Quantities
- i. Limits of operation
- ii. Permissible ripples
- iii. Interruption of input voltage

e. Electromagnetic Compatibility Test:
- i. 1 MHZ. burst disturbance test
- ii. Electrostatic Discharge Test
- iii. Radiated Electromagnetic Field Disturbance Test
- iv. Electrical Fast transient Disturbance Test
- v. Conducted Disturbances Tests induced by Radio Frequency Field
- vi. Magnetic Field Test
- vii. Emission (Radio interference level) Test.
- viii. Conducted Interference Test

f. Function Tests:

i. Indication
ii. Commands
iii. Measured value Acquisition
iv. Display Indications

g. Environmental tests:

i. Cold Temperature
ii. Dry Heat
iii. Wet heat
iv. Humidity (Damp heat Cycle)
v. Vibration
vi. Bump
vii. Shock

6.2 Factory Acceptance Tests:

The supplier shall submit a test specification for factory acceptance test (FAT) and commissioning tests of the station automation system for approval. For the individual bay level IED's applicable type test certificates shall be submitted.

The manufacturing and configuration phase of the SAS shall be concluded by the factory acceptance test (FAT). The purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. During FAT the entire Sub-station Automation System including complete control and protection system to be supplied under present scope shall be tested for complete functionality and configuration in factory itself. The extensive testing shall be carried out during FAT. The purpose of Factory Acceptance Testing is to ensure trouble free installation at site. No major configuration setting of system is envisaged at site.

If the complete system consists of parts from various suppliers or some parts are already installed on site, the FAT shall be limited to sub-system tests. In such a case, the complete system test shall be performed on site together with the site acceptance test (SAT).

6.2.1 Hardware Integration Tests:

The hardware integration test shall be performed on the specified systems to be used for Factory tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware integration tests. The vendor specifically demonstrates how to add a device in future in SAS during FAT. The

device shall be from a different manufacturer than the SAS supplier.

6.2.2 Integrated System Tests:

Integrated system tests shall verify the stability of the hardware and the software. During the tests all functions shall run concurrently and all equipment shall operate a continuous 100 Hours period. The integrated system test shall ensure the SAS is free of improper interactions between software and hardware while the system is operating as a whole.

6.3 Site Acceptance Tests:

The site acceptance tests (SAT) shall completely verify all the features of SAS hardware and software. The bidder shall submit the detailed SAT procedure and SAT procedure shall be read in conjunction with the specification.

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 colour. 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 annuncia-

tion 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.
2No.s of Inverter of minimum 2KVA capacity shall be provided for servers, gateways station HMI disturbance recorder evaluation unit and its peripheral devices e.g. printer etc. In the event of Power failure, necessary safeguard software shall be built for proper shutdown. Inverter shall be connected to 220V DC independent source and should be used to drive 1No. each server/HMI/Gateway so that in case any failure of DC power supply system is not affected.

9.0 DOCUMENTATION

The following documents shall be submitted for employer's approval during detailed engineering:

(a) System Architecture Drawing
(b) Hardware Specification
(c) Functional Design Document
(d) Clear procedure describing how to add an IED/bay/diameter in future covering all major supplier

The following documentation to be provided for the system in the course of the project shall be consistent, CAD supported, and of similar look/feel. All CAD drawings to be provide in "dxf" format.

- List of Drawings
- Substation automation system architecture
- Block Diagram
- Guaranteed technical parameters, Functional Design Specification and Guaranteed availability and reliability
- Calculation for power supply dimensioning
- I/O Signal lists
- Schematic diagrams

- List of Apparatus
- List of Labels
- Logic Diagram (hardware & software)
- **Switchyard Panel Room** (If applicable)layout drawing
- Control Room Lay-out
- Test Specification for Factory Acceptance Test (FAT)
- Product Manuals
- Assembly Drawing
- Operator's Manual
- Complete documentation of implemented protocols between various elements
- Listing of software and loadable in CD ROM
- Other documents as may be required during detailed engineering

Two sets of hard copy and Four sets of CD ROM containing all the as built documents/drawings shall be provided.

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 Nepal. The Contractor shall provide all necessary training material. Each trainee shall receive individual copies of all technical manuals and all other documents used for training. These materials shall be sent to Employer at 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.

The Contractor shall quote training prices as indicated in BPS.

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, perform 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 configured 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 configured systems.

10.3 Computer System Software Course

The Contractor shall provide a computer system software course that covers the following subjects:

(g) 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.

(h) 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

(i) System Initialization and Failover: Including design, theory of operation, and practice

(j) Diagnostics: Including the execution of diagnostic procedures and the interpretation of diagnostic outputs,

(k) Software Documentation: Orientation in the organization and use of system software documentation.

(l) 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:

(m) Overview: Block diagrams of the application software and data flows. Programming standards and program interface conventions.

(n) Application Functions: Functional capabilities, design, and major algorithms. Associated maintenance and expansion techniques.

(o) Software Development: Techniques and conventions to be used for the preparation and integration of new software functions.

(p) Software Generation: Generation of application software from source code and associated software configuration control procedures.

(q) Software Documentation: Orientation in the organization and use of functional and detailed design documentation and of programmer and user manuals.

(r) 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 OWNER'S personnel comprehensively covering following courses.

S. No.	Name of Course
1	Computer System Hardware
2	Computer System Software
3	Application Software

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. **During guarantee period as specified in tender document, contractor shall arrange bi-monthly visit of their representative to site to review the performance of system and in case any defect/shortcoming etc. is observed during the period, the same shall be set right by the contractor within 15 days.**

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 electromagnetic 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 owner 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 $1/4^{th}$ of an hour. Time less than $1/4^{th}$ of an hour shall be counted as having duration of $1/4^{th}$ 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

$$AOH = \sum AOD$$

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 owner.

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 as detailed in Section – Project Specification Requirement.
iv) Bay Level Unit for Auxiliary system (as per requirement)
v) Disturbance Recorder Work Station(Maintenance HMI)
vi) Colour Laser Printer – 1 No. (For Reports & Disturbance records)
vii) Dot matrix printers - (one each for Alarms and log sheets)
viii) All interface equipment for gateway to RCC and RSCC
ix) Communication infrastructure between Bay level units, Station HMI, Printers, gateways, redundant LAN etc. as required
x) Remote workstation including HMI and along with one printer
xi) Modems as per requirement.
xii) Any other equipment as necessary.

List of Analogue and Digital Inputs

Basic Monitoring requirements are:

- Switchgear status indication
- Measurements (U, I, P, Q, f)
- Event
- Alarm
- Winding temperature of transformers & reactors
- ambient temperature
- Status and display of 400V LT system, 220/110V & 48V DC system
- Status of display of Fire protection system and Air conditioning system.
- Acquisition of all counters in PLCC panels through potential free contacts from PLCC or independently by counting the receive/send commands.
- Acquisition of alarm and fault record from protection relays
- Disturbance records
- Monitoring the state of batteries by displaying DC voltage, charging current and load current etc.
- Tap-position of Transformer

List of Inputs

The list of input for typical bays 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/reactor

Current	R phase
	Y phase
	B phase

WTI (for transformer and reactor)
Tap position (for transformer only)

iii) For TBC and bus coupler

Current	R phase
	Y phase
	B phase

iv) Common

a) Voltage for Bus-I, Bus-II and Transfer bus wherever applicable

Voltage R-Y phase
Y-B phase
B-R phase

b) Frequency for Bus-I and Bus-II

c) Ambient temperature (switchyard)

d) Switchyard Panel Room Temperature.

e) LT system

i) Voltage R-Y, Y-B, B-R of Main Switch Board section-I
ii) Voltage R-Y, Y-B, B-R of Main Switch Board section-II
iii) Voltage R-Y, Y-B, B-R of Diesel Generator
iv) Current from LT transformer-I
v) Current from LT transformer-II
vi) Current from Diesel Generator
vii) Voltage of 220V DCDB-I
viii) Voltage of 220V DCDB-II
ix) Current from 220V Battery set-I
x) Current from 220V Battery set-II
xi) Current from 220V Battery charger-I
xii) Current from 220V Battery charger-I
xiii) Voltage of 48V DCDB-I
xiv) Voltage of 48V DCDB-II
xv) Current from 48V Battery set-I
xvi) Current from 48V Battery set-II
xvii) Current from 48V Battery charger-I
xviii) Current from 48V Battery charger-I

Digital Inputs

The list of input for various bays/SYSTEM is as follows:

1. Line bays

i) Status of each pole of CB.
ii) Status of Isolator, Earth switch
iii) CB trouble
iv) CB operation/closing lockout
v) Pole discrepancy optd
vi) Trip coil faulty
vii) LBB optd
viii) Bus bar protn trip relay optd
ix) Main bkr auto recloser operated
x) Tie/transfer auto recloser operated
xi) A/r lockout
xii) Tie/transfer bkr a/r lockout
xiii) Direct trip-I/II sent
xiv) Direct trip-I/II received
xv) Main I/II blocking
xvi) Main I/II-Inter trip send
xvii) Main I/II-Inter trip received
xviii) O/V STAGE – I operated
xix) O/V STAGE – II operated

xx) FAULT LOCATOR FAULTY
xxi) MAIN-I/II CVT FUSE FAIL
xxii) MAIN-I PROTN TRIP
xxiii) MAIN-II PROTN TRIP
xxiv) MAIN-I PSB ALARM
xxv) MAIN-I SOTF TRIP
xxvi) MAIN-I R-PH TRIP
xxvii) MAIN-I Y-PH TRIP
xxviii) MAIN-I B-PH TRIP
xxix) MAIN-I START
xxx) MAIN-I/II Carrier aided trip
xxxi) MAIN-I/II fault in reverse direction
xxxii) MAIN-I/II ZONE-2 TRIP
xxxiii) MAIN-I/II ZONE-3 TRIP
xxxiv) MAIN-I/II weak end infeed optd
xxxv) MAIN-II PSB alarm
xxxvi) MAIN-II SOTF TRIP
xxxvii) MAIN-II R-PH TRIP
xxxviii) MAIN-II Y-PH TRIP
xxxix) MAIN-II B-PH TRIP
xl) MAIN-II start
xli) MAIN-II aided trip
xlii) MAIN-I/II fault in reverse direction
xliii) Back-up o/c optd
xliv) Back-up e/f optd
xlv) 220V DC-I/II source fail
xlvi) SPEECH CHANNEL FAIL
xlvii) PLCC Protection Channel-I FAIL
xlviii) PLCC Protection Channel-II FAIL

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 protn 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 CVT ½ FUSE FAIL
xv) MV BUS CVT ½ FUSE FAIL
xvi) OTI ALARM/TRIP
xvii) PRD OPTD
xviii) OVERLOAD ALARM
xix) BUCHOLZ TRIP
xx) BUCHOLZ ALARM
xxi) OLTC BUCHOLZ ALARM
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

3. **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 protn trip relay optd
viii) REF OPTD
ix) DIF OPTD
x) HV BUS CVT ½ FUSE FAIL
xi) OTI ALARM/TRIP
xii) PRD OPTD
xiii) BUCHOLZ TRIP
xiv) BUCHOLZ ALARM
xv) OIL LOW ALARM
xvi) Back-up impedance relay
xvii) 220v DC-I/II source fail
xviii) GR-A PROTN OPTD
xix) GR-B PROTN OPTD

4. Line/Bus Reactor bays (as applicable):

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 protn trip relay optd
viii) REF OPTD
ix) DIF OPTD
x) Line/ BUS CVT ½ FUSE FAIL
xi) OTI ALARM/TRIP
xii) PRD OPTD
xiii) BUCHOLZ TRIP
xiv) BUCHOLZ ALARM
xv) OIL LOW ALARM
xvi) Back-up impedance relay
xvii) 220V DC-I/II source fail
xviii) GR-A PROTN OPTD
xix) GR-B PROTN OPTD

5 **Bus bar Protection**

i) Bus bar main-I trip
ii) Bus bar main-II trip
iii) Bus bar zone-I CT open
iv) Bus bar zone-II CT open
v) Bus transfer CT sup. Optd
vi) Bus transfer bus bar protn optd
vii) Bus protection relay fail

6. **Auxiliary system**

i) Incomer-I On/Off
ii) Incomer-II On/Off
iii) 400V Bus-I/II U/V
iv) 400V 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 Bunchholz Alarm & trip
viii) LT transformer-II Buchloz Alarm & trip
ix) LT transformer-I WTI Alarm & trip
x) LT transformer-II WTI Alarm & trip
xi) LT transformer-I OTI Alarm & trip
xii) LT transformer-II OTI Alarm & trip
xiii) PLCC exchange fail
xiv) Time sync. Signal absent
xv) Alarm/trip signals as listed in Section: Battery and Battery charger
xvi) 220V DC-I earth fault
xvii) 220V DC-II earth fault
xviii) Alarm/trip signals as listed in Section: Fire protection system

7. Switchyard Panel Room:

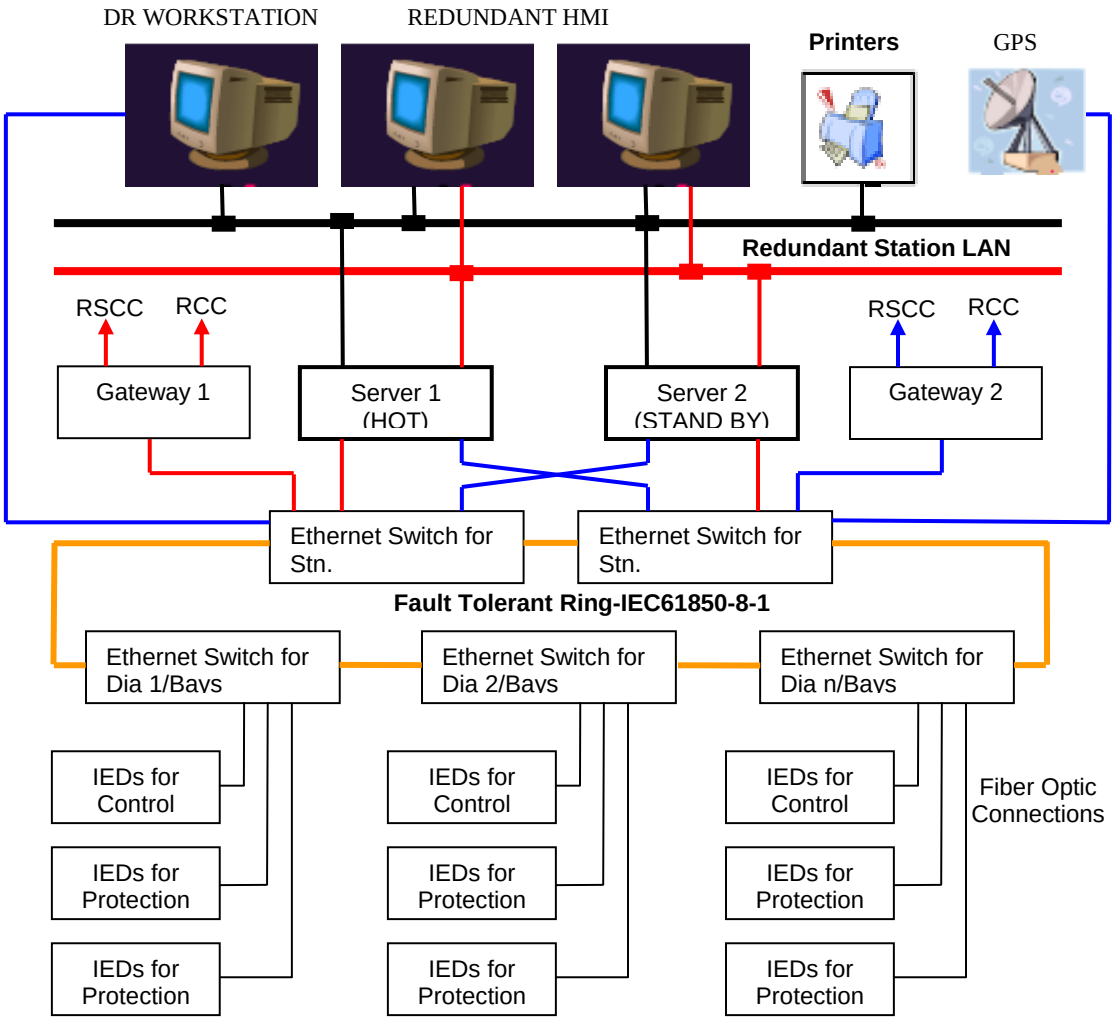
i) AC Compressor 1 ON/OFF
ii) AC Compressor 2 ON/OFF
iii) Fire Detection 1 ON/OFF
iv) Fire Detection 2 On/OFF
v) Switchyard Panel Room Temperature High Alarm

The exact number and description of digital inputs shall be as per detailed engineering requirement Apart from the above mentioned digital inputs, minimum of 200 inputs shall be kept for future use.

TYPICAL ARCHITECTURAL DRAWING
OF
SUBSTATION AUTOMATION SYSTEM

Note:

1. The redundant managed bus shall be realized by high speed optical bus using industrial grade components and shall be as per IEC 61850.
2. Inside the sub-station, all connections shall be realized as per IEC 61850 protocol.
3. For gateway, it shall communicate with Remote Supervisory Control Centre (RSCC) on IEC 60870-5-101 protocol.
4. The printer as required shall be connected to station bus directly and can be managed either from station HMI, HMI view node or disturbance recorder work station.
5. The above layout is typical. However if any contractor offers slightly modified architecture based on their standard practice without compromising the working, the same shall be subject to approval during detailed engineering.



List of IO Points to be transmitted to RSCC

a) MW and MVAR for all lines , transformers, reactors and Capacitors
b) Voltage of all buses
c) Frequency of 220kV Bus
d) All Breakers
e) All isolators
f) Tap Position for all transformers
g) Master protection signal for all feeders, transformers Units and Bus Bar
h) Loss of Voltage signal for Bus bar
i) All the points identified in point (e), (h) and (i) above as GPS Time stamped.
j) Temperature value per substation.
k) Any other point decided during detailed engineering

TECHNICAL SPECIFICATION
VOL-II, SEC-XX
TRANSFORMER (UPTO 220 KV CLASS)

SECTION- XIX - TRANSFORMER (UPTO 400 KV CLASS)

Clause No.	Description
1.	General
2.	Transportation
3.	Performance
4.	Measurable Defects
5.	Design review
6.	Construction Details
7.	Paint system and procedures
8.	Unused inhibited Insulating Oil
9.	Spare Transformer Units Connection Arrangement
10.	Bushings
11.	Neutral Formation and Earthing Arrangement.
12.	Delta Formation
13.	Cooling Equipment and its Control
14.	Cabling
15.	Tap Changing Equipment
16.	SCADA Integration
17.	Constructional features of Cooler Control Cabinet/ Individual Marshalling Box/ Common Marshalling Box/ Junction Box / Outdoor cubicle and Digital RTCC Panel
18.	Current Transformer
19.	Hand Tools
20.	Test Kit
21.	Fittings & accessories
22.	Inspection and Testing
Annexure –A	Technical Particulars / Parameters of T transformers
Annexure –B	Test Plan
Annexure –C	Test Procedures
Annexure –D	Design Review Document
Annexure –E	Painting Procedure
Annexure –F	Unused inhibited Insulating Oil Parameters.
Annexure–G	Technical parameters of Current Transformers
Annexure–H	Cable specification
Annexure–I	BDV Test Set & Portable Dissolved Gas An analysis of Transformer Oil
Annexure–J	Online Dissolved Gas (Multi-gas) and Moisture Measuring Equipment
Annexure–K	Online Hydrogen and Moisture Measuring Equipment
Annexure–L	On-line insulating oil drying system (Cartridge type)
Annexure–M	Nitrogen Injection Type Fire Prevention & Extinguishing System
Annexure –N	Oil sampling bottles & Oil Syringe
Annexure –O	Oil Storage Tank

1.0 General

1.1 This specification covers design, engineering, manufacture, testing, delivery at site including all materials, accessories, spares, unloading, handling, proper storage at site, erection, testing and commissioning of the equipment specified.

1.2 The transformers shall in general have constant ohmic impedance between HV and IV on all taps. However, in case of parallel operation with the existing transformer,

i) The percentage impedance, vector group, OLTC connection and range etc. of the transformer is to be matched with that of the existing transformer.

ii) Necessary provision is to be kept in the transformer control scheme for parallel operation with the existing OLTC control scheme having provision of Master/Follower/Independent /Off operation etc.

iii) External or internal reactors shall not be used to achieve the specified HV/LV and IV/LV impedances

1.3. Matching of physical orientation, mounting rail gauge etc. shall be done to facilitate inter-changeability.

2. Transportation

2.1. The Contractor shall be responsible to select and verify the route, mode of transportation and make all necessary arrangement with the appropriate authorities for the transportation of the equipment. The dimension of the equipment shall be such that when packed for transportation, it will comply with the requirements of loading and clearance restrictions for the selected route. It shall be the responsibility of the contractor to coordinate the arrangement for transportation of the transformer for all the stages from the manufacturer's work to site.

2.2. The contractor shall carry out the route survey along with the transporter and finalize the detail methodology for transportation of transformer and based on route survey; any modification/ extension/ improvement to existing road, bridges, culverts etc. if required, shall be in the scope of the contractor.

2.3. The inland transportation of the Transformer shall be on trailers equipped with GPS system for tracking the location of transformer at all times during transportation from manufacturer works to designated site. The contractor shall intimate to Employer about the details of transporter engaged for transportation of the Transformer for tracking the Transformer during transit. Requirement of **Hydraulic trailer** is envisaged for 400kV class Transformers.

2.4. All metal blanking plates and covers which are specifically required to transport and storage of the transformer shall be considered part of the transformer and handed over to the Purchaser after completion of the erection. Bill of quantity of these items shall be included in the relevant drawing/document.

2.5. The Contractor shall dispatch the transformer filled with dry air at positive pressure. The necessary arrangement shall be ensured by the contractor to take care of pressure an sit and storage till completion of oil filling during erection. A dry air pressure testing valve with necessary pressure gauge and adaptor valve shall be provided. Generally, the

duration of the storage of transformer at site with dry air, shall preferably be limited to three months, after which the Transformer shall be processed as per the recommendation of manufacturer if not filled with oil. The dry air cylinder(s) provided to maintain positive pressure can be taken back by the contractor after oil filling.

In case turret, having insulation assembly, is transported separately then positive dry air pressure shall be ensured.

2.6. Transformer shall also be fitted with Electronic impact recorders (on returnable basis) at least 2 numbers for 400kV Class Transformer and 1 number for below 400kV class Transformers during transportation to measure the magnitude and duration of the impact in all three directions. The mounting location of impact recorder shall be finalized during detailed engineering. The acceptance criteria and limits of impact, which can be withstood by the equipment during transportation and handling in all three directions, shall not exceed "3g" for 50mSec (20Hz) or as per contractor standard, whichever is lower.

3. Performance

3.1. The transformers shall be used for bi-directional flow of rated power. The major technical parameters of single phase and three phase transformer units are defined at **Annexure – A.**

3.2. Transformers shall be capable of operating under natural cooled condition up to the specified load. The forced cooling equipment shall come into operation by pre-set contacts of winding temperature indicator and the transformer shall operate as a forced cooling unit initially as ONAF up to specified load and then as 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 (10) minutes without the calculated winding hot spot temperature exceeding 140 deg C. Transformers fitted with two coolers, each capable of dissipating 50 per cent of the loss at continuous maximum rating, shall be capable of operating for 20 minutes in the event of failure of the oil circulating pump or blowers associated with one cooler without the calculated winding hot spot temperature exceeding 140deg C at continuous max rating. The contractor shall submit supporting calculations for the above and the same shall be reviewed during design review.

3.3. The transformer shall be free from any electrostatic charging tendency (ECT) under all operating conditions when all oil circulation systems are in operation. In general, oil flow speed shall not exceed 1.0 m/sec within winding in the oil flow system of the transformers. The manufacturer shall ensure that there is no electrostatic charging tendency in the design.

3.4. The transformers shall be capable of being continuously operated at the rated MVA without danger, at any tapping with voltage variation of ⍰10% corresponding to the voltage of that tapping.

3.5. The transformers shall be capable of being over loaded in accordance with IEC-60076-7. There shall be no limitation imposed by bushings, tap changers etc. or any other associated equipment.

3.5.1. Tank hotspot shall not exceed 130 Deg. Celsius. Maximum ambient temperature shall be considered as 50 Deg. C.

3.6. The transformer and all its accessories including bushing/ built in CTs etc. shall be designed to withstand without damage, 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 2 secs. The short circuit level of the HV & IV System to which the transformers will be connected is as follows:

400kV system	- 63kA for 1 sec (sym, rms, 3 phase fault)
220kV system	- 40 kA for 1 sec (sym, rms, 3 phase fault)
132kV system	- 31.5 kA for 1 sec (sym, rms, 3 phase fault)
66kV system	- 31.5 kA for 1 sec (sym, rms, 3 phase fault)
33kV system	- 25 kA for 1 sec (sym, rms, 3 phase fault)

However, for transformer design purpose, the through fault current shall be considered limited by the transformer self-impedance only (i.e. $Z_s = 0$).

3.7. Transformer shall be capable of withstanding thermal and mechanical stresses caused by symmetrical or asymmetrical faults on any terminals. Mechanical strength of the transformer shall be such that it can withstand 3-phase and 1- phase through fault for transformer rated voltage applied to HV and / or IV terminals of transformer. The short circuit shall alternatively be considered to be applied to each of the HV, IV and tertiary (LV) transformer terminals as applicable. The tertiary terminals shall be considered not connected to system source. For short circuit on the tertiary terminals, the in-feed from both HV & IV system shall be limited by the transformer self-impedance only and the rated voltage of HV and IV terminals shall be considered. The maximum short circuit output current at the tertiary terminals shall be limited to a safe value to make the transformer short circuit proof.

The transformer shall be designed to withstand for short circuit duration of 2 seconds for Thermal stress and the same shall be verified during design review.

3.8. The maximum flux density in any part of the core and yoke at the rated MVA, voltage and frequency shall be such that under 10 % continuous over-voltage condition it does not exceed 1.9 Tesla at all tap positions.

3.9. Transformers shall withstand without damage, heating due to the combined voltage and frequency fluctuations which produce the following over fluxing conditions:

110 % for continuous
125 % for 1 minute
140 % for 5 seconds

3.10. The air core reactance of HV winding of transformer shall not be less than 20% for 400kV class Transformer.

3.11. **Tertiary Windings (if applicable as per Annexure - A)**

The tertiary windings shall be suitable for connection of reactors or capacitors which would be subjected to frequent switching and shall be suitable for connection to LT Transformer for auxiliary supply. All the windings shall be capable of withstanding the stresses which may be caused by such switching.

The Tertiary winding shall be designed to withstand mechanical and thermal stresses due to dead short circuit on its terminals.

3.12. **Radio Interference and Noise Level**

The transformers shall be designed with particular attention to the suppression of harmonic voltage, especially the third and fifth so as to minimise interference with communication circuit.

The noise level of transformer, when energised at normal voltage and frequency with fans and pumps running shall not exceed the values specified at **Annexure - A**, when measured under standard conditions.

3.13. **Dynamic Short Circuit Test requirement**

3.13.1. **For 400 kV Class Auto transformer**

Bidder / Manufacturer should have successfully carried out Dynamic Short Circuit test on 315MVA, 400/220/33kV Auto transformer as on the originally scheduled date of bid opening and shall enclose the relevant Test Report/certificate along with bid. In case bidder has not successfully tested 315MVA, 400/220/33kV Auto transformer for Dynamic Short Circuit test, their bid shall be considered technically non responsive. Further, design review of offered 400 kV Class Auto transformer shall be carried out based on the design of short circuit tested 315MVA Auto transformer.

3.13.2. **For 220 kV Class Transformer:**

Bidder / Manufacturer should have successfully carried out Dynamic Short Circuit Test on any rating of 220 kV or above voltage class transformer as on the originally scheduled date of bid opening and shall enclose the relevant Test Report / Certificate along with bid. In case bidder has not successfully tested 220 kV or above voltage class transformer for Dynamic Short Circuit Test, their bid shall be considered technically non-responsive. Further design review of offered 220 kV class transformers shall be carried out based on design of short circuit tested 220 kV or above voltage class transformer.

3.13.3. **For 132 kV Class Transformer:**

Bidder / Manufacturer should have successfully carried out Dynamic Short Circuit Test on any rating of 132 kV or above voltage class transformer as on the originally scheduled date of bid opening and shall enclose the relevant Test Report / Certificate along with bid. In case bidder has not successfully tested 132 kV or above voltage class transformer for Dynamic Short Circuit Test, their bid shall be considered technically non-responsive. Further design review of offered 132 kV class transformers shall be carried out based on design of short circuit tested 132 kV or above voltage class transformer.

4. Measurable Defects

The following shall constitute as Measureable Defects for the purpose of Defect Liabilities as per relevant clauses of GCC / SCC of the bidding document:

a) Repair, inside the Transformer and OLTC (including oil migration) either at site or at factory is carried out after commissioning.

b) The concentration of any fault gas is more than values of condition-1 indicated in clause no 6.5 of IEEE-C57.104-2008, which are as detailed below.

H2	CH4	C2H2	C2H4	C2H6	CO	CO2	TDCG
100	120	1	50	65	350	2500	720

c) The winding tan delta goes beyond 0.005 or increase more than 0.001 within a year w.r.t. pre-commissioning values. No temperature correction factor shall be applicable for tan delta.

d) The moisture content goes above 12 ppm at any temperature during operation including full load.

5. Design review

5.1. The transformer shall be designed, manufactured and tested in accordance with the best international engineering practices under strict quality control to meet the requirement stipulated in the technical specification. The manufacturer will be required to demonstrate the adequate safety margin w.r.t thermal, mechanical, dielectric and electrical stress etc. shall be maintained during design, selection of raw material, manufacturing process etc. in order to achieve long life of transformer with least maintenance and to take into account the uncertainties of his design and manufacturing processes. The scope of such design review shall include but not limited to the requirement as mentioned at **Annexure – E** .

5.2. Design reviews shall be conducted by Purchaser or an appointed consultant during the procurement process for transformers; however the entire responsibility of design shall be with the manufacturer. Purchaser may also visit the manufacturer's works to inspect design, manufacturing and test facilities at any time.

The design review will commence after placement of award and shall be finalised before commencement of manufacturing activity. These design reviews shall be carried out in detail to the specific design with reference of the transformer under the scope. It shall be conducted generally following the "Guideli nes for conducting design reviews for transformers - Guidelines for conducting design reviews for power transformers working group A2.36 Task Force 2 (Replaces TB 204).

5.3. The manufacturer shall provide all necessary information and calculations to demonstrate that the transformer meets the requirements for short circuit strength and durability. The latest recommendations of IEC and Cigre SC 12 shall be applied for short circuit withstand evaluation.

5.4. **The validity of Type tests (except dynamic short circuit test) of Transformer shall be 5 years as on the date of NOA,** provided that offered transformer is of same design as that of type tested transformer and active materials like – CRGO, copper conductor and insulation material are of same or better grade with respect to type tested unit. Failing which, type testing of transformer shall be

carried out by the contractor at his own cost. Further, type test report of Transformer from the same manufacturing plant shall only be acceptable. With regard to Validity of Dynamic short circuit test, refer clause 3.13 above.

6. Construction Details

The construction details and features of transformer shall be in accordance with the requirement stated hereunder. .

6.1. Tank

6.1.1. Tank shall be fabricated from tested quality low carbon steel of adequate thickness. Unless otherwise approved, metal plate, bar and sections for fabrication shall comply with BS-4360 / IS 2062.

6.1.2. All seams and joints which are not required to be opened at site, shall be factory welded, and wherever possible they shall be double welded. Welding shall conform to BS-5135/IS 9595. After fabrication of tank and before painting, dye penetration test shall be carried out on welded parts of jacking bosses, lifting lugs and all load bearing members. The requirement of post weld heat treatment of tank/stress relieving shall be based on recommendation of BS-5500 table 4.4.3.1/IS 10801.

6.1.3. Tank stiffeners shall be provided for general rigidity and these shall be designed to prevent retention of water.

6.1.4. The tank shall be of proven design either bell type with bolted /welded joint or conventional type with welded / bolted top cover. Bell type tank shall be provided with joint at about 500 mm above the bottom of the tank. The welded joint shall be provided with flanges suitable for repeated welding. The joint shall be provided with a suitable gasket to prevent weld splatter inside the tank. Proper tank shielding shall be done to prevent excessive temperature rise at the joint.

6.1.5. Tank shall be provided with:

a. Lifting lugs: Four symmetrically placed lifting lugs shall be provided so that it will be possible to lift the complete transformer when filled with oil without structural damage to any part of the transformer. The factor of safety at any one point shall not be less than 2.

b. A minimum of four jacking pads in accessible position to enable the transformer complete with oil to be raised or lowered using hydraulic jacks. Each jacking pad shall be designed to support with an adequate factor of safety at least half of the total mass of the transformer filled with oil allowing in addition to maximum possible misalignment of the jacking force to the centre of the working surface.

c. Suitable haulage holes shall be provided.

d. 04 nos. of Gate valves for UHF sensors for PD Measurements (applicable for 400kV Transformer only) at various locations. Location of valves shall be finalized during design review.

e. Suitable provisions of pockets for OTI, WTI & RTDs including two spare pockets.

6.1.6. The tank shall be designed in such a way that it can be mounted either on the plinth directly or on rollers, as per manufacturer's standard practice.

6.1.7. 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 damage when using plates or rails.

6.2. **Tank Cover**

6.2.1. The tank cover shall be designed to prevent retention of water and shall not distort when lifted. The internal surface of the top cover shall be shaped to ensure efficient collection and direction of free gas to the Buchholz relay.

6.2.2. At least two adequately sized 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. Handles shall be provided on the inspection cover to facilitate lifting.

6.2.3. The tank cover shall be provided with pockets for oil and winding temperature indicators. The location of pockets (for OTI, WTI & RTDs including two spare pockets) shall be in the position where oil reaches maximum temperature. Further, it shall be possible to remove bulbs of OTI/WTI/RTD without lowering the oil in the tank. The thermometer shall be fitted with a captive screw to prevent the ingress of water.

6.2.4. Bushing turrets, covers of inspection openings, thermometer pockets etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.

6.2.5. To allow for the effect of possible induced and capacitive surge current flow, the tank cover and bushing turret shall be fixed to the transformer in such a way that good electrical contact is maintained around the perimeter of the tank and turrets.

6.2.6. The transformer shall be provided with a suitable diameter pipe flange, butterfly valve, bolted blanking plate and gasket shall be fitted at the highest point of the transformer for maintaining vacuum in the tank.

6.2.7. **Gas venting** - The transformer cover and generally the internal spaces of the transformer and all pipe connections shall be designed so as to provide efficient venting of any gas in any part of the transformer to the Buchholz relay. The space created under inspection /manhole covers shall be filled with suitable material to avoid inadvertent gas pockets. The Covers shall be vented at least at both longitudinal ends. The design for gas venting shall take into accounts the slopes of the plinth (if any) on which the transformer is being mounted.

6.3. **Gasket for tank & cover**

All gasketed joints shall be designed, manufactured and assembled to ensure long-term leak and maintenance free operation. All gasketed joints shall preferably of O-ring and groove type. The Gaskets / O-Ring in contact with oil shall be Nitrile rubber or any other better approved quality.

All bolted connections shall be fitted with weather proof, hot oil resistant, resilient gasket in between for complete oil tightness. If gasket is compressible, metallic stops/other suitable means shall be provided to prevent over-compression.

The properties of all the above gaskets / O-Rings shall comply with the requirements of IS-11149. Gaskets and O-rings shall be replaced every time whenever the joints are opened.

6.4. **Roller Assembly and Anti Earthquake Clamping Device**

The roller mounted transformers are to be provided with flanged bi-directional wheels and axles. This set of wheels and axles shall be suitable for fixing to the under carriage of transformer to facilitate its movement on rail track. Suitable locking arrangement along with foundation bolts shall be provided for the wheels to prevent accidental movement of transformer. The rail track gauge shall be 1676 mm. In case rail is not required for smaller rating Transformers, arrangement of unidirectional roller mounted on channel shall be provided and channel shall be locked with the plinth suitably.

To prevent transformer movement during earthquake, suitable clamping devices shall be provided for fixing the transformer to the foundation.

6.5. **Conservator**

6.5.1. Main tank conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture. Conservator shall be fitted with magnetic oil level gauge with potential free high and low oil level alarm contacts and prismatic oil level gauge.

6.5.2. Conservator tank shall have adequate capacity with highest and lowest visible-levels to meet the requirements of expansion of total cold oil volume in the transformer and cooling equipment from minimum ambient temperature to top oil temperature of 110 deg C. The capacity of the conservator tank shall be such that the transformer shall be able to carry the specified overload without overflowing of oil.

6.5.3. The conservator shall be fitted with lifting lugs in such a position so that it can be removed for cleaning purposes. Suitable provision shall be kept to replace air cell and cleaning of the conservator as applicable.

6.5.4. Conservator shall be positioned so as not to obstruct any electrical connection to transformer.

6.5.5. The connection of air cell to the top of the conservator is by air proof seal preventing entrance of air into the conservator. The main conservator tank shall be stencilled on its underside with the words **"Caution: Air cell fitted".** Lettering of at least 150 mm size shall be used in such a way to ensure clear legibility from ground level when the transformer is fully installed. To prevent oil filling into the air cell, the oil filling aperture shall be clearly marked. The transformer rating and diagram plate shall bear a warning statement that the **"Main conservator is fitted with an air cell".**

6.5.6. Contact of the oil with atmosphere is prohibited by using a flexible air cell of nitrile rubber reinforced with nylon cloth. The temperature of oil in the conservator is likely to raise up to 110^{0}C during operation. As such air cell used shall be suitable for operating continuously at this temperature.

6.5.7. The transformer manual shall give full and clear instructions on the operation, maintenance, testing and replacement of the air cell. It shall also indicate shelf life, life expectancy in operation, and the recommended replacement intervals.

6.5.8. The conservator tank and piping shall be designed for complete vacuum / filling of the main tank and conservator tank. Provision must be made for equalising the pressure in the conservator tank and the air cell during vacuum / filling operations to prevent rupturing of the air cell.

6.5.9. The contractor shall furnish the leakage rates of the rubber bag/ air cell for oxygen and moisture. It is preferred that the leakage rate for oxygen from the air cell into the oil will be low enough so that the oil will not generally become saturated with oxygen. Air cells with well proven long life characteristics shall be preferred.

6.5.10. OLTC shall have conventional type conservator (without aircell) with magnetic oil level gauge with potential free oil level alarm contact and prismatic oil level gauge.

6.6. **Piping works for conservator**

6.6.1. Pipe work connections shall be of adequate size preferably short and direct. Only radiused elbows shall be used.

6.6.2. The feed pipe to the transformer tank shall enter the transformer cover plate at its highest point and shall be straight for a distance not less than five times its internal diameter on the transformer side of the Buchholz relay, and straight for not less than three times that diameter on the conservator side of the relay. This pipe shall rise towards the oil conservator, through the Buchholz relay, at an angle of not less than 5 degrees. The. feed pipe diameter for the main conservator shall be not less than 80mm. The Gas-venting pipes shall be connected to the final rising pipe between the transformer and Buchholz relay as near as possible in an axial direction and preferably not less than five times pipe diameters from the Buchholz relay.

6.6.3. A double flange valve of preferably 50 mm and 25 mm size shall be provided to fully drain the oil from the main tank conservator and OLTC conservator tank respectively.

6.6.4. Pipe work shall neither obstruct the removal of tap changers for maintenance or the opening of inspection or manhole covers.

6.7. **Dehydrating Silicagel Filter Breather**

Conservator of Main Tank and OLTC shall be fitted with a dehydrating silicagel filter breather. Connection shall be made to a point in the oil conservator not less than 50 mm above the maximum working oil level by means of a pipe with a minimum diameter of 25 mm. Breathers and connecting pipes shall be securely clamped and supported to the transformer, or other structure supplied by the contractor, in such a manner so as to eliminate undesirable vibration and noise. The design shall be such that:

a) Passage of air is through silicagel.
b) Silicagel is isolated from atmosphere by an oil seal.
c) Moisture absorption indicated by a change in colour of the crystals.
d) Breather is mounted approximately 1200 mm above rail top level.

e) To minimise the ingress of moisture three breathers (of identical size) shall be connected in series for main tank conservator. Contractor shall provide flexible connection pipes to be used during replacement of any silicagel breather.
f) To minimise the ingress of moisture, two in series of identical size shall be connected to OLTC Conservator. Contractor shall provide flexible connection pipes to be used during replacement of any silicagel breather.

6.8. **Pressure Relief Device**

Adequate number of pressure relief devices (at least 2 numbers) shall be provided at suitable locations preferably close to bushing turret/ cover. These shall have opening diameter of at least 100 mm for rapid release of any pressure that may be generated in the tank and which may result in damage to equipment. The device shall maintain its oil tightness under static oil pressure equal to the static operating head of oil plus 20 kPa. The device shall operate and attain its full opening in not more than 2.5 ms when subject to an internal pressure impulse equal to static operating head of oil plus 50 kPa. It shall be capable of withstanding full internal vacuum at mean sea level. It shall be mounted directly on the tank. Suitable canopy shall be provided to prevent ingress of rain water. One set of potential free contacts (**with plug & socket type arrangement)** per device shall be provided for tripping. Following routine tests shall be conducted on PRD:

a) Air pressure test
b) Liquid pressure test
c) Leakage test
d) Contact operation test
e) Dielectric test on contact terminals

6.9. **Sudden Pressure Relay**

One number of Sudden Pressure relay with alarm/trip contacts **(Terminal connection plug & socket type arrangement**) shall be provided on tank of transformer. Operating features and size shall be reviewed during design review. Suitable canopy shall be provided to prevent ingress of rain water. Pressurised water ingress test for Terminal Box (routine tests) shall be conducted on Sudden Pressure Relay

6.10. **Buchholz Relay**

Two numbers double float, reed type Buchholz relay shall be provided in series of the connecting pipe between the oil conservator and the Transformer tank with minimum distance of five times pipe diameters between them. Any gas evolved in the Transformer shall be collected in this relay. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation and taking gas sample. A copper tube shall be connected from the gas collector to a valve located about 1200
mm above ground level to facilitate sampling while the Transformer in service. Suitable canopy shall be provided to prevent ingress of rain water. Each device shall be provided with two potential free contacts **(Plug & socket type arrangement),** one for alarm / trip on gas accumulation and the other for tripping on sudden rise of pressure.

The Buchholz relay shall not operate during starting/ stopping of the transformer oil circulation under any oil temperature conditions. The pipe or relay aperture

baffles shall not be used to decrease the sensitivity of the relay. The relay shall not mal-operate for through fault conditions or be influenced by the magnetic fields around the transformer during the external fault conditions. Pressurised water ingress test for Terminal Box (routine tests) shall be conducted on Buchholz relay.

6.11. **Oil Temperature Indicator (OTI)**

All transformers shall be provided with a dial type thermometer of around 150 mm diameter for top oil temperature indication. It shall have adjustable, potential free alarm and trip contacts besides that required for control of cooling equipment if any. A temperature sensing element suitably located in a pocket on top oil shall be provided. This shall be connected to the OTI by means of capillary tubing. Temperature indicator dials shall have linear gradations to clearly read at least every 2 deg C. Accuracy of OTI shall be ± 3.0 deg C or better or better for a temperature of 100 deg C. The setting of alarm and tripping contacts shall be adjustable at site.

In addition to the above, the following accessories shall be provided for remote indication of oil temperature:

Temperature transducer with Pt100 sensor

RTD shall be provided with PT100 temperature sensor having nominal resistance of 100 ohms at zero degree centigrade. The PT100 temperature sensor shall have three wire ungrounded system. The calibration shall be as per IEC 60751-2 or equivalent. The PT100 sensor may be placed in the pocket containing temperature sensing element. RTD shall include image coil for OTI system and shall provide dual output 4-20mA for SCADA system. The transducer shall be installed in the Individual Marshalling Box. Any special cable required for shielding purpose, for connection between PT100 temperature sensor and transducer, shall be in the scope of Contractor. 4-20mA signal shall be wired to Digital RTCC panel / BCU for further transfer data to SCADA through IEC 61850 compliant communications.

6.12. **Winding Temperature Indicator (WTI)**

All Transformers shall be provided with a device for measuring the hot spot temperature of each winding (HV, IV and LV) with dial type thermometer of 150 mm diameter for winding temperature indication and shall have adjustable potential free alarm and trip contacts besides that required for control of cooling equipment if any. WTI shall have Temperature sensing element, Image coil and Auxiliary CTs, if required to match the image coil, shall be mounted in the cooler control cabinet. Temperature indicator dials shall have linear gradations to clearly read at least every 2 deg C. Accuracy of WTI shall be ± 3.0 deg C or better for a temperature of 100 deg C.

The setting of alarm and tripping contacts shall be adjustable at site.

In addition to the above, the following accessories shall be provided for remote indication of oil temperature:

Temperature transducer with Pt100 sensor for each winding

RTD shall be provided with Pt100 temperature sensor having nominal resistance of 100 ohms at zero degree centigrade. The Pt100 temperature sensor shall have three wire ungrounded system. The calibration shall be as per IEC 60751-2 or equivalent. The Pt100 sensor may be placed in the pocket containing temperature sensing element. RTD shall include image coil, Auxiliary CTs, if required to match the image coil, for

WTI system and shall provide dual output 4-20mA for remote WTI and SCADA system individually. The transducer, Auxiliary CT shall be installed in the Individual Marshalling Box. Any special cable required for shielding purpose, for connection between Pt100 temperature sensor and transducer, shall be in the scope of Contractor. 4-20mA signal shall be wired to Digital RTCC / BCU panel for further transfer data to SCADA through IEC 61850 compliant communications.

6.13. The temperature indicators (OTI & WTI) shall be so mounted that the dials are about 1200 mm from ground level. Glazed door of suitable size shall be provided for convenience of reading.

6.14. **Optical sensors & temperature measuring unit (for 400kV Class Transformer)**

Optical temperature sensors shall be fitted on each Transformer unit. 16 number probes for 3-ph unit and 8 number probes for 1-ph unit shall be provided. The optical sensors measuring system shall be of direct measurement non-calibrating type. All the sensors shall be brought out to separate optical sensor box or in Individual Marshalling Box mounted on transformer tank to facilitate measurement of temperature during service life on each unit.

In order to facilitate measurement of temperature from the optical sensors, temperature-measuring unit/system having at least 16 channels shall be mounted inside the separate optical sensor box or Transformer Marshalling Box for each transformer unit**.** The measuring unit shall be capable to retain temperature data for at least 30 days with facility to download these data.

Temperature measuring unit/system shall be suitable for satisfactory operation with ambient conditions and IEC 61850 compliant to interface with Employer's SCADA system through FO port.

Location of optical temperature sensors inside the transformer shall be decided during design review.

The installation and commissioning at site shall be done under the supervision of OEM representative or OEM certified representative.

6.15. **Earthing Terminals**

6.15.1. Two (2) earthing pads (each complete with two (2) nos. holes, M16 bolts, plain and spring washers) suitable for connection to 75 x 12 mm galvanised steel grounding flat shall be provided each at position close to earth of the two (2) diagonally opposite bottom corners of the tank.

6.15.2. Two earthing terminals suitable for connection to 75 x 12 mm galvanised steel flat shall also be provided on each cooler, individual/common marshalling box and any other equipment mounted separately. For the tank-mounted equipment like online drying/ Online DGA/ Optical Sensor Box etc. double earthing shall be provided through the tank for which provision shall be made through tank and connected through two flexible insulated copper link.

6.15.3. Equipotential flexible copper link of suitable size at least 4 Nos. for Tank mounted turret with tank and tank with cover and or Bell shall be provided. For other

components like - pipes, conservator support etc. connected to tank shall also be provided with equipotential flexible copper link.

6.15.4. Each transformer unit should have provision for earthing and connected to grounding mat when not in service. For this purpose, neutral shall have provision for connection to ground by a brass/tinned copper grounding bar supported from the tank by using porcelain insulator. The end of the tinned/brass copper bar shall be brought to the bottom of the tank at a convenient point for making bolted connection to 75 X 12 mm GS flat connected to station grounding mat. The other end of the tinned/brass copper bar shall be connected to the neutral bushing through flexible conductor/jumper.

HV & IV Terminals shall also be earthed through neutral by flexible copper connection. Contractor shall provide suitable arrangement for the above.

6.16. **Core**

6.16.1. The core shall be constructed from non-ageing, cold rolled high permeability grade (as per BIS / IEC) or better grain oriented silicon steel laminations. Indian transformer manufacturers shall use core material as per above specification with BIS certification.

6.16.2. The design of the magnetic circuit shall be such as to avoid static discharges, development 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.

6.16.3. The temperature of any part of the core or its support structure in contact with oil shall not exceed 120 deg C under normal operating condition and 130 deg C under 10% over voltage and maximum ambient air temperature conditions of 50 deg C. Adequate temperature margin shall be provided to maintain the long life expectancy for this material.

6.16.4. 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.

6.16.5. All steel sections used for supporting the core shall be thoroughly sand / shot blasted after cutting, drilling and welding.

6.16.6. Each core lamination shall be insulated with a material that will not deteriorate due to pressure and hot oil.

6.16.7. The supporting frame work of the core shall be so designed as to avoid presence of pockets which would prevent complete emptying of tank through drain valve or cause trapping of air during oil filling.

6.16.8. Adequate lifting lugs will be provided to enable the core and windings to be lifted.

6.16.9. The core shall be earthed to the core clamping structure at one point only, through a removable external link of minimum size of 80 sq. mm copper suitably located and protected to facilitate testing after installation of the transformer. The removable links shall have adequate section to carry ground fault current. Separate identification name plate/labels shall be provided for the 'Core' and ' Core clamp' on the outside of tank cover.

6.16.10. In case core laminations are divided into sections by insulating barriers or cooling ducts parallel to the plane of the lamination, tinned copper bridging strips shall be inserted to maintain electrical continuity between sections.

6.17. **Windings**

6.17.1. The Contractor shall ensure that windings of all transformers are made in dust proof and conditioned atmosphere.

6.17.2. The conductors shall be of electrolytic grade copper free from scales and burrs.

6.17.3. The insulation of transformer windings and connections shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse and shall be non-catalytic and chemically inactive in transformer oil during service.

6.17.4. Coil assembly and insulating spacers shall be so arranged as to ensure free circulation of oil and to reduce the hot spot of the winding.

6.17.5. The coils would be made up, shaped and braced to provide for expansion and contraction due to temperature changes.

6.17.6. The conductor shall be transposed at sufficient intervals in order to minimize eddy currents and to equalise the distribution of currents and temperature along the winding.

6.17.7. The windings shall be designed to withstand the dielectric tests specified. The type of winding used shall be of time tested. An analysis shall be made of the transient voltage distribution in the windings, and the clearances used to withstand the various voltages. Margins shall be used in recognition of manufacturing tolerances and considering the fact that the system will not always be in the new factory condition.

6.17.8. The barrier insulation including spacers shall be made from high- density pre-compressed pressboard (1.1 gm/cc minimum for load bearing and 1 gm/cc minimum for non-load bearing) to minimize dimensional changes.

6.17.9. The conductor insulation shall be made from high-density (at least 0.75 gm/cc) paper having high mechanical strength. The characteristics for the paper will be reviewed at the time of design review.

6.17.10. Wherever required, electrostatic shield, made from material that will withstand the mechanical forces, will be used to shield the high voltage windings from the magnetic circuit.

6.17.11. All winding insulation shall be processed to ensure that there will be no detrimental shrinkage after assembly. All windings shall be pre-sized before being clamped.

6.17.12. Windings shall be provided with clamping arrangements which will distribute the clamping forces evenly over the ends of the winding.

6.17.13. The bracing of the windings and connections shall be such that these parts shall safely withstand the cumulative effects of stresses which may occur during handling,

transportation, installation and service including line-to–line and line-to–ground faults.

6.18. **Current carrying connections**

The mating faces of bolted connections shall be appropriately finished and prepared for achieving good long lasting, electrically stable and effective contacts. All lugs for crimping shall be of the correct size for the conductors. Connections shall be carefully designed to limit hot spots due to circulating eddy currents.

6.19. **Winding terminations into bushings**

6.19.1. Winding termination interfaces with bushings shall be designed to allow for repeatable and safe connection under site conditions to ensure the integrity of the transformer in service.

6.19.2. The winding end termination, insulation system and transport fixings shall be so designed that the integrity of the insulation system generally remains intact during repeated work in this area.

6.19.3. Allowances shall be made on the winding ends for accommodating tolerances on the axial dimensions of the set of bushings and also for the fact that bushings may have to be rotated to get oil level inspection gauges to face in a direction for ease of inspection from ground level.

6.19.4. In particular, rotation or straining of insulated connections shall be avoided during the fastening of conductor pads (or other methods) on the winding ends onto the termination surfaces of the bushing.

6.19.5. Suitable inspection and access facilities into the tank in the bushing oil-end area shall be provided to minimize the possibility of creating faults during the installation of bushings.

7. Paint system and procedures

The typical painting details for transformer main tank, pipes, conservator tank, radiator, control cabinet/ marshalling box / oil storage tank etc. shall be as given in **Annexure – F**. The proposed paint system shall generally be similar or better than this. The quality of paint should be such that its colour does not fade during drying process and shall be able to withstand temperature up to 120 deg C. The detailed painting procedure shall be finalized during award of the contract.

8. Unused inhibited Insulating Oil

The insulating oil shall be virgin high grade inhibited, conforming to IEC-60296 & all parameters specified at **Annexure – G** , while tested at oil supplier's premises. The contractor shall furnish test certificates from the supplier against the acceptance norms as mentioned at **Annexure – G** , prior to despatch of oil from refinery to site. Under no circumstances, poor quality oil shall be filled into the transformer and thereafter be brought up to the specified parameter by circulation within the transformer. The Unused inhibited Insulating Oil parameters including parameters of oil used at manufacturer’s works, processed oil, oil after filtration and settling are attached at **Annexure – G** . The oil test results shall form part of equipment test report.

Sufficient quantity of oil necessary for maintaining required oil level in case of leakage in tank, radiators, conservator etc. till the completion of warranty period shall be supplied.

Inhibited oil used for first filling, testing and impregnation of active parts at manufacturer's works shall be of same type of oil (in line with IEC 60076-3) which shall be supplied at site and shall meet parameters as per specification.

8.1. **Particles in the oil**

The particle analysis shall be carried out in an oil sample taken after completion of the oil filtration at site. The procedure and interpretation shall be in accordance with the recommendation of CIGRE report WG-12.17 - "Effect o f particles on transformer dielectric strength".

8.2. **Moisture content in the solid insulation**

Dummy insulation test block (2 Nos.) shall be inserted in the active part of Transformer at factory and same shall be used to detect the volume of moisture content. Manufacturer to ensure that moisture content in the dummy insulation test block is less than 0.5% after drying process of solid insulation. Out of two dummy blocks, one block shall be used during manufacturing stage and another one shall be sent with Transformer at site. Before application of vacuum and oil filling, the 2nd dummy block shall be used for DP Test (Degree of polymerisation).

To review the moisture content in the active part insulation at site during erection, Dew Point method shall be applied.

8.3. **Oil filling**

8.3.1. Procedures for site drying, oil purification, oil filling etc. shall be done as per EMPLOYER Field Quality Plan (FQP).

8.3.2. The duration of the vacuum treatment shall be demonstrated as adequate by means of water / dew point measurement with a cold trap or other suitable method. The vacuum shall be measured on the top of the transformer tank and should be less than 1mbar.

8.3.3. Oil filling under vacuum at site shall be done with transformer oil at a temperature not exceeding 65°C. Vacuum shall not be broken until th e Transformer is oil filled up to the Buchholz relay.

8.3.4. The minimum safe level of oil filling (if different from the Buchholz level) to which the Transformer shall be oil filled under vacuum, shall be indicated in the manual.

8.3.5. The Ultra High Vacuum type oil treatment plant (on returnable basis) of adequate capacity (**generally 6000** litres per hour and above) suitable for treatment of oil in EHV

class Transformer shall be used. The plant shall be capable of treatment of new oil (as per IEC 60296 and reconditioning of used oil (as per IS: 1866/IEC: 60422 for oil in service) at rated capacity on single pass basis as follow:

i) Removal of moisture from 100 ppm to 3 ppm (max.)
ii) Removal of dissolved gas content from 10% by Vol. to 0.1% by vol.
iii) Improvement of dielectric strength break down voltage from 20 to 70 KV
iv) Vacuum level of degassing chamber not more than 0.15 torr/0.2 mbar at rated flow and at final stage. Machine shall have minimum of two degassing chambers and these should have sufficient surface areas to achieve the final parameters.
v) Filter shall be capable of removing particle size more than 0.5 micron in the filtered oil.
vi) Processing temperature shall be automatically controlled and have an adjustable range from 40□C to 80□C.

The above oil treatment plant (Filtration unit) shall be arranged by the bidder at his own cost.

8.3.6. **Transportation of Oil**

The insulating oil for the Transformer shall be delivered at site generally not before 90 days from the date of commissioning, with prior information to the Employer, in view of risk involved in balk storage, pilferage and fire hazard. In case this oil is not filled in Transformer due to delay in commissioning, same oil shall be used only after testing and ensuring that oil parameters are well within the specified limits.

Insulating oil shall be delivered to the site in returnable oil drums / flexi bag / tanker. The oil drums / flexi bag / tanker shall be taken back without any extra cost to Employer within generally 45 days after utilisation of oil but in any case before contract closing. However, the spare oil shall be delivered in non-returnable drums.

9. Spare Transformer Units Connection Arrangement

Detail procedure for storage of spare transformer unit with and without **isolator switching arrangement** is enclosed at **Annexure-Q.**

10. Bushings

10.1. Bushings shall be robust and designed for adequate cantilever strength to meet the requirement of seismic condition, substation layout and movement along with the spare Transformer with bushing erected and provided with proper support from one foundation to another foundation within the substation area. The electrical and mechanical characteristics of bushings shall be in accordance with IEC: 60137/DIN 42530. All details of the bushing shall be submitted for approval and design review.

10.2. Bushing for voltage of 52 kV and above shall be RIP bushing with composite polymer insulator. 36 kV and below voltage class bushing shall be solid porcelain or oil communicating type.

10.3. RIP type bushing shall be provided with tap for capacitance and tan delta test. Test taps relying on pressure contacts against the outer earth layer of the bushing is not acceptable.

10.4. Where current transformers are specified, the bushings shall be removable without disturbing the current transformers.

10.5. Bushings of identical rating shall be interchangeable to optimise the requirement of spares. Mounting dimensions of bushing shall be as per drawing mentioned at **Annexure – D** .

10.6. Porcelain used in bushing manufacture shall be homogenous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

10.7. Polymer / composite insulator shall be seamless sheath of a silicone rubber compound. The housing & weather sheds should have silicon content of minimum 30% by weight. It should protect the bushing against environmental influences, external pollution and humidity. The interface between the housing and the core must be uniform and without voids. The strength of the bond shall be greater than the tearing strength of the polymer. The manufacturer shall follow non-destructive technique (N.D.T.) to check the quality of jointing of the housing interface with the core. The technique being followed with detailed procedure and sampling shall be finalized during finalization of MQP.

The weather sheds of the insulators shall be of alternate shed profile as per IEC 60815-
3. The weather sheds shall be vulcanized to the sheath (extrusion process) or moulded as part of the sheath (injection moulding process) and free from imperfections. The vulcanization for extrusion process shall be at high temperature and for injection moulding shall be at high temperature & high pressure. Any seams / burrs protruding axially along the insulator, resulting from the injection moulding process shall be removed completely without causing any damage to the housing. The track resistance of housing and shed material shall be class 1A4.5 according to IEC60587**.** The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The composite insulator shall be capable of high pressure washing.

End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively, sealed to prevent moisture ingress, effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth with the projecting points or irregularities which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.

The hollow silicone composite insulators shall comply with the requirements of the IEC publications IEC 61462 and the relevant parts of IEC 62217. The design of the composite insulators shall be tested and verified according to IEC 61462 (Type & Routine test)

10.8. Clamps and fittings shall be of hot dip galvanised/stainless steel.

10.9. Bushing turrets shall be provided with vent pipes, to route any gas collection through the Buchholz relay.

10.10. No arcing horns shall be provided on the bushings.

10.11. RIP Bushing shall be specially packed to avoid any damage during transit and suitable for long storage, with non-returnable packing wooden boxes with hinged type cover. Without any gap between wooden planks. Packing Box opening cover with nails/screws type packing arrangement shall not be acceptable. Bushing oil end portion shall be fitted with metal housing with positive dry air pressure and a suitable pressure monitoring device shall be fitted on the metal housing during storage to avoid direct contact with moisture with epoxy. Alternatively, oil filled metal housing with suitable arrangement for taking care oil expansion due to temperature variations shall also be acceptable. Manufacturer shall submit drawing/ documents of packing for approval during detail engineering. Detail method for storage of bushing including accessories shall be brought out in the instruction manual.

10.12. The terminal marking and their physical position shall be as per IEC: 60076.

10.13. Tan delta measurement at variable frequency (in the range of 20 Hz to 350 Hz) shall be carried out on each condenser type bushing (OIP & RIP) at Transformer manufacturing works as routine test before despatch and the result shall be compared at site during commissioning to verify the healthiness of the bushing.

10.14. If the bushing Tan delta goes beyond 0.005 or increase is more than 0.001 within the warrantee period w.r.t. pre-commissioning values, the contractor shall arrange to replace the defective bushing by new one. No temperature correction factor shall be applicable for tan delta.

11. Neutral Formation and Earthing Arrangement

11.1. For 3-Phase Unit

The neutral of the transformer shall be brought out through bushing. The neutral terminal of 3-phase transformer shall be brought to the ground level by a brass/tinned copper grounding bar, supported from the tank by using porcelain insulators. 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) 75 x 12 mm galvanised steel flats connected to Employer's grounding mat.

11.2. For 1-Phase Unit (if specified in BPS)

The neutral of the transformer shall be brought out through bushing. The contractor shall connect the neutrals of 1-phase transformers by overhead connection using an overhead common brass/tinned copper/Aluminum pipe /ACSR conductor grounding bus, supported from the tank and fire walls by using porcelain insulators and wherever flexible jumper needs to be provided, same shall be through twin conductor. All material like Bus post insulator, Aluminium tube, conductor, clamps & connectors, earthing materials, support structure, hardware etc required for neutral formation and connection with neutral CT and earthing of neutral shall be provided by contractor. The neutral formation shall be such that neutral winding of single-phase spare transformer can be disconnected or connected to either of the three phase banks.

12. Delta Formation (applicable for 1-Phase Transformer) :(if specified in BPS)

The tertiary/LV winding terminals of the transformer shall be brought out through bushing. The contractor shall connect Tertiary/LV of 1-phase transformers in DELTA

configuration by overhead connection to operate in 3-Phase Bank. The Delta shall be formed by approximate size of 3" IPS Al tube, which shall be insulated with heat shrinkage insulating sleeve or cable of suitable voltage class and adequate thickness and shall be supported by structure mounted bus post insulators at suitable intervals. Jumpers (twin) wherever provided shall also be insulated at site using suitable insulation tape or sleeve atleast 52kV class for 33kV Bus and atleast 36kV class for below 33kV voltage class Bus. The minimum phase to phase horizontal spacing for delta formation shall be 1.5 meter. Suitable cable shall be used for delta formation for below 33kV winding All associated materials like bus post insulators, Aluminium tube clamps & connectors, support structures; hardware etc. required for tertiary delta formation shall be provided by the contractor.

13. Cooling Equipment and its Control

13.1. Cooling Equipment for Radiator Bank

13.1.1. The cooler shall be designed using radiator banks or tank mounted radiators. Design of cooling system shall satisfy the performance requirements.

13.1.2. In case of separately mounted radiator bank arrangement, the main tank shall have provision such that cooler banks can be placed on either side of the main tank without the need of any extra member/pipe maintaining the electrical clearances.

13.1.3. The radiator shall be of sheet steel in accordance with IS 513 and minimum thickness 1 mm. Each radiator bank shall be provided with the following accessories:

(a) Cooling Fans, Oil Pumps, Oil Flow Indicator (as applicable)
(b) Top and bottom shut off valve
(c) Drain Valve and sampling valve
(d) Top and bottom oil filling valves
(e) Air release plug
(f) Two grounding terminals for termination of two (2) Nos. 75x12 mm galvanised steel flats.
(g) Thermometer pockets with captive screw caps at cooler inlet and outlet.
(h) Lifting lugs

13.1.4. Each radiator bank shall be detachable and shall be provided with flanged inlet and outlet branches. Expansion joint shall be provided on top and bottom cooler pipe connection.

13.2. If radiators are directly mounted on tank, sufficient number of thermometer pockets fitted with captive screw cap on the inlet and outlet of tank side pipe of radiators shall be provided to record temperature during temperature rise test.

13.2.1. One number standby fan shall be provided with each radiator bank.

13.2.2. Cooling fans shall not be directly mounted on radiator. It may cause undue vibration. These shall be located so as to prevent ingress of rain water. Each fan shall be suitably protected by galvanised wire guard. The exhaust air flow from cooling fan shall not be directed towards the main tank in any case.

13.2.3. Two (2), 100% centrifugal or axial in line oil pumps, if applicable, (out of which one pump shall be standby) shall be provided with each radiator bank. Measures shall be

taken to prevent mal-operation of Buchholz relay when all oil pumps are simultaneously put into service. The pump shall be so designed that upon failure of power supply to the pump motor, the pump impeller will not limit the natural circulation of oil.

13.2.4. An oil flow indicator shall be provided for the confirmation of the oil pump operating in a normal state. An indication in the flow indicator and potential free contacts for remote alarm shall be provided.

13.2.5. Valves shall be provided across the pump and oil flow indicator to avoid oil drain and long outage during maintenance / replacement of pump and oil flow indicator.

13.2.6. Cooling fans and oil pump motors shall be suitable for operation from 415 volts, three phase 50 Hz power supply and shall conform to IS: 325 / IEC 60034. Each cooling fan and oil pump motors shall be provided with starter thermal overload and short circuit protection. The motor winding insulation shall be conventional class 'B' type. Motors shall have hose proof enclosure equivalent to IP: 55 as per IS: 4691/ IEC 60034-5.

13.2.7. The cooler pipes, support structure including radiators and its accessories shall be hot dip galvanised or corrosion resistant paint should be applied to external surface of it.

13.2.8. Air release device and oil plug shall be provided on oil pipe connections. Drain valves shall be provided in order that each section of pipe work can be drained independently.

13.3. **Cooling Equipment Control for Radiator banks**

13.3.1. Automatic operation control of fans/pumps shall be provided (with temperature change) from contacts of winding temperature indicator. The Contractor shall recommend the setting of WTI for automatic changeover of cooler control over entire cooling option. The setting shall be such that hunting i.e. frequent start-up operations for small temperature differential do not occur.

13.3.2. Suitable manual control facility for cooler fans and oil pumps shall be provided. Selector switches and push buttons shall also be provided in the cooler control cabinet to disconnect the automatic control and start/stop the fans and pump manually.

13.3.3. The changeover to standby oil pump in case of failure of service oil pump shall be automatic.

13.3.4. In addition to the traditional starting of fan and pump by winding & oil temperature, the starting of forced cooling shall be done if the load exceeds a current setting of 0.6 p.u. for 5 seconds. Furthermore, a one-week timer is required to check the healthiness of the cooling system on a routine basis for one hour at a time.

13.3.5. Following lamp indications shall be provided in cooler control cabinet:

a) Cooler Supply failure (main)
b) Cooler supply changeover
c) Cooler Supply failure (standby)
d) Control Supply failure

e) Cooling fan failure for each bank
f) Cooling pump failure for each pump
g) Common thermal overload trip

One potential free initiating contact for all the above conditions shall be wired independently to the terminal blocks of cooler control cabinet and for single ph. unit connection shall be extended further to CMB.

13.3.6. The cooler control cabinet / Individual Marshalling box shall have all necessary devices meant for cooler control and local temperature indicators. All the contacts of various protective devices mounted on the transformer and all the secondary terminals of the bushing CTs shall also be wired upto the terminal board in the cooler control cabinet/Individual Marshalling box. All the CT secondary terminals in the cooler control cabinet shall have provision for shorting to avoid CT open circuit while it is not in use.

13.3.7. All the necessary terminations for remote connection to Purchaser's panel shall be wired upto the Common Marshalling box (in case of 1-Ph unit) or Marshalling Box (3-Ph unit).

13.3.8. The Contractor shall derive AC power for Cooler Control Circuitry from the AC feeder. In case auxiliary power supply requirement for Cooler Control Mechanism is different than station auxiliary AC supply, then all necessary converters shall be provided by the Contractor. Details of station auxiliary power supply are mentioned in GTR.

13.4. **Unit cooler arrangement for transformer (if applicable)**

13.4.1. The cooler shall be designed using Unit Cooler arrangement with capacity as specified in Annexure-A. Design of cooling system shall satisfy the performance requirements.

13.4.2. Each Unit Cooler shall have its own cooling fans, oil pumps, oil flow indicator, shut off valves at the top and bottom of at least 80 mm size, lifting lugs, top and bottom oil filling valves, air release plug at the top, a drain and sampling valve and thermometer pocket fitted with captive screw cap on the inlet and outlet.

13.4.3. An oil flow indicator shall be provided for the confirmation of the oil pump operating in a normal state. An indication shall be provided in the flow indicator to indicate reverse flow of oil/loss of oil flow.

13.4.4. Valves shall be provided across the pump and oil flow indicator to avoid oil drain and long outage during maintenance / replacement of pump and oil flow indicator.

13.4.5. Cooling fans and oil pump motors shall be suitable for operation from 415 volts, three phase 50 Hz power supply and shall conform to IS: 325/IEC34. Each cooling fan and oil pump motors shall be provided with starter thermal overload and short circuit protection. The motor winding insulation shall be conventional class 'B' type. Motors shall have hose proof enclosure equivalent to IP:55 as per IS:4691/IEC:34-5

13.4.6. The cooler, pipes, support structure and its accessories shall be hot dip galvanised or corrosion resistant paint should be applied to external surface of it.

13.4.7. Expansion joint shall be provided on top and bottom cooler pipe connections as per requirement.

13.4.8. Air release device and oil plug shall be provided on oil pipe connections. Drain valves shall be provided in order that each section of pipe work can be drained independently.

13.5. **Cooling Equipment Control (OFAF or ODAF) for Unit Coolers (if applicable)**

i) Suitable manual control facility for unit cooler shall be provided.

ii) The changeover to standby unit cooler bank oil pump in case of failure of any service unit cooler shall be automatic.

iii) Selector switches and push buttons shall also be provided in the cooler control cabinet to disconnect the automatic control and start/stop the unit cooler manually.

iv) Cooler fans & oil pumps of all unit coolers (except standby cooler) shall operate continuously. The starting of unit cooler shall be done as soon the Circuit Breaker of HV/IV/LV (as applicable) side is switched on.

v) Once started the cooling shall remain in operation as long as the transformer is in service. When the transformer is switched off the cooling shall continue to run for a further duration of 30 minutes. This timer shall be at least adjustable from 15 to 60 minutes. Further, a one-week timer is required to check the healthiness of the complete cooling system on a routine basis for one hour at a time. Spurious operation should however be avoided by appropriate settings. All settings shall be adjustable

vi) Adequate warning/ safety labels are required to indicate that the fans may start at any time.

vii) If any one group(s) is out of service and isolated, this shall not affect the automatic starting of the other unit cooler.

viii) Following lamp indications shall be provided in cooler control cabinet:

- Cooler Supply failure (main)
- Cooler supply changeover
- Cooler Supply failure (standby)
- Control Supply failure
- Cooler unit failure for each unit cooler
- No oil flow/reverse oil flow for pumps
- Thermal overload trip for each fan / pump

One potential free initiating contact for all the above conditions shall be wired independently to the terminal blocks of cooler control cabinet and for single ph. unit connection shall be extended further to CMB.

13.6. **Auxiliary Power Supply for OLTC, Cooler Control and Power Circuit**

13.6.1. **For Single Phase unit**

13.6.1.1. Two auxiliary power supplies, 415 volt, three phase four (4) wire shall be provided at common marshalling box through bus bar arrangement. All loads shall be fed by one of the two sources through an electrically interlocked automatic transfer scheme housed in the CMB. Power supply to individual phase unit shall be extended from the CMB. Power supply to spare unit shall be extended from nearest CMB only. Suitably rated power contactors, separate MCBs/MCCBs shall be provided in the Common Marshalling Box for each circuit.

13.6.1.2. For each circuit, suitably rated MCBs/MCCBs as required for further distribution of auxiliary power supply to DM boxes, Online Gases and moisture monitoring system, Online drying system and Fibre optic sensor Box etc.(as applicable), shall be provided by contractor, in individual marshalling boxes /cooler control boxes. POWER from CMB (through bus bar at CMB) to IMB (at bus inside) through cable shall be provided by contractor.

13.6.1.3. Auxiliary power supply distribution scheme shall be submitted for approval.

13.6.1.4. Supply and laying of Power, Control and special cables from common marshalling box to individual MB/Cooler Control Cubicle (including spare unit) & further distribution from IMB/CCC to all accessories is in the scope of the contractor. Further any special cable (if required) from CMB to Owner's Control Panels/Digital RTCC panels is also in the scope of the contractor.

13.6.2. **For Three Phase Transformer**

13.6.2.1. Two auxiliary power supplies, 415 volt, three phase four (4) wire shall be provided by the Purchaser at cooler control cabinet / Marshalling Box. All loads shall be fed by one of the two sources through an electrically interlocked automatic transfer scheme housed in the cooler control cabinet / Marshalling.

13.6.2.2. For each circuit, suitably rated power contactors, MCBs/MCCBs as required for entire auxiliary power supply distribution scheme including distribution to DM boxes, Online Gases and moisture monitoring system, Online drying system and Fibre optic sensor Box etc. (as applicable), shall be provided by contractor in cooler control cabinet/ Marshalling.

13.6.2.3. Auxiliary power supply distribution scheme shall be submitted for approval. Supply and laying of Power, Control and special cables from marshalling box to all accessories is in the scope of the contractor. Further any special cable (if required) from MB to Owner's Control Panels/Digital RTCC panels is also in the scope of the contractor.

13.6.3. **Design features of the transfer scheme** shall include the following:

a) Provision for the selection of one of the feeder as normal source and other as standby.
b) Upon failure of the normal source, the loads shall be automatically transferred after an adjustable time delay to standby sources.
c) Indication to be provided at cooler control cabinet/Individual Marshalling Box/Common Marshalling Box for failure of normal source and for transfer to standby source and also for failure to transfer.
d) Automatic re-transfer to normal source without any intentional time delay following re-energization of the normal source.

e) Both the transfer and the re-transfers shall be dead transfers and AC feeders shall not be paralleled at any time.

13.6.4. For spare unit which is not connected through isolator switching arrangement, 415 volt, three phase four (4) wire AC supply shall be provided for heater, On line drying system, On line DGA etc. as applicable. Necessary cabling in this regard shall be done by the Contractor.

13.7. **Valves**

13.7.1. All valves upto and including 100 mm shall be of gun metal or of cast steel/cast iron. Larger valves may be of gun metal or may have cast iron bodies with gun metal fittings. They shall be of full way type with internal screw and shall open when turned counter clock wise when facing the hand wheel.

13.7.2. Suitable means shall be provided for locking the valves in the open and close positions. Provision is not required for locking individual radiator valves.

13.7.3. Each valve shall be provided with the indicator to show clearly the position (open/close) of the valve.

13.7.4. All valves flanges shall have machined faces. Drain valves/plugs shall be provided in order that each section of pipe work can be drained independently.

13.7.5. All valves in oil line shall be suitable for continuous operation with transformer oil at 115 deg C.

13.7.6. The oil sampling point for main tank shall have two identical valves put in series. Oil sampling valve shall have provision to fix rubber hose of 10 mm size to facilitate oil sampling.

13.7.7. Valves or other suitable means shall be provided to fix various on line condition monitoring systems to facilitate continuous monitoring. The location & size of the same shall be finalised during detail design review.

13.7.8. **Flow sensitive conservator Isolation valve**

a) In order to restrict the supply of oil in case of a fire in transformer, flow sensitive valve shall be provided to isolate the conservator oil from the main tank.

b) A valve which shall be flow sensitive and shut off when the flow in the pipe is more than the flow expected in the permissible normal operating conditions. This valve shall be located in the piping between the conservator and the buchholz relay and shall not affect the flow of oil from and to the conservator in normal conditions.

c) When the flow from conservator to main tank is more than the normal operating conditions, the valve shall shut off by itself and will have to be reset manually. It shall be provided with valve open/close position indicator along with alarm contact indication in control room during closing operation of valve. This valve shall be provided with locking arrangement for normal position and oil filling / filtration position. A suitable platform or ladder (if required) shall be provided to approach the valve for manual reset.

13.7.9. All valves shall be painted with a shade (preferably red or yellow) distinct and different from of main tank surface and as per the painting system and procedure specified.

13.7.10. All hardware used shall be hot dip galvanised / stainless steel.

14. Cabling

14.1. All interconnecting control and power cables between various parts of Transformers like turret CT, MBs, Fans, pumps, Buchholz, PRD etc. shall be routed through covered cable tray or GI conduit and shall be properly dressed. All cables shall be armoured type. Un-armoured cables (if provided) in any circuitry, shall be through GI conduit and no part shall be exposed. Cable terminations shall be through stud type TB and ring type lugs. Typical Technical specification for cables is attached at **Annexure-I**. Contractor shall provide type tested cables from approved sources. No type testing

for cables is envisaged. Both ends of all the wires (control & power) shall be provided with proper ferrule numbers for tracing and maintenance. Further, any special cables (if required) shall also be considered included in the scope. All cable accessories such as glands, lugs, cable tags/ numbers etc as required shall be considered included in the scope of supply.

14.2. Cabling of spare unit with isolator switching arrangement shall be in such a way that spare unit of transformer can be connected in place of faulty unit without physically shifting and all the control, protection, indication signals of spare unit shall be brought in common marshalling box of all the banks. From CMB all the control, protection and indication signals of R, Y, B and Spare units shall be transferred to Purchaser's Control panels / SCADA. Change-over of spare unit signals with faulty unit shall be done through Purchaser's C & R panels / SCADA level. Change over of RTCC signals shall be carried out in CMB (Please refer clause 15.3.1).

15. Tap Changing Equipment

Each transformer shall be provided with Off load tap / On Load Tap changing equipment as specified elsewhere.

15.1. Off load tap Changer equipment (if applicable)

The off load / Off Circuit tap changer (OCTC) equipment shall be handle operated with a locking arrangement along with tap position indicator. The external handle shall be situated in an unobstructed position. The contacts are positively self-locating in each tapping position without constraint from the operating mechanism. The rating of the contacts shall be suitable to carry maximum current of the transformer. For three phase transformer the tap change switch shall simultaneous switch the similar taps on the three phases. A warning plate indicating that OCTC shall be operated only when the transformer is de-energised, shall be fitted.

15.2. ON Load Tap Changing (OLTC) Equipment (Vacuum or Oil type)

15.2.1. Main OLTC Gear Mechanism

15.2.1.1. Each single / three phase transformer shall be provided with voltage control equipment of the tap changing type for varying its effective transformation ratio whilst the transformers are on load.

15.2.1.2. OLTC shall be motor operated suitable for local as well as remote operation. The diverter switch or arcing switch shall be designed so as to ensure that its operation once commenced shall be completed independently of the control relays or switches, failure of auxiliary supplies etc. To meet any contingency which may result in incomplete operation of the diverter switch, adequate means shall be provided to safeguard the transformer and its ancillary equipment. The current diverting contacts shall be housed in a separate oil chamber not communicating with the oil in main tank of the transformer. The contacts shall be accessible for inspection without lowering oil level in the main tank and the contacts shall be replaceable.

15.2.1.3. Necessary safeguards shall be provided to avoid harmful arcing at the current diverting contacts in the event of operation of the OLTC gear under overload conditions of the transformer.

15.2.1.4. The OLTC oil chamber shall have oil filling and drain valve, oil sampling valve, relief vent and level glass. Oil sampling valve of minimum size, accessible from ground, shall be provided to take sample of oil from the OLTC chamber. It shall also be fitted with an oil surge relay which shall be connected between OLTC oil chamber and OLTC conservator tank.

15.2.1.5. Tap changer shall be so mounted that bell cover of transformer can be lifted without removing connections between windings and tap changer.

15.2.2. **Local OLTC Control Cabinet (Drive Mechanism Box)**

Each transformer unit of OLTC gear shall have following features:

15.2.2.1. OLTC shall be suitable for manually handle operated and electrically motor operated. For local manual operation from Local OLTC Control cabinet (Drive Mechanism Box), an external handle shall be provided.

15.2.2.2. OLTC's Local control cabinet shall be mounted on the tank in accessible position. The cranking device/handle for manual operation for OLTC gear shall be removable and suitable for operation by a man standing at ground level. The mechanism shall be complete with the following:

- Mechanical tap position indicator which shall be clearly visible from near the transformer.
- A mechanical operation counter of at least five digits shall be fitted to indicate the number of operations completed and shall have no provision for resetting.
- Mechanical stops to prevent over-cranking of the mechanism beyond the extreme tap positions.
- The manual control considered as back up to the motor operated on load tap changer control shall be interlocked with the motor to block motor start-up during manual operation.
- The manual operating mechanism shall be labelled to show the direction of operation for raising the voltage and vice-versa.
- An electrical interlock to cut-off a counter impulse for reverse step change being initiated during a progressing tap change and until the mechanism comes to rest and resets circuits for a fresh position.

15.2.2.3. For electrical operation from local as well as remote, motor operated mechanism shall be provided. It shall not be possible to operate the electric drive when the manual operating gear is in use. It shall not be possible for any two controls to be in operation at the same time. Transfer of source in the event of failure of one AC supply shall not affect the tap changer. Thermal device or other means shall be provided to protect the motor and control circuit.

15.2.2.4. The Local OLTC Drive Mechanism Box shall house all necessary devices meant for OLTC control and indication. It shall be complete with the followings:

i. A circuit breaker/contactor with thermal overload devices for controlling the AC Auxiliary supply to the OLTC motor
ii. Emergency Push Button to stop OLTC operation
iii. Cubicle light with door switch
iv. provided with anti-condensation metal clad heaters to prevent condensation of moisture

v. Padlocking arrangement for hinged door of cabinet
vi. All contactors relay coils and other parts shall be protected against corrosion, deterioration due to condensation, fungi etc.
vii. The cabinet shall be tested at least IP 55 protection class.

15.2.2.5. All relays and operating devices shall operate correctly at any voltage within the limits specified in Section - GTR. In case auxiliary power supply requirement for OLTC DM Box is different than station auxiliary AC supply, then all necessary converters shall be provided by the Contractor.

15.2.2.6. Operating mechanism for on load tap changer shall be designed to go through one step of tap change per command only, until the control switch is returned to the off position between successive operations / repeat commands.

15.2.2.7. Limit switches shall be provided to prevent overrunning of the mechanism and shall be directly connected in the control circuit of the operating motor provided that a mechanical de-clutching mechanism is incorporated. In addition, a mechanical stop shall be provided to prevent over-running of the mechanism under any condition. An interlock to cut-out electrical control when it tends to operate the gear beyond either of the extreme tap positions.

15.2.2.8. OLTC local control cabinet shall be provided with tap position indication for the transformer. Drive Mechanism shall be equipped with a fixed resistor network capable of providing discrete voltage steps or provide 4-20mA transducer outputs for tap position indication in CMB (for single phase unit) and input to Digital RTCC/SCADA system.

15.2.2.9. 'Local-remote' selector switch shall be provided inthe local OLTC control cabinet. In Local mode, all electrical commands from remote (i.e. from CMB, Digital RTCC, SCADA etc.) shall be cut-off/blocked. Electrical operations to change tap positions shall be possible by using raise/lower push buttons under local mode from DM Box. In remote mode electrical commands from CMB/ Digital RTCC/SCADA etc. shall be executed. The remote-local selector switch shall be having at-least two spare contacts per position.

15.2.2.10. Following minimum contacts shall be available in DM Box, which shall be wired to CMB for single phase unit. Further these contacts shall be wired to Digital RTCC panel:

a. INCOMPLETE STEP which shall not operate for momentary loss of auxiliary power.
b. OLTC motor overload protection
c. Supply to DM Motor fail
d. OLTC IN PROGRESS
e. Local / Remote Selector switch position
f. OLTC upper/lower limits reached

15.2.2.11. All relays, switches, fuses etc. shall be mounted in the OLTC local control cabinet and shall be clearly marked / labelled for the purpose of identification.

15.2.2.12. A permanently legible lubrication chart if required shall be fitted within the OLTC local control cabinet.

15.3. **OLTC Control from Common Marshalling Box (CMB)**

15.3.1. It shall be possible to monitor, control/operate, the OLTC of all the three 1-phase transformers of a transformer bank from Common Marshalling Box. The control and monitoring terminations of a spare transformer unit (1-Ph) shall be brought to CMB. The necessary switching arrangement through male-female plug-in TB assembly shall be provided for replacing spare unit with any one of the faulty phase unit for monitoring & control from CMB.

15.3.2. 'Independent-combined-remote selector switch, raise/lower switch and emergency stop Push Button shall be provided in the common marshalling box for OLTC control.

15.3.3. When the selector switch is in **independent** position, the OLTC control shall be possible from individual Local OLTC Control Cabinet (DM Box) only.

15.3.4. In ' **combined position'**, raise-lower switch (provided in the CMB), shall be used to operate for bank of three single phase transformers from CMB.

15.3.5. In **'remote position'** control of OLTC shall be possible from Digital RTCC/SCADA etc.

15.3.6. From CMB, the operation of OLTC shall be for 3-phases of transformer units without producing phase displacement. Independent operation of each single phase transformer from CMB/ Digital RTCC/SCADA will be prevented.

15.3.7. Following minimum **LED indications** shall be provided in CMB:

a. INCOMPLETE STEP
b. OLTC motor overload protection
c. Supply to DM Motor fail
d. OLTC IN PROGRESS
e. Local / Remote Selector switch positions of DM
f. OLTC upper/lower limits reached
g. 415V Main AC supply ON
h. 415V Standby AC supply ON

Following **contacts** shall be wired to TBs in CMB for further wiring to C & R Panels.

i. 415V Main AC supply Fail
j. 415V Standby AC supply Fail

Following **contacts** shall be wired to TBs in CMB for further wiring to digital RTCC Panel:

a. INCOMPLETE STEP
b. OLTC motor overload protection
c. Supply to DM Motor fail
d. OLTC IN PROGRESS
e. Local / Remote Selector switch positions of DM
f. OLTC upper/lower limits reached
g. 'Independent-combined-remote' selector switch positions of CMB

Further, OLTC Tap position Digital indications for all three 1-Ph Transformer units either separately or through selector switch shall be provided in CMB. The same shall also be wired to Digital RTCC Panel to display tap positions for all three 1-ph unit separately.

15.4. **Digital RTCC Panel**

15.4.1. The digital RTCC relay shall have Automatic Tap Changer control and monitoring relay with Automatic Voltage Regulating features (referred as **Digital RTCC relay**) to remotely control and monitor OLTC.

15.4.2. For new substation, the contractor shall provide Digital RTCC panel consisting of 4 Nos. Digital RTCC relays. Further, one spare Digital RTCC relay shall also be provided in the same panel. Each digital RTCC relay shall be used to control 1 bank of transformers (i.e. 3 Nos. 1-Phase units or 1 No. 3-Phase unit),

For existing substations, the requirement of digital RTCC panel and relays are specified in Section-Project/BPS. However, bidders are advised to get clarified about the availability of existing RTCC schemes /Digital RTCC relays to finalise matching digital RTCC relays requirements. The Digital RTCC relays envisaged for existing transformers shall be integrated for parallel operations. All required cables for the same shall be included in the scope.

15.4.3. Digital RTCC relay shall be microprocessor based adopting the latest state of the art design & technology with in-built large display for ease of programming and viewing. The unit supplied shall be field programmable so that in the event of change in transformer / location, it could be customized to site conditions without sending back to works. The programming shall be menu driven and easily configurable. If it is designed with draw out type modules, it should take care of shorting all CT inputs automatically while drawing out. The CT / VT ratio shall be field programmable and Relay shall display the actual HV Voltage and current considering suitable multiplying factors. The system shall be self-sufficient and shall not require any additional devices like parallel balancing module etc.

All Digital RTCC Relays shall be of same make for smooth integration of these relays for parallel operations of all transformers in the substation.

15.4.4. The RTCC Panel shall be provided with digital RTCC relay having Raise/Lower push buttons, Manual/ Automatic mode selection features, Master / Follower/ Independent/ Off mode selection features for control of OLTC. Touch screen option in the relay, instead of electrical push button/switch is also acceptable.

15.4.5. **In Manual Mode**: In this mode, power system voltage based automatic control from digital RTCC relay shall be blocked and commands shall be executed manually by raise/lower push buttons.

15.4.6. **In Auto Mode:** In Auto mode, digital RTCC relay shall automatically control OLTC taps based on power system voltage and voltage set points. An interlock shall be provided to cut off electrical control automatically upon recourse being taken to the manual control in emergency.

15.4.7. **Master / Follower/ Independent/ Off mode**

Master / Follower parallel operation is required with Group simultaneous feature in Digital RTCC relay. Master-follower scheme implies that controlled decision shall be taken by the Master and control actions (Raise/Lower tap position) shall be executed

simultaneously by Master & Follower units. Same logic needs to be implemented in digital RTCC relays.

Master Position: If the digital RTCC relay is in master position, it shall be possible to control the OLTC units of other parallel operating transformers in the follower mode by operation from the master unit.

Follower Position: If the digital RTCC relay is in Follower position, control of OLTC shall be possible only from panel where master mode is selected.

Independent Position: In independent position of selector switch, control of OLTC shall be possible only from the panel where independent mode is selected.

Suitable interlock arrangement shall be provided to avoid unwanted/inconsistent operation of OLTC of the transformer

15.4.8. **Raise/Lower control:** The remote OLTC scheme offered shall have provision to raise or lower taps for the complete bank of three 1-phase transformers / 3-Phase Transformers. Individual 1-phase OLTC operation shall not be possible from the remote control panel.

15.4.9. Digital RTCC relays shall communicate with SCADA using IEC 61850 through FO port to monitor, parameterise & control the OLTC. Any software required for this purpose shall be supplied. The supplied software shall not have restriction in loading on multiple computers for downloading and analyzing the data. Software shall indicate the current overview of all measured parameters of the connected transformer in real time. The digital RTCC Relay shall have multiple selectable set point voltages and it shall be possible to select these set points from SCADA, with a facility to have the possibility of additional set points command from SCADA.

Communication between the Digital RTCC relays to execute the commands for parallel operation shall be implemented using required communication protocol. IEC- 61850 GOOSE messaging between Digital RTCC relays for OLTC parallel operation is not permitted. Suitable communication hardware shall be provided to communicate up to distance of 1km between digital RTCC relays. Scope shall also include communication cables between digital RTCC relays. Cables as required for parallel operation of OLTCs of all transformers (including existing transformers wherever required) from Digital RTCC relays shall be considered included in the scope of bidder.

15.4.10. The Digital RTCC relay shall have additional programmable Binary Inputs (minimum 7 Nos.) and Binary outputs (minimum 7 Nos.) for Employer's future use. It shall be possible to have additional module for Binary Input / output as well as Analogue input module depending upon requirement.

15.4.11. The relays shall ensure positive completion of lowering/raising of the OLTC tap, once the command is issued from the relay. "Step-by-Step" operation shall be ensured so that only one tap change from each tap changing pulse shall be effected. If the command remains in the "operate" position, lock-out of the mechanism is to be ensured.

15.4.12. Following minimum indications/alarms shall be provided in Digital RTCC relay either through relay display panel or through relay LEDs:

a. INCOMPLETE STEP alarm

b. OLTC motor overload protection alarm
c. Supply to DM Motor fail alarm
d. OLTC IN PROGRESS alarm
e. Local / Remote Selector switch positions in DM Box
f. OLTC upper/lower limits reached alarm
g. OLTC Tap position indications for transformer units
h. Independent-combined-remote selector switch positions of CMB (In case of single phase transformer)
i. 415V, AC Mail Supply Fail.
j. 415V, AC Standby Supply Fail

15.4.13. In case of parallel operation or 1-Phase Transformer unit banks, OLTC out of step alarm shall be generated in the digital RTCC relay for discrepancy in the tap positions.

16. SCADA Integration

All the online monitoring equipment i.e. Optical Temperature Sensors & Measuring Unit, Online Dissolved Gas (Multi-gas) and Moisture Analyser, On-line insulating oil drying system (Cartridge type) etc. provided for individual transformer unit including spare (if any), are IEC 61850 compliant (either directly or through a Gateway). These monitoring equipment are required to be integrated with SAS through managed Ethernet switch conforming to IEC 61850. This Ethernet switch shall be provided in IMB or CMB by the contractor. The switch shall be powered by redundant DC supply (110V or as per available Station DC supply). Ethernet switch shall be suitable for operation at ambient temperature of 50 Deg C. All required power & control cables including optical cable, patch chord (if any) upto IMB (for 3-Ph unit) or CMB (for 1-Ph unit) shall be in the scope of contractor. All cable from RTCC to DM shall also be in the scope of contractor. Further, any special cable between IMB (for 3-Ph unit) or CMB (for 1-Ph unit) to switchyard panel room/control room shall be in the scope of contractor.

However, fiber optic cable, power cable, control cables, as applicable, between IMB (for 3-Ph unit) or CMB (for 1-Ph unit) to switchyard panel room/control room and power supply (AC & DC) to MB and integration of above said IEC-61850 compliant equipment with Substation Automation System shall be under the scope of sub-station contractor.

17. Constructional features of Cooler Control Cabinet/ Individual Marshalling Box/ Common Marshalling Box/ Junction Box / Outdoor cubicle and Digital RTCC Panel

17.1. Each transformer unit shall be provided with local OLTC Drive Mechanism Box, cooler control cabinet /individual marshalling box, Digital RTCC panel (as applicable) and common marshalling (for a bank of three 1-phase units) shall be provided.

17.2. Common marshalling box (for single phase unit) shall be floor mounted and of size, not less than 1600mm (front) X 650mm (depth) X 1800mm (height). Individual Marshalling Box and Cooler control Box shall be tank mounted or ground mounted.

17.3. The cooler control cabinet / individual marshalling box, common marshalling box, Junction box and all other outdoor cubicles (**except OLTC Drive Mechanism box**) shall be made of stainless steel sheet of minimum thickness of 1.6 mm. Digital RTCC

panel shall be made of CRCA sheet of minimum thickness of 2.5mm and shall be painted suitably as per **Annexure –F** .

17.4. The degree of protection shall be IP: 55 for outdoor and IP: 43 for indoor in accordance with IS: 13947/IEC: 60947.

17.5. All doors, removable covers and plates shall be gasketed all around with suitably profiled. All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion to make a tight seal. For Control cubicle / Marshalling Boxes etc. which are outdoor type, all the sealing gaskets shall be of EPDM rubber or any better approved quality, whereas for all indoor control cabinets / Digital RTCC panel, the sealing gaskets shall be of neoprene rubber or any better approved quality. The gaskets shall be tested in accordance with approved quality plan, IS: 1149 and IS: 3400.

17.6. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh of brass. All the control cabinets shall be provided with suitable lifting arrangement. Thermostat controlled space heater and cubicle lighting with ON-OFF switch shall be provided in each panel.

17.7. The size of Common marshalling box shall not be less than 1600mm (front) X 650mm (depth) X 1800mm (height). All the separately mounted cabinets and panels shall be free standing floor mounted type and have domed or sloping roof for outdoor application.

18. Current Transformer

18.1. Current transformers shall comply with IEC-61869-1 and 61869-2.

18.2. It shall be possible to remove the turret mounted current transformers from the Transformer tank without removing the tank cover. Necessary precautions shall be taken to minimize eddy currents and local heat generated in the turret.

18.3. Current transformer secondary leads shall be brought out to a weatherproof terminal box near each bushing. These terminals shall be wired out to common marshalling box using separate cables for each core.

18.4. For 1-Phase Transformer, one number single phase current transformer (outdoor) for earth fault protection shall be provided for each bank of transformer and shall be located in the neutral conductor connecting common neutral point with earth.

18.5. Technical Parameters of Bushing CTs and Neutral CTs are enclosed at **Annexure – H.** The CT's used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection. Bushing Current transformer parameters indicated in this specification are tentative and liable to change within reasonable limits. The Contractor shall obtain Purchaser's approval before proceeding with the design of bushing current transformers.

18.6. Secondary resistance and magnetising current characteristics of PX class (protection) (as per IEC) CT of same rating shall be similar. This is applicable for Neutral CT (outdoor) also and shall be reviewed during detail engineering.

19. Hand Tools (if specified in BPS)

One set of hand tools of reputed make packed in a carry bag/box broadly comprising of double ended spanners (open jaws, cranked ring, tubular with Tommy bar each of sizes 9mm to 24mm, one set each), adjustable wrenches (8 &12 inch one set), gasket punches (of different sizes used - one set), pliers (flat nose, round nose & side cutting one of each type), hammer with handle (one), files with handle (two), knife with handle (one), adjustable hacksaw (one), and cold chisel (one), bushing handling and lifting tools with nylon rope/belt, chain block (2 Nos.) and D-Shackle shall be supplied.

20. Test Kit (if specified in BPS)

BDV Kit as per Annexure-K of specification
Portable DGA Kit as per Annexure-K of specification

21. Fittings & accessories

The following fittings & accessories shall be provided with each transformer covered in this specification. The fittings listed below are not exhaustive and other fittings which are required for satisfactory operation of the transformer are deemed to be included.

a. Conservator for main tank with aircell, oil filling hole and cap, isolating valves, drain valve, magnetic oil level gauge, prismatic oil level gauge and dehydrating silicagel filter breather with flexible connection pipes to be used during replacement of any silicagel breather

b. Conservator for OLTC with drain valve, oil surge Relay, filling hole with cap, prismatic oil level gauge and dehydrating breather

c. Pressure relief devices

d. Sudden pressure relief relay (for 400kV Transformer only)

e. Buchholz relay double float, reed type with isolating valves on both sides, bleeding pipe with pet cock at the end to collect gases and alarm / trip contacts.

f. Air release plug

g. Inspection openings and covers

h. Bushing of each type with metal parts and gaskets to suit the termination arrangement

i. Winding & Oil temperature indicators

j. Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs

k. Protected type mercury or alcohol in glass thermometer or magnetic or micro-switch type dial type temperature indicator as applicable

l. Rating and diagram plates (in Hindi & English) on transformers and auxiliary apparatus

m. Roller Assembly (as per clause 6.4)

n. On load tap changing gear, OLTC DM Box, Off Circuit Tap Changer (OCTC) individual marshalling box / Cooler control cabinet, Common Marshalling Box, Fibre optic sensor box and Digital RTCC Panel as applicable

o. Cooling equipment

p. Bushing current transformers, Neutral CT (if applicable)

q. Oil flow indicators (if applicable)

r. Terminal marking plates

s. Valves schedule plate

t. Bottom oil sampling valve, Drain valves, Filter valves at top and bottom with threaded male adaptors, Shut off valves on the pipe connection between radiator bank and Transformer tank, Shut off valves on both sides of Buchholz relay, Sampling gas collectors for Buchholz relay at accessible height, Valves for Radiators, Valve for vacuum application, Valve for on line DGA, valves for Drying out system, Flow sensitive conservator Isolation valve, Valve for UHF sensors, valves for NIFPS system (if applicable) etc.

u. Ladder to climb up to the Transformer tank cover with suitable locking arrangement to prevent climbing during charged condition

v. Suitable Platform for safe access of Flow sensitive non-return valve and buchholz relay shall be provided, in case these are not accessible from transformer top.

w. Haulage lugs

x. Neutral bus connection arrangement (3-Phase Transformer)

y. Brass/tinned copper grounding bar supported from the tank by using porcelain insulator and flexible conductor for earthing of neutral, HV & IV terminals as per clause 6.15.4

z. On line insulating oil drying system(if specified in BPS) as per Annexure-N

aa. Online Dissolved Gas (Multi-gas) and Moisture Measuring Equipment (if specified in BPS) as per Annexure-L

bb. On line dissolved Hydrogen and Moisture Measuring Equipment (if specified in BPS) as per Annexure-M

cc. Fibre optic sensor based temperature measuring system (for 400kV Transformer only)

dd. Nitrogen Injection Type Fire Prevention & Extinguishing System (if specified in BPS) as per **Annexure – K**

ee. Managed Ethernet switch, LIU patch cords etc. shall be provided in CMB/MB (as per clause 16). All IEC 61850 compliant signals from various monitoring equipment/accessories shall be wired upto the Ethernet switch.

22. Inspection and Testing

The Contractor shall carry out a comprehensive inspection and testing programme during manufacture of the equipment. The inspection envisaged by the Purchaser is given below. 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 Purchaser for necessary implementation. All accessories and components of transformer shall be purchased from approved soured of purchaser. All process tests, critical raw material tests and witness / inspection of these testing shall be carried out as per approved manufacturing quality plan (MQP) by purchaser.

22.1. Factory Tests

The manufacturer shall be fully equipped to perform all the required tests as specified. Bidder shall confirm the capabilities of the proposed manufacturing plant in this regard when submitting the bid. Any limitations shall be clearly stated in.

The contractor shall bear all additional costs related to tests which are not possible to carry out at his own works.

The contractor shall carry out type & routine tests as per " **Annexure-B & Annexure-C".** All tests shall be done in line with IEC: 60076 and the test procedures as mentioned in " **Annexure-C".** Complete test report shall be submitted to purchaser after proper scrutiny and signing on each page by the test engineer of the contractor.

22.2. Type Tests on fittings:

Following fittings shall conform to type tests and the type test reports shall be furnished by the contractor along with drawing of the equipment / fittings as per the Section – GTR. However, approval of drawings, GTP and type test reports for following fittings shall not be required, if the make and models are as per EMPLOYER's Compendium of Vendor (COV).

1) Bushing (Type Test as per IEC:60137 including Snap back & Seismic test for 400 kV and above voltage class bushing)
2) OLTC (Test as per IEC:60214 and IP-55 test on driving mechanism box)
3) Buchholz relay
4) OTI & WTI
5) Pressure Relief device Test (including IP 55 test in terminal box)
6) Sudden Pressure Relay Test (including IP 55 test in terminal box)
7) Magnetic Oil Level gauge & Terminal Box for IP-55 degree of protection.
8) 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
9) Marshalling & common marshalling box and other outdoor cubicle (IP-55 test)
10) RTCC (IP-43)

22.3. Pre-Shipment Checks at Manufacturer's Works

22.3.1. Check for inter-changeability of components of similar transformers for mounting dimensions.

22.3.2. Check for proper packing and preservation of accessories like radiators, bushings, dehydrating breather, rollers, buchholz relay, fans, control cubicle, connecting pipes, conservator etc.

22.3.3. Ensure following setting of impact recorder at the time of installation with Transformer unit before despatch from factory:

1g: Start recording
2g: Warning
3g: Alarm

Further, drop-out setting shall be 1g and threshold setting shall be in the range of 5g to 10g.

22.3.4. Check for proper provision for bracing to arrest the movement of core and winding assembly inside the tank.

22.3.5. Gas tightness test to confirm tightness and record of dew point of gas inside the tank.
Derivation of leakage rate and ensure the adequate reserve gas capacity.

22.4. **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 up to commissioning stage. An indicative programme of inspection as envisaged by the Purchaser is given below. However, it is contractor's responsibility to draw up and carry out such a programme duly approved by the Purchaser. Testing of oil sample at site shall be carried out as per specification.

22.5. **Receipt and Storage Checks**

22.5.1. Check and record condition of each package, visible parts of the transformer etc. for any damage.

22.5.2. Check and record the gas pressure in the transformer tank as well as in the gas cylinder.

22.5.3. Visual check for wedging of core and coils before filling up with oil and also check conditions of core and winding in general.

22.5.4. Check and record reading of impact recorder at receipt and verify the allowable limits as per manufacturer's recommendations.

22.6. **Installation Checks**

22.6.1. Inspection and performance testing of accessories like tap changers, cooling fans, oil pumps etc.

22.6.2. Check the direction of rotation of fans and pumps and Check the bearing lubrication.

22.6.3. Check whole assembly for tightness, general appearance etc.

22.6.4. Oil leakage test

22.6.5. Capacitance and tan delta measurement of bushing before fixing/connecting to the winding, contractor shall furnish these values for site reference.

22.6.6. Leakage check on bushing before erection.

22.6.7. Measure and record the dew point of gas in the main tank before assembly.

22.7. **Commissioning Checks**

22.7.1. Check the colour of silicagel in silicagel breather.

22.7.2. Check the oil level in the breather housing, conservator tanks, cooling system, condenser bushing etc.

22.7.3. Check the bushing for conformity of connection to the lines etc.,

22.7.4. Check for correct operation of all protection devices and alarms/trip :

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

22.7.5. Check for the adequate protection on the electric circuit supplying the accessories.

22.7.6. 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

22.7.7. Check for cleanliness of the transformer and the surroundings

22.7.8. 2 kV for 1 minute test between bushing CT terminal and earth.

22.7.9. Phase out and vector group test

22.7.10. Ratio test on all taps

22.7.11. Magnetising current test

22.7.12. Capacitance and Tan delta measurement of winding and bushing

22.7.13. Frequency response analysis (FRA). FRA equipment shall be arranged by purchaser.

22.7.14. DGA of oil just before commissioning and after 24 hours energisation at site.

22.7.15. 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.

22.7.16. Continuously observe the transformer operation at no load for at least 24hours.

22.7.17. Contractor shall prepare a comprehensive commissioning report including all commissioning test results as per Pre-Commissioning Procedures forward to Purchaser for future record.

1.0 Technical Particulars / Parameters of Transformers (400/220/33 kV, 3-Phase Auto Transformer)

Clause No.	Description	Unit	Technical Parameters	
1.1	Rated Capacity			
	HV	MVA	500	167
	IV	MVA	500	167
	LV (Tertiary) : Active + Reactive loading	MVA	1/3 RD of rated capacity of HV winding	
1.2	Voltage ratio (Line to Line)		400/220/33	
1.3	Single / Three Phase Design		3 (THREE)	1 (SINGLE)
1.4	Applicable Standard		IEC 60076	
1.5	Frequency	Hz	50	50
1.6	Cooling & Percentage Rating at different cooling		ONAN/ONAF/(OFAF or ODAF) : 60% / 80%/100% OR ONAN/ONAF1/ONAF2: 60% / 80%/100% OR OFAF (with 5 x 25% unit cooler if specified in Section Project)	
1.7	Type of Transformer		Constant Ohmic impedance type (Refer note 1)	
1.8	Impedance at 75 Deg C			
	HV - IV			
	Max. Voltage tap	%	10.3	
	Principal tap	%	12.5	
	Min. Voltage tap	%	15.4	
	HV - LV			
	Principal tap (minimum)	%	60.0	
	IV - LV			
	Principal tap (minimum)	%	45.0	
1.9	Tolerance on Impedance (HV-IV)	%	As per IEC	
1.10	Service		Outdoor	
1.11	Duty		Continuous	
1.12	Overload Capacity		IEC-60076-7	
1.13	Temperature rise over 50deg C ambient Temp			
i)	Top oil measured by thermometer	O_C	50	
ii)	Average winding measured by resistance method	^{0} C	55	
1.14	Windings			
i)	System Fault level			
	HV	kA	63	
	IV	kA	40	
	LV	kA	25	
ii)	Lightning Impulse withstand Voltage			
	HV	kV_p	1300	
	IV	kV_p	950	
	LV	kV_p	250	

	Neutral	kV_p	95
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
iv)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	570
	IV	kVrms	395
	LV	kVrms	95
	Neutral	kVrms	38
v)	Neutral Grounding		Solidly grounded
vi)	Insulation		
	HV		Graded
	IV		Graded
	LV		Uniform
vii)	Tertiary Connection		Ungrounded Delta
viii)	Tan delta of winding	%	< 0.5
1.15	Vector Group (3 –ph) (unless specified differently elsewhere)		YNaOd11
1.16	Tap Changer		OLTC
i)	Tap Range & No. of steps		? 10% of HV variation in the step of 1.25%, 16 steps
ii)	Location of Tap changer		On the 220 kV side of the series winding
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I
iv)	Tap control		Full capacity - on load tap changer suitable for group / independent, remote/local electrical and local manual operation and bi-directional power flow
1.17	Bushing		
i)	Rated voltage		
	HV	kV	420
	IV	kV	245
	LV	kV	52
	Neutral	kV	36
ii)	Rated current (Min.)		
	HV	A	1250
	IV	A	2000
	LV	A	3150
	Neutral	A	2000
iii)	Lightning Impulse withstand Voltage		
	HV	kV_p	1425
	IV	kV_p	1050
	LV	kV_p	250
	Neutral	kV_p	170
iv)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
	IV	kV_p	850
v)	One Minute Power Frequency withstand		

	Voltage			
	HV	kVrms	695	
	IV	kVrms	505	
	LV	kVrms	105	
	Neutral	kVrms	77	
vi)	Minimum total creepage distances			
	HV	mm	10500	
	IV	mm	6125	
	LV	mm	1300	
	Neutral	mm	900	
vii)	Tan delta of bushings			
	HV	%	< 0.4	
	IV	%	< 0.4	
	LV	%	< 0.4	
	Neutral			
viii)	Max Partial discharge level at U_m			
	HV	pC	10	
	IV	pC	10	
	LV	pC	10	
	Neutral		-	
1.18	Max Partial discharge level at 1.58 * U_r / $\sqrt{3}$	pC	100	
1.19	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	80	
1.20	**Maximum Permissible Losses of Transformers**		500 MVA	167MVA
i)	Max. No Load Loss at rated voltage and frequency	kW	90	Refer Note 4 below
ii)	Max. Load Loss at rated current and at 75° C	kW	500	
iii)	Max. Auxiliary Loss at rated voltage and frequency	kW	15	

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be " **Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

2.0 Technical Particulars / Parameters of Transformers (400/220/33 kV Auto Transformer)

Clause No.	Description	Unit	Technical Parameters	
2.1	Rated Capacity			
	HV	MVA	315	105
	IV	MVA	315	105
	LV (Tertiary) : Active + Reactive loading	MVA	1/3 RD of rated capacity of HV winding	
2.2	Voltage ratio (Line to Line)		400/220/33	
2.3	Single / Three Phase Design		3 (THREE)	1 (SINGLE)
2.4	Applicable Standard		IEC 60076	
2.5	Frequency	Hz	50	50
2.6	Cooling & Percentage Rating at different cooling		ONAN/ONAF/(OFAF or ODAF) : 60% / 80%/100% OR ONAN/ONAF1/ONAF2: 60% / 80%/100% OR OFAF (with 5 x 25% unit cooler if specified in Section Project)	
2.7	Type of Transformer		Constant Ohmic impedance type (Refer note 1)	
2.8	Impedance at 75 Deg C			
	HV - IV			
	Max. Voltage tap	%	10.3	
	Principal tap	%	12.5	
	Min. Voltage tap	%	15.4	
	HV - LV			
	Principal tap (minimum)	%	60.0	
	IV - LV			
	Principal tap (minimum)	%	45.0	
2.9	Tolerance on Impedance (HV-IV)	%	As per IEC	
2.10	Service		Outdoor	
2.11	Duty		Continuous	
2.12	Overload Capacity		IEC-60076-7	
2.13	Temperature rise over 50deg C ambient Temp			
i)	Top oil measured by thermometer	O_C	50	
ii)	Average winding measured by resistance method	^{0} C	55	
2.14	Windings			
i)	System Fault level			
	HV	kA	63	
	IV	kA	40	
	LV	kA	25	
ii)	Lightning Impulse withstand Voltage			
	HV	kV_p	1300	
	IV	kV_p	950	
	LV	kV_p	250	
	Neutral	kV_p	95	

iii)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
iv)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	570
	IV	kVrms	395
	LV	kVrms	95
	Neutral	kVrms	38
v)	Neutral Grounding		Solidly grounded
vi)	Insulation		
	HV		Graded
	IV		Graded
	LV		Uniform
vii)	Tertiary Connection		Ungrounded Delta
viii)	Tan delta of winding	%	< 0.5
2.15	Vector Group (3 –ph) (unless specified differently elsewhere)		YNaOd11
2.16	Tap Changer		OLTC
i)	Tap Range & No. of steps		± 10% of HV variation in the step of 1.25%, 16 steps
ii)	Location of Tap changer		On the 220 kV side of the series winding
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I
iv)	Tap control		Full capacity - on load tap changer suitable for group / independent, remote /local electrical and local manual operation and bi-directional power flow
2.17	Bushing		
i)	Rated voltage		
	HV	kV	420
	IV	kV	245
	LV	kV	52
	Neutral	kV	36
ii)	Rated current (Min.)		
	HV	A	1250
	IV	A	1250
	LV	A	3150
	Neutral	A	2000
iii)	Lightning Impulse withstand Voltage		
	HV	kV_p	1425
	IV	kV_p	1050
	LV	kV_p	250
	Neutral	kV_p	170
iv)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
	IV	kV_p	850
v)	One Minute Power Frequency withstand		

	Voltage			
	HV	kVrms	695	
	IV	kVrms	505	
	LV	kVrms	105	
	Neutral	kVrms	77	
vi)	Minimum total creepage distances			
	HV	mm	10500	
	IV	mm	6125	
	LV	mm	1300	
	Neutral	mm	900	
vii)	Tan delta of bushings			
	HV	%	< 0.4	
	IV	%	< 0.4	
	LV	%	< 0.4	
	Neutral			
viii)	Max Partial discharge level at U_m			
	HV	pC	10	
	IV	pC	10	
	LV	pC	10	
	Neutral		-	
2.18	Max Partial discharge level at 1.58 * U_r / $\sqrt{3}$	pC	100	
2.19	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	80	
2.20	**Maximum Permissible Losses of Transformers**		315MVA	105MVA
i)	Max. No Load Loss at rated voltage and frequency	kW	Refer Note 4 below	30
ii)	Max. Load Loss at rated current and at 75^0 C	kW		190
iii)	Max. Auxiliary Loss at rated voltage and frequency	kW		8

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be " **Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

3.0 Technical Particulars / Parameters of Transformers (400/132/33 kV 3-Phase Auto Transformer)

Clause No.	Description	Unit	Technical Parameters
3.1	Rated Capacity		
	HV	MVA	200
	IV	MVA	200
	LV (Tertiary) : Active + Reactive loading	MVA	1/3 RD of rated capacity of HV winding
3.2	Voltage ratio (Line to Line)		400/132/33
3.3	Single / Three Phase Design		3 (THREE)
3.4	Applicable Standard		IEC 60076
3.5	Frequency	Hz	50
3.6	Cooling & Percentage Rating at different cooling		ONAN/ONAF/(OFAF or ODAF) : 60% / 80%/100% OR ONAN/ONAF1/ONAF2: 60% / 80%/100% OR OFAF (with 5 x 25% unit cooler if specified in Section Project)
3.7	Type of Transformer		Constant Ohmic impedance type (Refer note 1)
3.8	Impedance at 75 Deg C		
i)	HV - IV		
	Max. Voltage tap	%	10.3
	Principal tap	%	12.5
	Min. Voltage tap	%	15.4
ii)	HV - LV		
	Principal tap (minimum)	%	45.0
iii)	IV - LV		
	Principal tap (minimum)	%	30.0
iv)	Tolerance on Impedance (HV-IV)	%	As per IEC
3.9	Service		Outdoor
3.10	Duty		Continuous
3.11	Overload Capacity		IEC-60076-7
3.12	Temperature rise over 50deg C ambient Temp		
i)	Top oil measured by thermometer	O_C	50
ii)	Average winding measured by resistance method	^{0} C	55
3.13	Windings		
i)	System Fault level		
	HV	kA	63
	IV	kA	31.5
	LV	kA	25
ii)	Lightning Impulse withstand Voltage		
	HV	kV_p	1300
	IV	kV_p	650
	LV	kV_p	250

	Neutral	kV_p	95
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
iv)	One Minute Power Frequency withstand Voltage		
	HV	^{kV}rms	570
	IV	kVrms	275
	LV	kVrms	95
	Neutral	kVrms	38
v)	Neutral Grounding		Solidly grounded
vi)	Insulation		
	HV		Graded
	IV		Graded
	LV		Uniform
vii)	Tertiary Connection		Ungrounded Delta
viii)	Tan delta of winding	%	< 0.5
ix)	Vector Group (3 –ph) (unless specified differently elsewhere)		YNaOd11
3.14	Tap Changer		OLTC
i)	Tap Range & No. of steps		± 10% of HV variation in the step of 1.25%, 16 steps
ii)	Location of Tap changer		On the 132 kV side of the series winding
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I
iv)	Tap control		Full capacity - on load tap changer suitable for group / independent, remote /local electrical and local manual operation and bi-directional power flow
3.15	Bushing		
i)	Rated voltage		
	HV	kV	420
	IV	kV	145
	LV	kV	52
	Neutral	kV	36
ii)	Rated current (Min.)		
	HV	A	1250
	IV	A	2000
	LV	A	3150
	Neutral	A	2000
iii)	Lightning Impulse withstand Voltage		
	HV	kV_p	1425
	IV	kV_p	650
	LV	kV_p	250
	Neutral	kV_p	170
iv)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
v)	One Minute Power Frequency withstand Voltage		

	HV	kVrms	695
	IV	kVrms	305
	LV	kVrms	105
	Neutral	kVrms	77
vi)	Minimum total creepage distances		
	HV	mm	10500
	IV	mm	3625
	LV	mm	1300
	Neutral	mm	900
vii)	Tan delta of bushings		
	HV	%	< 0.4
	IV	%	< 0.4
	LV	%	< 0.4
viii)	Max Partial discharge level at U_m		
	HV	pC	10
	IV	pC	10
	LV	pC	10
3.16	Max Partial discharge level at 1.58 * U_r / √3	pC	100
3.17	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	80

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be " **Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

4.0 Technical Particulars / Parameters of Transformers (220/132/33 kV 3-Phase Auto Transformer)

Cl. No.	Description	Unit	TECHNICAL PARAMETERS		
4.1	Rated Capacity				
	HV	MVA	160	100	50
	IV	MVA	160	100	50
	LV (Tertiary: Active Loading)	MVA	5	5	5
4.2	Voltage ratio	kV	220/132/33		
4.3	Single / Three Phase Design		Three		
4.4	Applicable Standard		IEC 60076		
4.5	Frequency	Hz	50		
4.6	Cooling & Percentage Rating at different cooling		ONAN/ONAF/(OFAF or ODAF) : 60% / 80%/100% OR ONAN/ONAF1/ONAF2: 60% / 80%/100%		
4.7	Type of Transformer		Constant Ohmic impedance type (Refer Note1)		
4.8	HV-IV Impedance at 75 Deg C				
i)	Max. Voltage tap	%	10.3		
ii)	Principal tap	%	12.5		
iii)	Min. Voltage tap	%	15.4		
iv)	Tolerance on Impedance	%	As per IEC		
4.9	Service		OUTDOOR		
4.10	Duty		CONTINUOUS		
4.11	Overload Capacity		IEC 60076-7		
4.12	Temperature rise over 50 deg C Ambient Temp				
i)	Top oil measured by thermometer	^{0} C	50		
ii)	Average winding measured by resistance method	^{0} C	55		
4.13	Windings				
i)	System Fault level				
	HV	kA	40		
	IV	kA	31.5		
	LV	kA	25		
ii)	Lightning Impulse withstand Voltage				
	HV	kVp	950		
	IV	kVp	650		
	LV	kVp	250		
	Neutral	kVp	95		
iii)	Switching Impulse withstand Voltage				
	HV	kVp	750		
iv)	One Minute Power Frequency withstand Voltage				
	HV	kVrms	395		

	IV	kVrms	275
	LV	kVrms	95
	Neutral	kVrms	38
v)	Neutral Grounding		Solidly grounded
vi)	Insulation		
	HV		GRADED
	IV		GRADED
	LV		UNIFORM
vii)	Tertiary Connection		DELTA
viii)	Tan delta of winding	%	<0.5%
4.14	Vector Group (3 –ph) (unless specified differently elsewhere)		YNa0d11
4.15	Tap Changer		OLTC
i)	Tap Range & No. of steps		– 5% to +10% of HV variation in the step of 1.25%, 12 Steps
ii)	Location of Tap changer		On the 132 kV side of the series winding
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I
iv)	Tap control		Full capacity - on load tap changer suitable for group / independent, remote /local electrical and local manual operation and bi-directional power flow
4.16	Bushings		
i)	Rated voltage		
	HV	kV	245
	IV	kV	145
	LV	kV	52
	Neutral	kV	36
ii)	Rated current (Min.)		
	HV	A	800
	IV	A	1250
	LV	A	800
	Neutral	A	1000
iii)	Lightning Impulse withstand Voltage		
	HV	kVp	1050
	IV	kVp	650
	LV	kVp	250
	Neutral	kVp	170
iv)	Switching Impulse withstand Voltage		
	HV	kVp	850
v)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	505

	IV	kVrms	305
	LV	kVrms	105
	Neutral	kVrms	77
vi)	Minimum total creepage distances		
	HV	mm	6125
	IV	mm	3625
	LV	mm	1300
	Neutral	mm	900
vii)	Tan delta of bushing		
	HV	%	<0.4%
	IV	%	<0.4%
	LV	%	<0.4%
	Neutral	%	-
viii)	Max Partial discharge level at U_m		
	HV	pC	10
	IV	pC	10
	LV	pC	10
4.17	Max Partial discharge level at $1.5Um/\sqrt{3}$	pC	100
4.18	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	75

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be " **Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

5.0 Technical Particulars / Parameters of Transformers (220/132/33 kV 1-Phase Auto Transformer)

Cl. No.	Description	Unit	TECHNICAL PARAMETERS	
5.1	Rated Capacity			
	HV	MVA	10	33.33
	IV	MVA	10	33.33
	LV (Tertiary: Active Loading)	MVA	1	2
5.2	Voltage ratio (HV/IV/LV) (Line to line)	kV	(220/√3) / (132/√3) / 33	
5.3	Single / Three Phase Design		SINGLE	
5.4	Applicable Standard		IEC 60076	
5.5	Frequency	Hz	50	
5.6	Cooling		ONAN/ONAF	
5.7	Rating at different cooling	%	60 / 100	
5.8	Type of Transformer		Constant Ohmic impedance type (Refer Note1)	
5.9	HV – IV Impedance at 75 Deg C			
i)	Max. Voltage tap	%	8.30	10.3
ii)	Principal tap	%	10.00	12.5
iii)	Min. Voltage tap	%	12.30	15.4
iv)	Tolerance on Impedance	%	As per IEC	As per IEC
5.10	Service		OUTDOOR	
5.11	Duty		CONTINUOUS	
5.12	Overload Capacity		IEC 60076-7	
5.13	Temperature rise over 50deg C Ambient Temp			
i)	Top oil measured by thermometer	O_C	50	
ii)	Average winding measured by resistance method	O_C	55	
5.14	Windings			
i)	System Fault level			
	HV	kA	40	
	IV	kA	31.5	
	LV	kA	25	
	Neutral	kA	-	
ii)	Lightning Impulse withstand Voltage			
	HV	kV_p	950	
	IV	kV_p	650	
	LV	kV_p	250	
	Neutral	kV_p	95	
iii)	Switching Impulse withstand Voltage			
	HV	kV_p	750	
iv)	One Minute Power Frequency withstand Voltage			
	HV	kVrms	395	
	IV	kVrms	275	
	LV	kVrms	95	
	Neutral	kVrms	38	

v)	Neutral Grounding		Solidly grounded	
vi)	Insulation			
	HV		GRADED	
	IV		GRADED	
	LV		UNIFORM	
vii)	Tertiary Connection (3Ph Bank)		Ungrounded Delta	
viii)	Tan delta of winding	%	<0.5%	
5.15	Vector Group (3 –ph) (unless specified differently elsewhere)		YNa0Od11	
5.16	Tap Changer		OLTC	
i)	Tap Range & No. of steps		–5% to +15% of HV variation in the step of 1.25%, 16 steps	
ii)	Location of Tap changer		On the 132 kV side of the series winding	
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I	
iv)	Tap control		Full capacity - on load tap changer suitable for group / independent, remote /local electrical and local manual operation and bi-directional power flow	
5.17	Bushings			
i)	Rated voltage			
	HV	kV	245	
	IV	kV	145	
	LV	kV	52	
	Neutral	kV	36	
ii)	Rated current (Min.)			
	HV	A	800	800
	IV	A	800	800
	LV	A	800	800
	Neutral	A	1000	1000
iii)	Lightning Impulse withstand Voltage			
	HV	kVp	1050	
	IV	kVp	650	
	LV	kVp	250	
	Neutral	kVp	170	
iv)	Switching Impulse withstand Voltage			
	HV	kVp	850	
v)	One Minute Power Frequency withstand Voltage			
	HV	kVrms	505	
	IV	kVrms	305	

	LV	kVrms	105
	Neutral	kVrms	77
vi)	Minimum total creepage distances		
	HV	mm	6125
	IV	mm	3625
	LV	mm	1300
	Neutral	mm	900
vii)	Tan delta of bushing		
	HV	%	<0.4
	IV	%	<0.4
	LV	%	<0.4
	Neutral	%	-
viii)	Max Partial discharge level at U_m		
	HV	pC	10
	IV	pC	10
	LV	pC	10
5.18	Max Partial discharge level at $1.5Um/\sqrt{3}$	pC	100
5.19	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	75

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be " **Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

6.0 Technical Particulars / Parameters of Transformers (132/66 kV 3-Phase Auto Transformer)

Cl. No.	Description	Unit	TECHNICAL PARAMETERS	
6.1	Rated Capacity			
	HV	MVA	50	25
	LV	MVA	50	25
6.2	Rated Voltage ratio (HV/LV) (Line to Line)	kV	132/66	
6.3	Single / Three Phase Design		Three	
6.4	Applicable Standard		IEC 60076	
6.5	Frequency	Hz	50	
6.6	Cooling		ONAN/ONAF	
6.7	Rating at different cooling	%	60 / 100	
6.8	Type of Transformer		Constant Ohmic impedance type (Refer Note1)	
6.9	HV-LV Impedance at 75 Deg C			
i)	Max. Voltage tap	%	8.26	
ii)	Principal tap	%	10	
iii)	Min. Voltage tap	%	12.34	
iv)	Tolerance on Impedance	%	As per IEC	
6.10	Service		OUTDOOR	
6.11	Duty		CONTINUOUS	
6.12	Overload Capacity		IEC 60076-7	
6.13	Temperature rise over 50 deg C Ambient Temp			
i)	Top oil measured by thermometer	^{0}C	50	
ii)	Average winding measured by resistance method	^{0}C	55	
6.14	Windings			
i)	System Fault level			
	HV	kA	31.5	
	LV	kA	31.5	
	Neutral	kA		
ii)	Lightning Impulse withstand Voltage			
	HV	kV_p	650	
	LV	kV_p	325	
	Neutral	kV_p	95	

iii)	Switching Impulse withstand Voltage		
	HV	kV_p	540
iv)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	275
	LV	kVrms	140
	Neutral	kVrms	38
v)	Neutral Grounding		Solidly grounded
	Insulation		
	HV		GRADED
	LV		GRADED
vi)	Tan delta of winding	%	<0.5
6.15	Vector Group (3 –ph) (unless specified differently elsewhere)		YNa0
6.16	Tap Changer		OLTC
i)	Tap Range & No. of steps		–10% to +10% of HV variation in the step of 1.25%, 16 steps
ii)	Location of Tap changer		On the 66 kV side of the series winding
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I
iv)	Tap control		Full capacity on load tap changer suitable for group/independent, remote /local electrical and local manual operation and bi-directional power flow.
6.17	Bushings		
i)	Rated voltage		
	HV	kV	145
	LV	kV	72.5
	Neutral	kV	36
ii)	Rated current (Min.)		
	HV	A	800
	LV	A	800
	Neutral	A	800
iii)	Lightning Impulse withstand Voltage		
	HV	kVp	650
	LV	kVp	325
	Neutral	kVp	170
iv)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	305
	LV	kVrms	155

	Neutral	kVrms	77
v)	Minimum total creepage distances		
	HV	mm	3625
	LV	mm	1813
	Neutral	mm	900
vii)	Tan delta of bushing		
	HV	%	<0.4
	LV	%	<0.4
viii)	Max Partial discharge level at U_m		
	HV	pC	10
	LV	pC	10
	Neutral	pC	-
6.18	Max Partial discharge level at $1.5Um/\sqrt{3}$	pC	100
6.19	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	75

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be " **Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

7.0 Technical Particulars / Parameters of Transformers (132/33 kV, 3-Phase Power Transformer)

Cl. No.	Description	Unit	TECHNICAL PARAMETERS			
7.1	Rated Capacity					
	HV	MVA	50	40	31.5	25
	LV	MVA	50	40	31.5	25
7.2	Voltage ratio (HV/LV) Line to line	kV	132/33			
7.3	Single / Three Phase Design		3 (THREE)			
7.4	Applicable Standard		IEC 60076			
7.5	Frequency	Hz	50			
7.6	Cooling		ONAN/ONAF			
7.7	Rating at different cooling	%	60 / 100			
7.8	Type of Transformer		Constant Ohmic impedance type (Refer note 1)			
7.9	HV-LV Impedance at 75 Deg C					
i)	Max. Voltage tap	%	10.3			
ii)	Principal tap	%	12.5			
iii)	Min. Voltage tap	%	15.4			
iv)	Tolerance on Impedance	%	As per IEC			
7.10	Service		OUTDOOR			
7.11	Duty		CONTINUOUS			
7.12	Overload Capacity		IEC 60076-7			
7.13	Temperature rise over 50deg C Ambient Temp					
i)	Top oil measured by thermometer	^{0}C	50			
ii)	Average winding measured by resistance method	^{0}C	55			
7.14	Windings					

i)	System Fault level		
	HV	kA	31.5
	LV	kA	25
	Neutral	kA	-
ii)	Lightning Impulse withstand Voltage		
	HV	kV_p	650
	LV	kV_p	170
	Neutral	kV_p	95
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	540
iv)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	275
	LV	kVrms	70
	Neutral	kVrms	38
v)	Neutral Grounding		Solidly grounded
vi)	Insulation		
	HV		GRADED
	LV		UNIFORM
vii)	Tan delta of winding	%	<0.5%
7.15	Vector Group (3 –ph) (unless specified differently elsewhere)		YNynO
7.16	Tap Changer		OLTC
i)	Tap Range & No. of steps		–15% to +5% of HV variation in the step of 1.25%, 16 stpes
ii)	Location of Tap changer		On Neutral side of 132 kV winding
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I
	Tap control		Full capacity on load tap changer

iv)			suitable for group/independent, remote /local electrical and local manual operation and bi-directional power flow.
7.17	Bushings		
i)	Rated voltage		
	HV	kV	145
	LV	kV	36
	Neutral	kV	36
ii)	Rated current (Min.)		
	HV	A	800
	LV	A	1250
	Neutral	A	1250
iii)	Lightning Impulse withstand Voltage		
	HV	kVp	650
	LV	kVp	170
	Neutral	kVp	170
iv)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	305
	LV	kVrms	77
	Neutral	kVrms	77
v)	Minimum total creepage distances		
	HV	mm	3625
	LV	mm	900
	Neutral	mm	900
vi)	Tan delta of bushing		
	HV	%	<0.4
vii)	Max Partial discharge level at U_m		

	HV	pC	10
7.18	Max Partial discharge level at 1.5Um/√3	pC	100
7.19	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	75

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be " **Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

8.0 Technical Particulars / Parameters of Transformers (110/22 kV, 3-Phase Power Transformer)

Cl. No.	Description	Unit	TECHNICAL PARAMETERS	
8.1	Rated Capacity			
	HV	MVA	25	16
	LV	MVA	25	16
8.2	Voltage ratio (HV/LV) Line to line	kV	110/22	
8.3	Single / Three Phase Design		3 (THREE)	
8.4	Applicable Standard		IEC 60076	
8.5	Frequency	Hz	50	
8.6	Cooling		ONAN/ONAF	
8.7	Rating at different cooling	%	60 / 100	
8.8	Type of Transformer		Two winding transformer (Refer note 1)	
8.9	HV-LV Impedance at 75 Deg C			
i)	Max. Voltage tap	%	10.30	
ii)	Principal tap	%	10.25	
iii)	Min. Voltage tap	%	9.60	
iv)	Tolerance on Impedance	%	As per IEC	
8.10	Service		OUTDOOR	
8.11	Duty		CONTINUOUS	
8.12	Overload Capacity		IEC 60076-7	
8.13	Temperature rise over 50deg C Ambient Temp			
i)	Top oil measured by thermometer	^{0}C	50	
ii)	Average winding measured by resistance method	^{0}C	55	
8.14	Windings			

i)	System Fault level		
	HV	kA	31.5
	LV	kA	25
	Neutral	kA	-
ii)	Lightning Impulse withstand Voltage		
	HV	kV_p	650
	LV	kV_p	125
	Neutral	kV_p	95
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	540
iv)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	275
	LV	kVrms	50
	Neutral	kVrms	38
v)	Neutral Grounding		Solidly grounded
vi)	Insulation		
	HV		UNIFORM
	LV		UNIFORM
vii)	Tan delta of winding	%	<0.5%
8.15	Vector Group (3 –ph) (unless specified differently elsewhere)		Dyn11
8.16	Tap Changer		OLTC
i)	Tap Range & No. of steps		–15% to +5% of HV variation in the step of 1.25%, 16 steps
ii)	Location of Tap changer		On Neutral side of 132 kV winding
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I
	Tap control		Full capacity on load tap changer

iv)			suitable for group/independent, remote /local electrical and local manual operation and bi-directional power flow.
8.17	Bushings		
i)	Rated voltage		
	HV	kV	145
	LV	kV	36
	Neutral	kV	36
ii)	Rated current (Min.)		
	HV	A	800
	LV	A	1000
	Neutral	A	1000
iii)	Lightning Impulse withstand Voltage		
	HV	kVp	650
	LV	kVp	170
	Neutral	kVp	170
v)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	305
	LV	kVrms	77
	Neutral	kVrms	77
vi)	Minimum total creepage distances		
	HV	mm	3625
	LV	mm	900
	Neutral	mm	900
vii)	Tan delta of bushing		
	HV	%	<0.4

viii)	Max Partial discharge level at U_m		
	HV	pC	10
8.18	Max Partial discharge level at 1.5Um/√3	pC	100
8.19	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	75

Notes:

5. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.

6. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.

7. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

8. The criteria for Transformer losses shall be " **Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

9.0 Technical Particulars / Parameters of Transformers (132/33 kV, 3-Phase Transformer)

Cl. No.	Description	Unit	TECHNICAL PARAMETERS		
9.1	**Rated Capacity**				
	HV	MVA	20	12.5	10
	LV	MVA	20	12.5	10
9.2	Rated Voltage ratio (HV/LV) (Line to line)	kV	132/33	132/33	132/33
9.3	Single / Three Phase Design		Three	Three	Three
9.4	Applicable Standard		IEC 60076	IEC 60076	IEC 60076
9.5	Frequency	Hz	50	50	50
9.6	Cooling		ONAN/ ONAF	ONAN	ONAN
9.7	Rating at different cooling	%	60/100	100	100
9.8	Type of Transformer		Constant Ohmic impedance type (Refer Note1)	Constant Ohmic impedance type (Refer Note1)	Constant Ohmic impedance type (Refer Note1)
9.9	**HV-LV Impedance at 75 Deg C at**				
i)	Max. Voltage tap	%	8.26	8.26	8.26
ii)	Principal tap	%	10.0	10.0	10.0
iii)	Min. Voltage tap	%	12.34	12.34	12.34
9.10	Service		OUTDOOR	OUTDOOR	OUTDOOR
9.11	Duty		Continuous	Continuous	Continuous
9.12	Overload Capacity		IEC 60076-7	IEC 60076-7	IEC 60076-7
9.13	**Temperature rise over 50 deg C Ambient Temp**				
i)	Top oil measured by thermometer	Deg C	50	50	50
ii)	Average winding measured by resistance method	Deg C	55	55	55
9.14	**Windings**				
i)	System Fault level				
	HV	kA	31.5	31.5	31.5
	LV	kA	25	25	25
ii)	Lightning Impulse				

	withstand Voltage				
	HV	kVp	650	650	650
	LV	kVp	170	170	170
	HV Neutral	kVp	95	95	95
	LV Neutral	kVp	170	170	170
iii)	Switching Impulse withstand Voltage				
	HV	kVp	540	540	540
iv)	One Minute Power Frequency withstand Voltage				
	HV	kVrms	275	275	275
	LV	kVrms	70	70	70
	HV Neutral	kVrms	38	38	38
	LV Neutral	kVrms	70	70	70
v)	Neutral (HV & LV)		Solidly grounded	Solidly grounded	Solidly grounded
vi)	Insulation				
	HV		GRADED	GRADED	GRADED
	LV		UNIFORM	UNIFORM	UNIFORM
vii)	Tan delta of winding at ambient Temperature	%	<0.5%	<0.5%	<0.5%
9.15	Vector Group (unless specified differently elsewhere)		YNyn0	YNyn0	YNyn0
9.16	**Tap Changer**		OLTC	OLTC	OLTC
i)	Tap range & No. of steps		–15% to +5% in the step of 1.25% for HV variation, 16 steps		
ii)	Location of Tap Winding		Neutral end of HV winding		
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I		
iv)	Tap control		Full capacity on load tap changer suitable for group/independent, remote /local electrical and local manual operation and bi-directional power flow.		
9.17	**Bushings**				
i)	Rated voltage				
	HV	kV	145	145	145
	LV	kV	36	36	36
	Neutral (HV & LV)	kV	36	36	36

ii)	Rated current (Min.)				
	HV	A	800	800	800
	LV	A	1000	1000	1000
	Neutral (HV & LV)	A	1000	1000	1000
iii)	Lightning Impulse withstand Voltage				
	HV	kVp	650	650	650
	LV	kVp	170	170	170
	Neutral (HV & LV)	kVp	170	170	170
iv)	One Minute Power Frequency withstand Voltage				
	HV	kVrms	305	305	305
	LV	kVrms	77	77	77
	Neutral (HV & LV)	kVrms	77	77	77
v)	Minimum total creepage distances				
	HV	mm	3625	3625	3625
	LV	mm	900	900	900
	Neutral (HV & LV)	mm	900	900	900
vi)	Tan delta of bushing at ambient Temperature				
	HV	%	<0.4%	<0.4%	<0.4%
vii)	Max Partial discharge level at U_m				
	HV	pC	10	10	10
9.18	Max Partial discharge level at 1.5Um/√3	pC	100	100	100
9.19	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	70	70	70

Notes:

1. For parallel operation with existing transformer, percentage impedance, OLTC connection & range, vector group and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be " **Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

10.0 Technical Particulars / Parameters of Transformers (132/33 kV, 1-Phase Transformer)

Cl. No.	Description	Unit	TECHNICAL PARAMETERS		
10.1	**Rated Capacity**				
	HV	MVA	10	8.33	5
	LV	MVA	10	8.33	5
10.2	Rated Voltage ratio (HV/LV) (Line to line)	kV	132/33	132/33	132/33
10.3	Single / Three Phase Design		Single	Single	Single
10.4	Applicable Standard		IEC 60076	IEC 60076	IEC 60076
10.5	Frequency	Hz	50	50	50
10.6	Cooling		ONAN	ONAN	ONAN
10.7	Rating at different cooling	%	100	100	100
10.8	Type of Transformer		Constant Ohmic impedance type (Refer Note1)	Constant Ohmic impedance type (Refer Note1)	Constant Ohmic impedance type (Refer Note1)
10.9	**HV-LV Impedance at 75 Deg C at**				
i)	Max. Voltage tap	%	8.26	8.26	7.60
ii)	Principal tap	%	10.0	10.0	8.00
iii)	Min. Voltage tap	%	12.34	12.34	9.40
10.10	Service		OUTDOOR	OUTDOOR	OUTDOOR
10.11	Duty		Continuous	Continuous	Continuous
10.12	Overload Capacity		IEC 60076-7	IEC 60076-7	IEC 60076-7
10.13	**Temperature rise over 50 deg C Ambient Temp**				
i)	Top oil measured by thermometer	Deg C	50	50	50
ii)	Average winding measured by resistance method	Deg C	55	55	55
10.14	**Windings**				
i)	System Fault level				
	HV	kA	31.5	31.5	31.5

	LV	kA	25	25	25
ii)	Lightning Impulse withstand Voltage				
	HV	kVp	650	650	650
	LV	kVp	170	170	170
	HV Neutral	kVp	95	95	95
	LV Neutral	kVp	170	170	170
iii)	Switching Impulse withstand Voltage				
	HV	kVp	540	540	540
iv)	One Minute Power Frequency withstand Voltage				
	HV	kVrms	275	275	275
	LV	kVrms	70	70	70
	Neutral	kVrms	38	38	38
	LV Neutral	kVrms	70	70	70
v)	Neutral		Solidly grounded	Solidly grounded	Solidly grounded
vi)	Insulation				
	HV		GRADED	GRADED	GRADED
	LV		UNIFORM	UNIFORM	UNIFORM
vii)	Tan delta of winding at ambient Temperature	%	<0.5%	<0.5%	<0.5%
10.15	Vector Group (unless specified differently elsewhere)		YNd11	YNd11	YNd11
10.16	**Tap Changer**		OLTC	OLTC	OCTC
i)	Tap range & No. of steps		–15% to +5% in the step of 1.25% for HV variation, 16 steps		–7.5% to +2.5% of HV variation in the step of 2.5%, 4 steps
ii)	Location of Tap Winding		Neutral end of HV winding		
iii)	Design		Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I		
iv)	Tap control		Full capacity on load tap changer suitable for group/independent, remote /local electrical and local manual operation and bi-directional power flow.		-
10.17	**Bushings**				

i)	Rated voltage				
	HV	kV	145	145	145
	LV	kV	36	36	36
	Neutral	kV	36	36	36
ii)	Rated current (Min.)				
	HV	A	400	400	400
	LV	A	630	630	630
	Neutral	A	630	630	630
iii)	Lightning Impulse withstand Voltage				
	HV	kVp	650	650	650
	LV	kVp	170	170	170
	Neutral (HV & LV)	kVp	170	170	170
iv)	One Minute Power Frequency withstand Voltage				
	HV	kVrms	305	305	305
	LV	kVrms	77	77	77
	Neutral (HV & LV)	kVrms	77	77	77
v)	Minimum total creepage distances				
	HV	mm	3625	3625	3625
	LV	mm	900	900	900
	Neutral (HV & LV)	mm	900	900	900
vi)	Tan delta of bushing at ambient Temperature				
	HV	%	<0.4%	<0.4%	<0.4%
vii)	Max Partial discharge level at U_m				
	HV	pC	10	10	10
10.18	Max Partial discharge level at 1.5Um/√3	pC	100	100	100
10.19	Max Noise level at rated voltage and at principal tap at no load and all cooling active	dB	70	70	70

Notes:

1. For parallel operation with existing transformer, percentage impedance, OLTC connection & range, vector group and the winding configuration (if necessary) is to be matched.

2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.

3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.

4. The criteria for Transformer losses shall be " **Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".**

Annexure -B

Test Plan

No.	Test	U_m ≤ 170kV	U_m > 170kV
1.	Measurement of winding resistance	Routine	Routine
2.	Voltage ratio measurement	Routine	Routine
3.	Polarity test	Routine	Routine
4.	No-load loss and current measurement	Routine	Routine
5.	Magnetic balance test (for three phase Transformer only)	Routine	Routine
6.	Impedance and load loss measurement	Routine	Routine
7.	Measurement of insulation resistance & Polarization Index	Routine	Routine
8.	Measurement of insulation power factor and capacitance between winding and earth and Bushings	Routine	Routine
9.	Full wave lightning impulse test for the line terminals (LI)	Routine	-
10.	Induced voltage withstand test (IVW)	Routine	-
11.	Applied voltage test (AV)	Routine	Routine
12.	Induced voltage test with PD measurement (IVPD)	Routine	Routine
13.	On-load tap changer test(Ten complete cycle before LV test)	Routine	Routine
14.	Gas-in-oil analysis	Routine	Routine
15.	Core assembly dielectric and earthing continuity test	Routine	Routine
16.	Oil leakage test on transformer tank	Routine	Routine
17.	Appearance, construction and dimension check	Routine	Routine
18.	Short duration heat run test (Not Applicable for unit on which temperature rise test is performed)	Routine	Routine
19.	Measurement of no load current & Short circuit Impedance with 415 V, 50 Hz AC.	Routine	Routine
20	Frequency Response analysis (Soft copy of test report to be submitted to site along with test reports)	Routine	Routine
21.	High voltage with stand test on auxiliary equipment and wiring after assembly	Routine	Routine
22.	Tank vacuum test	Routine	Routine
23.	Tank pressure test	Routine	Routine
24.	Chopped wave lightning impulse test for the line terminals (LIC)	Type	Routine
25.	Switching impulse test for the line terminal (SI)	Type	Routine
26	Line terminal AC withstand voltage test (LTAC)	Routine	Type
27.	Measurement of transferred surge on LV or Tertiary as applicable due to HV lightning impulse and IV lighting impulse (as applicable)	Type	Type
28.	Lightning impulse test for the neutral terminals (LIN)	Type	Type
29.	Temperature rise test	Type	Type
30.	Measurement of Zero seq. reactance (for three phase Transformer only)	Type	Type
31.	Measurement of harmonic level in no load current	Type	Type

32.	Measurement of acoustic noise level	Type	Type
33.	Measurement of power taken by fans and oil pumps (Not applicable for ONAN)	Type	Type
34.	Dynamic Short circuit withstand test (If specified in BPS)	Type	Type

Test Procedures

General

Tests shall be carried out as per following procedure. However, IEC 60076 shall be followed in general for other tests. Manufacturer shall offer the transformer unit for type testing with all major fittings including radiator bank, Marshalling Box, Common Marshalling Box RTCC (as applicable) assembled.

1. Core assembly dielectric and earthing continuity test

After assembly each core shall be tested for 1 minute at 2000 Volts between all yoke clamps, side plates and structural steel work (core to frame, frame to tank & core to tank).

The insulation of core to tank, core to yoke clamp (frame) and yoke clamp (frame) to tank shall be able to withstand a voltage of 2 kV (DC) for 1 minute. Insulation resistance shall be minimum 1 GΩ for all cases mentioned above.

2. Measurement of winding resistance

After the transformer has been under liquid without excitation for at least 3 h, the average liquid temperature shall be determined and the temperature of the winding shall be deemed to be the same as the average liquid temperature. The average liquid temperature is taken as the mean of the top and bottom liquid temperatures. Measurement of all the windings including compensating (in case terminal is available at outside) at normal and extreme taps.

In measuring the cold resistance for the purpose of temperature-rise determination, special efforts shall be made to determine the average winding temperature accurately. Thus, the difference in temperature between the top and bottom liquid shall not exceed 5 K. To obtain this result more rapidly, the liquid may be circulated by a pump.

3. No-load loss and current measurement As per IEC 60076-1:2011 clause 11.5

4. Measurement of short-circuit impedance and load loss

The short-circuit impedance and load loss for a pair of windings shall be measured at rated current & frequency with voltage applied to the terminals of one winding, with the terminals of the other winding short-circuited, and with possible other windings open-circuited. The difference in temperature between the top and bottom liquid shall not exceed 5 K. To obtain this result more rapidly, the liquid may be circulated by a pump. Loss measurement for all combinations (HV-IV, HV-LV, IV-LV and at Normal and extreme taps).

5. Short term heat run test (Not Applicable for unit on which temperature rise test is performed)

In addition to the type test for temperature rise conducted on one unit, each cooling combination shall routinely be subjected to a short term heat run test to confirm the

performance of the cooling system and the absence of manufacturing defect such as major oil flow leaks that may bypass the windings or core.

DGA samples shall be taken at intervals to confirm the gas evolution.

For ODAF or OFAF cooling, the short term heat run test shall be done with the minimum number of pumps for full load operation in order to shorten the temperature build up. Each short term heat run test is nevertheless expected to take about 3 hours.

For ODAF or OFAF cooled transformers an appropriate cross check shall be performed to prove the effective oil flow through the windings. For this purpose the effect on the temperature decay by switching the pumps off/ on at the end of the heat run should demonstrate the effectiveness of the additional oil flow. Refer to SC 12, 1984 cigre 1984 SC12-13 paper by Dam, Felber, Preiniger et al.

Short term heat run test may be carried out with the following sequence:

- Heat run test with pumps running but oil not through coolers.
- Raise temperature to 5 deg less than the value measured during temperature rise test.
- Stop power input and pumps for 6 minutes and observe cooling down trend
- Restart pumps and observe increased cooling trend due to forced oil flow

This test is applicable for the Transformer without Pump also (ONAN or ONAF rating). For such type of transformer test may be carried out with the following sequence:

Arrangement shall be required with pump of suitable capacity (considering the oil velocity) without cooler bank. Raise the oil temperature 20-25 deg C above ambient. Stop power input and pumps for 6 minutes and observe cooling down trend. Restart pumps and observe increased cooling trend due to forced oil flow.

6. Temp. Rise Test as per IEC: 60076

Gas chromatographic analysis on oil shall also be conducted before, during and after this test and the values shall be recorded in the test report. The sampling shall be in accordance with IEC 60567.

The temperature rise test shall be conducted at a tap for the worst combination of loading (3-Winding Loss) for the Top oil of the transformer.

3-Winding Loss = HV (Max MVA) + IV(Max MVA) + LV (Max MVA).

The Contractor before carrying out such test shall submit detailed calculations showing losses 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 Temperature rise type test results shall serve as a “finger print” for the units to be tested only with short term heat run test.

Gas chromatographic analysis on oil shall also be conducted before, during and after this test and the values shall be recorded in the test report. The sampling shall be in accordance with IEC 60567.

Oil sample shall be drawn before and after heat run test and shall be tested for dissolved gas analysis. Oil sampling to be done 2 hours prior to commencement of temperature rise test. Keep the pumps running for 2 hours before and after the heat run test. Take oil samples during this period. For ONAN/ONAF cooled transformers, sample shall not be taken earlier than 2 hours after shut down. The acceptance norms with reference to various gas generation rates shall be as per IEC 61181.

The DGA results shall generally conform to IEC/IEEE/CIGRE guidelines.

i. Test conditions for temperature rise test:

- This test shall be generally carried out in accordance with IEC 60076-2
- For each cooling combination with cooler bank, tests shall be done on the maximum current tap for a minimum of 12 hours for ONAN/ONAF and 24 hours for ODAF or OFAF or ONAF2 with saturated temperature for at least 4 hours while the appropriate power and current for core and load losses are supplied.
- The total testing time, including ONAN heating up period, steady period and winding resistance measurements is expected to be about 48 hours.
- DGA tests shall be performed before and after heat run test and DGA results shall generally conform to IEC/IEEE/CIGRE guidelines.

ii. Test records:

Full details of the test arrangements, procedures and conditions shall be furnished with the test certificates and shall include at least the following.

iii. General:

- Purchaser's order number and transformer site designation.
- Manufacturer's name and transformer serial number.
- Rating of transformer
- MVA
- Voltages and tapping range
- Number of phases
- Frequency
- Rated currents for each winding
- Vector Group
- Cooling Type
- Measured no-load losses and load losses at 75° C.
- Altitude of test bay.
- Designation of terminals supplied and terminals strapped.

iv. Top oil temperature rise test:

A log of the following quantities taken at a minimum of 30 minute intervals:

- time
- Voltage between phases

- Current in each phase and total power
- Power in each phase and total power
- Ambient temperature
- Top oil temperature
- Cooler inlet and outlet oil temperatures
- Hot spot temperatures (make use of probes) (if applicable)
- Colour photographs of the four sides and top of the transformer together with the corresponding series of thermal images (colour) during starting of the test then after every four hours till the temperature stabilised and finally during temperature stabilised for each rating (ONAN/ONAF/OFAF or ONAN/ONAF1/ONAF2).

Notes:
The probes may be left in position provided the reliability and integrity of unit will not be jeopardized during its long life expectancy.

v. Winding temperature rise test

- Record the 'cold' resistance of each winding and th e simultaneous top oil and ambient air temperatures, together with the time required for the effect to disappear.
- Record the thermal time constant of the winding.
- Log the half-hourly readings of the quantities as for the top oil temperature rise test.
- Provide a table of readings, after shut-down of power, giving the following information ;

  a) Time after shut- down:
  b) Time increment:
  c) Winding resistance: At least 20 minutes reading
  d) Resistance increment:
- Provide a record of all calculations, corrections and curves leading to the determination of the winding temperatures at the instant of shut-down of power.
- Record any action taken to remedy instability of the oil surge device during initiation of the oil circulating pumps.

Temperature measurements as per special probes or sensors (fibre optic) placed at various locations shall also be recorded.

7. Dielectric Tests

Following Test shall be performed in the sequence given below as per IEC 60076-3:2013 clause 7.2.3 shall be followed:

a) Lightning impulse tests (LIC, LIN)
b) Switching impulse (SI)
c) Applied voltage test (AV)
d) Line terminal AC withstand test (LTAC)
e) Induced voltage test with partial discharge measurement (IVPD)

8. Measurement of transferred surge on LV or Tertiary due to HV & IV Lightning impulse

Following tests shall be carried out with applying 20% to 80% of rated Impulse & Switching impulse (upto 60% for IV, Sr. No. 7 & 8 of below table) voltage. Finally, measured value shall be extrapolated for 100% rated voltage.

Table for Transfer surge (Impulse) at Max, Nor. and Min. Voltage Tap

Sr. No.	Impulse Type	Voltage applied	Earthed Points	Open / not earthed point	Measurement Point
1	FW	1.1	2.1, N & 3.2	-	3.1
2	FW	1.1	2.1, N & 3.1	-	3.2
5	FW	2.1	1.1, N & 3.2	-	3.1
6	FW	2.1	1.1, N & 3.1	-	3.2

Similar tests to be conducted for switching surge transformer at Max, Nor. and Min. Voltage Tap.

Where 1.1 : HV Terminal
2.1 : IV Terminal
3.1 & 3.2 : LV or Tertiary Terminal

Acceptance criteria

Transfer surge at Tertiary should not exceed 250kVp at any conditions for 400kV Voltage class Transformer. For other transformer it shall be below the impulse level of LV winding.

9. Chopped wave & full wave lightning impulse test for the line terminals (LIC & LI) and Switching impulse test

Chopped wave lightning impulse and Switching impulse test shall be performed at normal and extreme taps on Unit-1, Unit-2 and Unit-3 respectively for 1-Ph unit, otherwise R ph, Y Ph and B Ph respectively for 3-Ph unit. All the parameters as per IEC shall be mentioned in the report.

10. Measurement of power taken by fans and oil pumps (100 % cooler bank)

Losses of each fan and pumps including spare shall be measured at rated voltage and frequency. Fans and Pumps shall be mounted with cooler bank as per approved drawing during measurement. Serial No, Applied voltage, measured current, frequency and make shall be furnished in the test report.

11. Tank Tests

i. Oil Leakage Test

All tanks and oil filled compartments shall be completely filled with air or oil of a viscosity not greater than that of insulating oil conforming to IEC 60296 at the ambient temperature and subjected to a pressure equal to normal head of oil plus 35 kN/sq.m (5 psi) measured at the base of the tank. This pressure shall be maintained for a period of not less than 12 hours for oil and 1 hour for air during which no leakage shall occur.

ii. Vacuum Test

All transformer tanks 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:

Horizontal Length (in mm)	**Permanent deflection of flat plate (in mm)**
Up to and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.5
2001 to 2250	11.0
2251 to 2500	12.5
2501 to 3000	16.0
Above 3000	19.0

iii. Pressure Test

All transformer tanks, its radiator, conservator and other fittings together or separately shall be subjected to a pressure corresponding to twice the normal head of oil or normal oil head pressure plus 35 KN/sq.m 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.

12. Dynamic short circuit withstand test shall be carried out as per IEC 60076-5. Dynamic short circuit test shall be carried out in HV-IV combination at nominal & extreme tap positions. For LV winding, dynamic short circuit shall be carried out either on HV-LV or IV-LV combination, whichever draws higher short circuit current as per calculation. Type tests shall be carried out before short circuit test. Following shall also be conducted before and after Short Circuit test:

i) Dissolved gas analysis
ii) Frequency response analysis
iii) All routine tests

Detail test procedure shall be submitted by contractor & shall be approved before short circuit test.

13. Routine test on bushings shall be done as per IEC 60137

Annexure–D

Design Review Document

Sr. No.	Description
1.	Core and Magnetic Design
2.	Over-fluxing characteristics upto $1.7U_m$
3.	Inrush-current characteristics while charging from HV & IV respectively.
4.	Winding and tapping design
5.	Short-circuit withstand capability including thermal stress for min. 2 Sec.
6.	Thermal design including review of localised potentially hot area.
7.	Cooling design
8.	Overload capability
9.	Eddy current losses
10.	Seismic design, as applicable
11.	Insulation co-ordination
12.	Tank and accessories
13.	Bushings
14.	Tap changers
15.	Protective devices
16.	Fans, pumps and radiators
17.	Sensors and protective devices– its location, fitment, securing and level of redundancy
18.	Oil and oil preservation system
19.	Corrosion protection
20.	Electrical and physical Interfaces with substation
21.	Earthing (Internal & External)
22.	Processing and assembly
23.	Testing capabilities
24.	Inspection and test plan
25.	Transport and storage

26.	Sensitivity of design to specified parameters
27.	Acoustic Noise
28.	Spares, inter-changeability and standardization
29.	Maintainability
30.	PRD and SPR (number & locations)
31.	Conservator capacity calculation
32.	Winding Clamping arrangement details with provisions for taking it "in or out of tank"
33.	Conductor insulation paper details
34.	Location of Optical temperature sensors
35.	The design of all current connections
36.	Location & size of the Valves

Annexure – E

Painting Procedure

PAINTING	Surface preparation	Primer coat	Intermediate undercoat	Finish coat	Total dry film thick-ness (DFT)	Colour shade
Main tank, pipes, conservator tank, oil storage tank& DM Box etc. (external surfaces)	Shot Blast cleaning Sa 2 ½*	Epoxy base Zinc primer (30-40□m)	Epoxy high build Micaceous iron oxide (HB MIO) (75□m)	Aliphatic polyurethane (PU) (Minimum 50□m)	Minimum 155□m	RAL 7035
Main tank, pipes (above 80 NB), conservator tank, oil storage tank & DM Box etc. (Internal surfaces)	Shot Blast cleaning Sa 2 ½*	Hot oil proof, low viscosity varnish or Hot oil resistant, non-corrosive Paint	--	--	Minimum 30□m	Glossy white for paint
Radiator (external surfaces)	Chemical / Shot Blast cleaning Sa 2 ½*	Epoxy base Zinc primer (30-40□m)	Epoxy base Zinc primer (30-40□m)	PU paint (Minimum 50□m)	Minimum 100□m	Matching shade of tank/ different shade aesthetically matching to tank
	contractor may also offer Radiators with hot dip galvanised in place of painting with minimum thickness of 40□m (min)					
Radiator and pipes up to 80 NB (Internal surfaces)	Chemical cleaning, if required	Hot oil proof, low viscosity varnish or Hot oil resistant, non-corrosive Paint	--	--	--	--
Digital RTCC Panel	Seven tank process as	Zinc chromate	--	EPOXY paint with PU top	Minimum 80□m / for	RAL 7035 shade for

	per IS:3618 & IS:6005	primer (two coats)		coat or POWDER coated	powder coated minimum 100 m	exterior and Glossy white for interior
Control cabinet / Marshalling Box - No painting is required.						

Note: (*) indicates Sa 2 ½ as per Swedish Standard SIS 055900 of ISO 8501 Part-1.

Annexure – F

Unused inhibited Insulating Oil Parameters

Sl. No.	Property	Test Method	Limits
A	**Function**		
1a.	Viscosity at 100degC	ISO 3104 or ASTM D445 or ASTM D7042	(Max.) 3 mm2/s
1b.	Viscosity at 40degC	ISO 3104 or ASTM D445 or ASTM D7042	(Max.)12 mm2/s
1c.	Viscosity at -30degC	ISO 3104 or ASTM D445 or ASTM D7042	(Max.)1800 mm2/s
2.	Appearance	A representative sample of the oil shall be examined in a 100 mm thick layer, at ambient temperature	The oil shall be clear and bright, transparent andfreefrom suspended matter or sediment
3.	Pour point	ISO 3016 or ASTM D97	(Max.)- 40degC
4.	Water content a) for bulk supply b) for delivery in drums	IEC 60814 or ASTM D1533	(Max.) 30 mg/kg 40 mg/kg
5.	Electric strength (breakdown voltage)	IEC 60156	(Min.)50 kV(new unfiltered oil) / 70 kV (after treatment)
6.	Density at 20 deg C	ISO 3675 or ISO 12185 or ASTM D 4052	0.820 - 0.895 g/ml
7.	Dielectric dissipation factor (tan delta) at 90 deg C	IEC 60247 or IEC 61620 Or ASTM D924	(Max) 0.0025
8.	Negative impulse testing KVp @ 25 deg C	ASTM D-3300	145 (Min.)
9.	Carbon type composition (% of Aromatic, Paraffins and Naphthenic compounds)	IEC 60590 and IS 13155 or ASTM D 2140	Max.Aromatic : 4 to12 % Paraffins : <50% & balance shall be Naphthenic compounds .
B	**Refining/Stability**		
1.	Acidity	IEC 62021-1 or ASTM D974	(Max) 0.01 mg KOH/g
2.	Interfacial tension at 27degC	ISO 6295 or ASTM D971	(Min) 0.04 N/m
3.	Total sulphur content	BS 2000 part 373 or ISO 14596 or ASTM D 2622 or ISO 20847	0.05 % (Max.) (before oxidation test)
4.	Corrosive sulphur	IEC 62535	Non-Corrosive on copper and paper
		ASTM D1275B	Non-Corrosive
5.	Presence of oxidation	IEC 60666 or ASTM	0.08% (Min.) to 0.4% (Max.)

	inhibitor	D2668 or D4768	Oil should contain no other additives .Supplier should declare presence of additives, if any.
6.	2-Furfural content	IEC 61198 or ASTM D5837	25 Microgram/litre (Max.)
C	**Performance**		
1	Oxidation stability -Total acidity -Sludge - Dielectric dissipation factor (tan delta) at 90degC	IEC 61125 (method c) Test duration 500 hour IEC 60247	 Max 0.3 mg KOH/g Max 0.05 % Max 0.05
2.	Oxidation stability	ASTM D2112 (a)	220 Minutes (Min.)
D	**Health, safety and environment (HSE)**		
1.	Flash point	ISO 2719	(Min.)135deg C
2.	PCA content	BS 2000 Part 346	Max 3%
3.	PCB content	IEC 61619 or ASTM D4059	Not detectable (Less than 2 mg/kg)
E	**Oil used (inhibited) for first filling, testing and impregnation of active parts at manufacturer's works shall meet parameters as mentioned below:**		
1	Break Down voltage (BDV)		70kV (min.)
2	Moisture content		5 ppm (max.)
3	Tan-delta at 90°C		0.005 (max)
4	Interfacial tension		0.04 N/m (min)
F	**Each lot of the oil shall be tested prior to filling in main tank at site for the following:**		
1	Break Down voltage (BDV)		70 kV (min.)
2	Moisture content		5 ppm (max.)
3	Tan-delta at 90°C		0.0025 (Max)
4	Interfacial tension		More than 0.04 N/m
G	**After filtration & settling and prior to energisation at site oil shall be tested for following:**		
1	Break Down voltage (BDV)	IS: 1866 / IEC 60422	70 kV (min.)
2	Moisture content at hot condition		5 ppm (max.)
3	Tan-delta at 90°C		0.005 (Max)
4	Interfacial tension		More than 0.04 N/m
5	*Oxidation Stability	Test method as per IEC	
	a) Acidity	61125 method C,	0.3 (mg KOH /g) (max.)
	b) Sludge	Test duration: 500hour for	0.05 % (max.)
	c) Tan delta at 90 °C	inhibited oil	0.05 (max.)
6	*Total PCB content		Not detectable (less than 2 mg/kg total)
	* Separate oil sample shall be taken and test results shall be submitted within 45 days after commissioning for approval of RECTPCL.		

1.0 Current Transformer Parameters (on each phase) for 1-ph, 105 MVA, 3-ph 315 MVA 400/220/33 kV Transformers and , 3-ph 200 MVA ,400/132/33 kV Transformers)

Description	**Current Transformer Parameters (Transformer)**			
	HV Side	**IV Side**	**Neutral Side**	**Outdoor type Neutral Current Transformer (**for each bank of three 1-ph units)
a) **Ratio**				
CORE 1	1000/1	1000/1	1000/1	1000/1
CORE 2	600/1	1000/1	-	-
b) Minimum knee point voltage or burden and accuracy class				
CORE 1	1000V, PX / PS	1000V, PX / PS	1000V, PX / PS	1000V, PX / PS
CORE 2	0.2S Class 20VA ISF≤5	0.2S Class 20VA ISF≤5		
c) Maximum CT Secondary Resistance				
CORE 1	2.5 Ohm	2.5 Ohm	2.5 Ohm	2.5 Ohm
CORE 2	-	-	-	-
d) Application				
CORE 1	Restricted Earth Fault	Restricted Earth Fault	Restricted Earth Fault	REF (High Impedance)
CORE 2	Metering	Metering	-	-
e) Maximum magnetization current (at knee point voltage)				
CORE 1	60 mA	60 mA	60 mA	60 mA
CORE 2	-	-	-	-

NOTE:

i) Parameters of WTI CT for each winding shall be provided by the contractor.

ii) For estimation of spares, one set of CTs shall mean one CT of each type used in transformer.

iii) The CT used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

2.0 Current Transformer Parameters (On each phase) for 3-ph 500MVA and 1-ph, 167 MVA, 400/220/33 kV Transformers

Description	**Current Transformer Parameters (Transformer)**			
	HV Side	**IV Side**	**Neutral Side**	**Outdoor type Neutral Current Transformer** (for each bank of three 1-ph units)
Ratio				
CORE 1	1600/1	1600/1	1600/1	1600/1
CORE 2	1000/1	1600/1	-	-
Minimum knee point voltage or burden and accuracy class				
CORE 1	1600V, PX / PS	1600V, PX / PS	1600V, PX / PS	1600V, PX / PS
CORE 2	0.2S Class 20VA ISF≤5	0.2S Class 20VA ISF≤5	-	-
Maximum CT Secondary Resistance				
CORE 1	4.0 Ohm	4.0 Ohm	4.0 Ohm	4.0 Ohm
CORE 2	-	-	-	-
Application				
CORE 1	Restricted Earth Fault	Restricted Earth Fault	Restricted Earth Fault	REF (High Impedance)
CORE 2	Metering	Metering	-	-
Maximum magnetization current (at knee point voltage)				
CORE 1	25 mA	25 mA	25 mA	25 mA
CORE 2	-	-	-	-

NOTE:

i) Parameters of WTI CT for each winding shall be provided by the contractor.

ii) For estimation of spares, one set of CTs shall mean one CT of each type used in transformer.

iii) The CT used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

3.0 Technical Parameters of Current Transformers (for 160MVA, 100MVA & 50MVA 220/132kV 3-Ph Transformers and 33.33 & 10 MVA 220/132kV 1-Ph Transformer)

Description	Current Transformer Parameters (Transformer)		
	HV Side	**IV Side**	**Neutral Side**
(a) Ratio			
CORE 1	1000/1	1000/1	1000/1
CORE 2	600/1	1000/1	-
(b) Minimum knee point voltage or burden and accuracy class			
CORE 1	600V, PX / PS	600V, PX / PS	600V, PX / PS
CORE 2	0.2S Class 15VA ISF ≤ 5	0.2S Class 15VA ISF ≤ 5	-
(c) Maximum CT Secondary Resistance			
CORE 1	1.5 Ohm	1.5 Ohm	1.5 Ohm
CORE 2	-	-	-
(d) Application			
CORE 1	Restricted Earth Fault	Restricted Earth Fault	Restricted Earth Fault
CORE 2	Metering	Metering	-
(e) Maximum magnetization current (at knee point voltage)			
CORE 1	100 mA	100 mA	100 mA
CORE 2	-	-	-

NOTE:

i) Parameters of WTI CT for each winding shall be provided by the contractor.

ii) For estimation of spares, one set of CTs shall mean one CT of each type used in transformer.

The CT used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

4.0 Technical Parameters of Current Transformers (for 50MVA & 25MVA, 132/66kV 3-Ph Transformer)

Description	Current Transformer Parameters (Transformer)		
	HV Side	**IV Side**	**Neutral Side**
(a) Ratio			
CORE 1	600/1	600/1	600/1
CORE 2	300/1	600/1	-
(b) Minimum knee point voltage or burden and accuracy class			
CORE 1	600V, PX / PS	600V, PX / PS	600V, PX / PS
CORE 2	0.2S Class 15VA ISF ≤ 5	0.2S Class 15VA ISF ≤ 5	-
(c) Maximum CT Secondary Resistance			
CORE 1	1.5 Ohm	1.5 Ohm	1.5 Ohm
CORE 2	-	-	-
(d) Application			
CORE 1	Restricted Earth Fault	Restricted Earth Fault	Restricted Earth Fault
CORE 2	Metering	Metering	-
(e) Maximum magnetization current (at knee point voltage)			
CORE 1	100 mA	100 mA	100 mA
CORE 2	-	-	-

NOTE:

i) Parameters of WTI CT for each winding shall be provided by the contractor.

ii) For estimation of spares, one set of CTs shall mean one CT of each type used in transformer.

The CT used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

5.0 Technical Parameters of Current Transformer (for 50 MVA, 40MVA 132/33kV 3-Ph Transformers & 25MVA, 16MVA 110/22kV 3-Ph Transformers)

Description	Current Transformer Parameters (Transformer)			
	HV Side	**HV Neutral Side**	**LV Side**	**LV Neutral Side**
(a) Ratio				
CORE 1	300/1	300/1	1000/1	1000/1
CORE 2	300/1	-	1000/1	-
(b)Minimum knee point voltage or burden and accuracy class				
CORE 1	600V, PX / PS	600V, PX / PS	1000V, PX / PS	1000V, PX / PS
CORE 2	0.2S Class 15VA ISF ≤ 5	-	0.2S Class 15VA ISF ≤ 5	-
(c)Maximum CT Secondary Resistance				
CORE 1	1.5 Ohm	1.5 Ohm	1.5 Ohm	1.5 Ohm
CORE 2	-	-	-	-
(d) Application				
CORE 1	Restricted Earth Fault	Restricted Earth Fault	Metering	Restricted Earth Fault
CORE 2	Metering			-
(e)Maximum magnetization current (at knee point voltage)				
CORE 1	100 mA	100 mA	100 mA	100 mA
CORE 2	-	-	-	-

NOTE:

i) Parameters of WTI CT for each winding shall be provided by the contractor.

iii) For estimation of spares, one set of CTs shall mean one CT of each type used in transformer.

iv)

v) The CT used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

6.0 Technical Parameters of Current Transformer (for 31.5 MVA, 25MVA, 20MVA, 12.5MVA 132/33kV 3-Ph Transformers & 10MVA, 1-Ph 132/33kV Transformer)

Description	Current Transformer Parameters (Transformer)			
	HV Side	HV Neutral Side	LV Side	LV Neutral Side
(f) Ratio				
CORE 1	200/1	200/1	600/1	600/1
CORE 2	200/1	-	600/1	-
(g)Minimum knee point voltage or burden and accuracy class				
CORE 1	400V, PX / PS	400V, PX / PS	600V, PX / PS	600V, PX / PS
CORE 2	0.2S Class 15VA ISF ≤ 5	-	0.2S Class 15VA ISF ≤ 5	-
(h)Maximum CT Secondary Resistance				
CORE 1	1.5 Ohm	1.5 Ohm	1.5 Ohm	1.5 Ohm
CORE 2		-	-	-
(i) Application				
CORE 1	Restricted Earth Fault	Restricted Earth Fault	Metering	Restricted Earth Fault
CORE 2	Metering			-
(j) Maximum magnetization current (at knee point voltage)				
CORE 1	100mA	100 mA	100 mA	100 mA
CORE 2		-	-	-

NOTE:

i) Parameters of WTI CT for each winding shall be provided by the contractor.
ii) For estimation of spares, one set of CTs shall mean one CT of each type used in transformer.

The CT used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

7.0 Technical Parameters of Current Transformer (for 5 MVA, 8.33MVA 132/33kV 1-Ph Transformers & 10MVA, 3-Ph 132/33kV Transformer)

Description	Current Transformer Parameters (Transformer)			
	HV Side	**HV Neutral Side**	**LV Side**	**LV Neutral Side**
(k) Ratio				
CORE 1	200/1	200/1	400/1	600/1
CORE 2	200/1	-	400/1	-
(l) Minimum knee point voltage or burden and accuracy class				
CORE 1	400V, PX / PS	400V, PX / PS	600V, PX / PS	600V, PX / PS
CORE 2	0.2S Class 10VA ISF ≤ 5	-	0.2S Class 10VA ISF ≤ 5	-
(m)Maximum CT Secondary Resistance				
CORE 1	1.5 Ohm	1.5 Ohm	1.5 Ohm	1.5 Ohm
CORE 2	-	-	-	-
(n) Application				
CORE 1	Restricted Earth Fault	Restricted Earth Fault	Metering	Restricted Earth Fault
CORE 2	Metering			-
(o)Maximum magnetization current (at knee point voltage)				
CORE 1	100mA	100 mA	100 mA	100 mA
CORE 2	-	-	-	-

NOTE:

i) Parameters of WTI CT for each winding shall be provided by the contractor.

ii) For estimation of spares, one set of CTs shall mean one CT of each type used in transformer.

iii) The CT used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

1.1 KV GRADE POWER & CONTROL CABLES

1.1 All Power & Control cables shall be supplied from Employer's approved vendors.

1.2 Separate cables shall be used for AC & DC.

1.2 Separate cables shall be used for DC1 & DC2.

1.3 At least one (1) core 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.

1.4 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.

1.5 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.

1.6 Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.

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.

1.8 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.

1.9 All the cables shall conform to fire resistance test as per IS: 1554 (Part - I).

1.10 The normal current rating of all PVC insulated cables shall be as per IS: 3961.

1.11 Repaired cables shall not be accepted.

1.12 Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.

1.13 **PVC Power Cables**

1.13.1 The PVC (70°C) insulated 1100V grade power cables s hall be of FR type, C1 category, conforming to IS: 1554 (Part-I) and its amendments read along with 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-A of IS: 5831. A distinct inner sheath shall be provided in all multi core cables. For multi core armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-1 of IS: 5831 for all cables. The contractor can used copper cable of required size.

1.14 **PVC Control Cables**

1.14.1 The 1100V grade control cables shall be of FR type C1 category conforming to IS: 1554 (Part-1) and its amendments, read along with this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A 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-1 of IS: 5831 and shall be grey in colour except where specifically advised by the Employer to be black.

1.14.2 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 : 1554 (Part - 1).

STANDARD TECHNICAL DATA SHEET (1.1kV GRADE XLPE POWER CABLES)

Sr. No	Description	Parameters	
1a	Cable Sizes	1 C x 630	3½ C x 300
b	Manufacturer's type designation	A2XWaY	A2XWY
2	Applicable standard	IS: 7098/PT-I/1988 & its referred specifications	
3	Rated Voltage(volts)	1100 V Grade	
4	Type & Category	FR & C1	FR & C1
5	Suitable for earthed or unearthed system	for both	
6	Continuous current rating when laid in air in a ambient temp. of 50°C and for maximum conductor temp. of 70 °C of PVC Cables[For information only]	732	410
7	Rating factors applicable to the current ratings for various conditions of installation	As per IS-3961-Pt-II-67	
8	Short circuit Capacity		
a	Guaranteed Short Circuit Amp. (rms) KA for 0.12 sec duration at rated conductor temperature of 90 degree C, with an initial peak of 105 KA	45kA	45kA
b	Maximum Conductor temp. allowed for the short circuit duty (deg C.) as stated above	250 °C	
9	Conductor		
a	Material	Stranded Aluminium as per Class 2 of IS : 8130	
b	Grade	H 2 (Electrolytic grade)	
c	Cross Section area (Sq.mm.)	630	300/150
d	Number of wires(No.) minimum	53	30/15
e	Form of Conductor	Stranded and compacted circular	Stranded compacted circular/sector shaped
f	Direction of lay of stranded layers	Outermost layer shall be R.H lay & opposite in successive layers	
10	Conductor resistance (DC) at 20 °C per km-maximum	0.0469	0.1/0.206
11	Insulation		
a	Composition of insulation	Extruded XLPE as per IS-7098 Part(1)	
b	Nominal thickness of insulation(mm)	2.8	1.8/1.4
c	Minimum thickness of insulation	2.42	1.52/1.16
12	Inner Sheath		
a	Material	Extruded PVC type ST-2 as per IS-5831-84	
b	Calculated diameter over the laid up cores,(mm)	NA	52
c	Thickness of Sheath (minimum)mm	NA	0.6

d	Method of extrusion	NA	Pressure/Vacuum extrusion
13	Armour		
a	Type and material of armour	Al wire [H4 grade]	Gal. Steel wire
b	Direction of armouring	Left hand	
c	Calculated diameter of cable over inner sheath (under armour), mm	33.9	53.2
d	Nominal diameter of round armour wire (minimum)	2	2.5
e	Guaranteed Short circuit capacity of the armour for 0.12 sec at room temperature.	45kA	45kA
f	DC resistance at 20 °C (/Km)	$	0.577
14	Outer Sheath	ST-2 & FR	ST-2 & FR
A	Material (PVC Type)	38.3	59.50
B	Calculated diameter under the sheath	1.72	2.36
C	Min. thickness of sheath(mm)	Min 29.0	Min 29.0
D	Guaranteed value of minimum oxygen index of outer sheath at 27 °C	Min 250	Min 250
E	Guaranteed value of minimum temperature index at 21 oxygen index	Black	Black
f	colour of sheath	$	$
15a	Nominal Overall diameter of cable	+2/-2 mm	
b	Tolerance on overall diameter (mm)	shall conform to IS 10418 and technical specification	
16	Cable Drums	1000/500	1000/500
a	Max./ Standard length per drum for each size of cable (single length) with ±5% Tolerance (mtrs)		
b	Non-standard drum lengths	Maximum one(1) non-standard lengths of each cable size may be supplied in drums only over & above the standard lengths as specified above.(if required for completion of project)	
17	Whether progressive sequential marking on outer sheath provided at1 meter interval 18	Yes	
18	Identification of cores		
a	colour of cores	As per IS 7098 Part(1)	
b	Numbering	NA	
19	Whether Cables offered are ISI marked	Yes	
20	Whether Cables offered are suitable for laying as per IS 1255	Yes	

$'- As per manufacturer design data

STANDARD TECHNICAL DATA SHEET - 1.1kV kV GRADE PVC POWER CABLES

SN	Description	Parameters					
1a	Cable Sizes	1 c x 150	3.5 cx 70	3.5 cx 35	4 c x 16	4c x 6	2 c x 6
1b	Manufacturer's type designation	AYWaY	AYFY	AYFY	AYFY	AYWY	AYWY
2	Applicable standard	IS: 1554/PT-I/1988 & its referred standards					
3	Rated Voltage(volts)	1100 V grade					
4	Type & Category	FR & C1	FR & C1	FR & C1	FR & C1	FR & C1	FR & C1
5	Suitable for earthed or unearthed system	for both					
6	Continuous current rating when laid in air in a ambient temp. of 50oC and for maximum conductor temp. of 70 oC of PVC Cables[For information only]	202	105	70	41	24	28
7	Rating factors applicable to the current ratings for various conditions of installation:	As per IS-3961-Pt-II-67					
8	Short circuit Capacity						
a)	Short Circuit Amp. (rms)KA for 1 sec duration	11.2	5.22	2.61	1.19	0.448	0.448
b)	Conductor temp. allowed for the short circuit duty (deg C.)	160^0C					
9	Conductor						
a)	Material	STRANDED ALUMINIUM					
b)	Grade	H 2 (Electrolytic grade)					
c)	Cross Section area (Sq.mm.)	150	M-70 N-35	M-35 N-16	16	6	6
d)	Number of wires(No.)	as per Table 2 of IS 8130					
e)	Form of Conductor	Non-compacted Stranded circular	shaped conductor	shaped conductor	shaped conductor	Non-compacted Stranded circular	Non-compacted Stranded circular
f)	Direction of lay of stranded layers	Outermost layer shall be R.H lay & opposite in successive layer					
10	Conductor resistance (DC) at 20 oC per km-maximum	0.206	0.443/0.868	0.868/1.91	1.91	4.61	4.61
11	Insulation						
a)	Composition of insulation	Extruded PVC type A as per IS-5831-84					
b)	Nominal thickness of insulation(mm)	2.1	1.4/1.2	1.2/1.0	1.0	1.0	1.0

c)	Minimum thickness of insulation	1.79	1.16/0.98	0.98/0.8	0.8	0.8	0.8
12	Inner Sheath						
a)	Material	Extruded PVC type ST-I as per IS-5831-84					
b)	Calculated diameter over the laid up cores,(mm)	N.A	27.6	20.4	15.7	11.6	9.6
c)	Thickness of Sheath (minimum) mm	N.A	0.4	0.3	0.3	0.3	0.3
13	Armour	as per IS 3975/88					
a)	a) Type and material of armour	Al. Wire[H4 grade]	Gal.steel strip	Gal.steel strip	Gal.steel strip	Gal.steel wire	Gal.steel wire
b)	b) Direction of armouring	left hand					
c)	c) Calculated diameter of cable	18	28.4	21	16.3	12.2	10.2
	over inner sheath (under armour), mm						
d)	d) Nominal diameter of round armour wire/strip	1.6 4	0.8 4	0.8 4	0.8	1.4	1.4
e)	e) Number of armour wires/strips	Armouring shall be as close as practicable					
f)	f) Short circuit capacity of the armour along for 1 sec-for info only	K x A√t (K Amp)(where A = total area of armour in mm^2& t = time in seconds), K=0.091 for Al & 0.05 for steel					
g)	g) DC resistance at 20 oC (/Km)	0.44	2.57	3.38 4	3.99	3.76	4.4
14	Outer Sheath						
a)	a) Material (PVC Type)	ST-1& FR	ST-1& FR	ST-1& FR	ST-1& FR	ST-1& FR	ST-1& FR
b)	b) Calculated diameter under the sheath	21.2	30.1	22.6	17.9	15	13
c)	c) Min. thickness of sheath(mm)	1.4	1.56	1.4	1.4	1.4	1.24
d)	d) Guaranteed value of minimum oxygen index of outer sheath at 27oC	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0
e)	e) Guaranteed value of minimum temperature index at 21 oxygen index	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250
f)	f) colour of sheath	Black	Black	Black	Black	Black	Black
15a)	a) Overall diameter of cable	$					
b)	b) Tolerance on overall diameter (mm)	+2/-2 mm					
16	Cable Drums	shall conform to IS 10418 and technical specification					
a)	a) Max./ Standard length per drum for each size of cable (single length) with ±5% Tolerance	1000/500	1000/500	1000/500	1000/500	1000/500	1000/500

	(mtrs)						
b)	b) Non standard drum lengths	Maximum one(1) non standard lengths of each cable size may be supplied in drums only over & above the standard lengths as specified above.(if required for completion of project)					
17	Whether progressive sequential marking on outer sheath provided	Yes					
18	Identification of cores						
a)	a) colour of cores	Red	R,Y,Bl & Bk	R,Y,Bl& Bk	R,Y,Bl & Bk	R,Y,Bl & Bk	Red & Bk
b)	b) Numbering	N.A	N.A	N.A	N.A	N.A	N.A
19	Whether Cables offered are ISI marked	YES					
20	Whether Cables offered are suitable for laying as per IS 1255	YES					

$'- As per manufacturer design data

STANDARD TECHNICAL DATA SHEET - 1.1kV kV GRADE PVC CONTROL CABLES

SN	Description	Parameters							
1a	Cable Sizes	2 c x 2.5	3c cx 2.5	5c x 2.5	7 c x 2.5	10 c x 2.5	14 c x 2.5	19 c x 2.5	27 c x 2.5
1b	Manufacturer's type designation	YWY	YWY	YWY	YWY	YWY	YWY	YWY	YWY
2	Applicable standard	IS: 1554/PT-I/1988 & its referred standards							
3	Rated Voltage(volts)	1100 V grade							
4	Type & Category	FR & C1							
5	Suitable for earthed or unearthed system	for both							
6	Continuous current rating when laid in air in a ambient temp. of 50oC and for maximum conductor temp. of 70 oC of PVC Cables[For information only]	22	19	19	14	12	10.5	9.7	8
7	Rating factors applicable to the current ratings for various conditions of installation:	As per IS-3961-Pt-II-67							
8	Short circuit Capacity								
a)	Short Circuit Amp. (rms)KA for 1 sec duration	0.285	0.285	0.285	0.285	0.285	0.285	0.285	0.285
b)	Conductor temp. allowed for the short circuit duty (deg C.)	160^0C							
9	Conductor								
a)	Material	Plain annealed High Conductivity stranded Copper (as per IS 8130/84)							
b)	Grade	Electrolytic							
c)	Cross Section area (Sq.mm.)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

d)	Number of wires(No.)	as per Table 2 of IS 8130							
e)	Form of Conductor	Non-compacted Stranded circular shaped conductor							
f)	Direction of lay of stranded layers	Outermost layer shall be R.H lay							
10	Conductor resistance (DC) at 20 oC per km-maximum	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41
11	Insulation								
a)	Composition of insulation	Extruded PVC type A as per IS-5831-84							
b)	Nominal thickness of insulation(mm)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
c)	Minimum thickness of insulation	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
12	Inner Sheath								
a)	Material	Extruded PVC type ST-I as per IS-5831-84							
b)	Calculated diameter over the laid up cores,(mm)	7.2	7.8	9.7	10.8	14.4	15.9	18	22.1
c)	Thickness of Sheath (minimum)mm	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
13	Armour	as per IS 3975/99							
a)	Type and material of armour	Gal. Steel Wire							
b)	Direction of armouring	left hand							
c)	Calculated diameter of cable over inner sheath (under armour), mm	7.8	8.4	10.3	11.4	15	6.5	18.6	22.7
d)	Nominal diameter of round armour wire/strip	1.4	1.4	1.4	1.4	1.6	1.6	1.6	1.6
e)	Number of armour wires/strips	Armouring shall be as close as practicable							
f)	Short circuit capacity of the armour along for 1	0.05 x A√t (K Amp)(where A = total area of armour in mm2 & t =							

	sec-for info only	time in seconds)							
g)	DC resistance at 20 oC (/Km) & Resistivity	As per IS 1554 Part (1), wherever applicable and IS 3975-1999							
14	Outer Sheath								
a)	Material (PVC Type)	ST-1& FR							
b)	Calculated diameter under the sheath	10.6	11.2	13.1	14.2	18.2	19.7	21.8	25.9
c)	Min.thickness of sheath(mm)	1.24	1.24	1.24	1.24	1.4	1.4	1.4	1.56
d)	Guaranteed value of minimum oxygen index of outer sheath at 27oC	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0
e)	Guaranteed value of minimum temperature index at 21 oxygen index	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250
f)	colour of sheath	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey
15a)	Overall diameter of cable	$							
b)	Tolerance on overall diameter (mm)	+2/-2 mm							
16	Cable Drums	shall conform to IS 10418 and technical specification							
a)	Max./ Standard length per drum for each size of cable (single length) with ±5% Tolerance (mtrs)	1000/500							
b)	Non standard drum lengths	Maximum one(1) non standard lengths of each cable size may be supplied in drums only over & above the standard lengths as specified above.(if required for completion of project)							
17	Whether progressive sequential marking on outer sheath provided								
18	Identification of cores	Yes							
a)	colour of cores	R &	R, Y	Red	Grey	Grey	Grey	Grey	Grey

		Bk	& Bl	R,Y,Bl					
b)	Numbering	N.A	N.A	N.A	Numerals in black ink				
19	Whether Cables offered are ISI marked	YES							
20	Whether Cables offered are suitable for laying as per IS 1255	YES							

$'- As per manufacturer design data

Technical Specification of Oil BDV Test Set (Applicable as per BPS)

Item	Specification
Functional Requirement	1. The instrument should be suitable for Automatic Measurement of Electrical Breakdown Strength of Transformer oil as per relevant standards. 2. The test results should have repeatability, consistency in laboratory condition.
Test Output	0-100 kV (Rate of rise: 0.5 to 5KV/Sec)
Accuracy	± 1 kV
Resolution	0.1 KV
Switch off Time	≤ 1ms
Display/Control	LCD/Keypads.
Printer	Inbuilt/External
Measurement Programmes	Fully Automatic Pre-programmed/User programmed Test Sequences including as per latest IEC & other national/international standards.
Test Lead/ Accessories	One complete set of electrodes, gauge etc. compatible with the instruments should be provided for successfully carrying out the test in EMPLYER S/S. Additionally all the required accessories, tools, drawing, documents should be provided for the smooth functioning of kit. Further hard carrying case (which should be robust/ rugged enough) for ensuring proper safety of the kit during transportation shall have to be provided.
Design/Engg.	The complete equipment along with complete accessories must be designed / engineered by Original Equipment Manufacturer.
Power Supply	It shall work on input supply variations, V: 230 ±10 %, f: 50 Hz ±5 % on standard sockets.
Operating Temperature	0 to +50 deg C
Relative humidity	Max. 90% non-condensing.
Protection/ Control	Against short circuit, over load, transient surges etc. Also the instrument should have facility of stopping automatically on power failure. Also the kit should have facility of HV chamber interlocking as well as zero start interlocking.
Environment	The test kit shall be compatible for EMI/EMC/Safety environment requirement as per IEC.
Guarantee	Warranty/Guarantee Period: Min 05 year from the date of successful & complete commissioning at Emplyer sub-station. All the materials, including accessories, cables, laptops etc. are to be covered under warranty/guaranty period. If the kit needs to be shifted to supplier's works for repairs within warranty/guaranty period, suppliers will have to bear the cost of spares, software, transportation of kit for repair at test lab / works.
Calibration Certificate	Unit shall be duly calibrated before supply and the date of calibration shall not be older than two month from the date of supply of Kit.
Training	Supplier shall have to ensure that the instrument is made user friendly. Apart from the detailed demonstration at site, the supplier shall also have to arrange necessary training to EMPLYER engineers.
Commissioning, handing over the Instrument	Successful bidder will have to commission the instrument to the satisfaction of EMPLOYER. The instrument failed during the demonstration shall be rejected and no repairs are allowed.
After sales service	Bidder will have to submit the documentary evidence of having established mechanism in India for prompt services.

Technical Specification of Portable Dissolved Gas Analysis of Oil (Applicable as per BPS)

S.No.	Particulars	Specification
01	Functional Requirement	The Portable DGA equipment to extract, detect, analyze and display the dissolved gases in insulating oil as specified in IEEE C 57-104-2008 and IEC 60599-2007.
02	Detection of Gases	All the fault gases i.e. H2, CH4, C2H2, C2H4, C2H6, CO & CO2 concentrations shall be individually measured and displayed. The minimum detection limits of the instrument for the above gases shall strictly be met the requirement of IEC-60567-2011-Page No. 47-clause 9.2, table-5.
03	Power Supply	It shall be operated with AC single phase,50 Hz +/-5%, 230 V +/- 10% supply. All power cable and necessary adaptors shall be provided by supplier.
05	Instrument control and Data handling, Internal Memory	a) Instrument shall be having in-built control for all the functions (data acquisitions and data storage), it shall have a facility for communication with computer for downloading the data from instrument via USB port. b) Laptop shall be provided for communication with the instrument. it shall be of latest specification along with licensed preloaded OS and software as well as software for interpreting DGA results accordance with IEEE C 57-104-1991 and IEC 60559-1999. Laptop carrying case shall also be provided. c) Internal Memory can capable of store atleast 15000 records
06	General Conditions	a) Performance Parameters like - Minimum Detection Limits, Working Range, Accuracy, repeatability etc. shall be finalized during detailed engineering. b) The portable DGA equipment supplier shall demonstrate during commissioning of the kit that the results shown by the kit are within the specified accuracy and repeatability range and EMPLOYER will provide only the insulating oil/ GAS-IN-OIL standard for testing. c) All required items/instruments /spares /consumables /connecting cables/communication cables/instruments/manuals/Certificates/training materials/original software/original licensed data/station operating software/education CD/DVDs that are essential to understand and operate the instrument shall be supplied at no extra cost.

07	Operating Temperature, Relative humidity	01. Temperature 0-50 Deg. C 02. 85% non-condensing
	& Dimensions	03. Portable
08	Warranty	The entire test set up shall be covered on warranty for a period of 5 year from the last date of complete commissioning and taking over the test set up. If the kit needs to be shifted to suppliers works for repairs, supplier will have to bear the cost of, spares, software, transportation etc of kit for repair at test lab/works.
09	Service Support	The supplier shall furnish the requisite documents ensuring that the equipment manufacturer is having adequate service team and facility in India to take care of any issues during operation of the instrument.
10	Training	The supplier shall provide adequate training for a period of two working days pertaining to the operation and troubleshooting to site personnel.

Online Dissolved Gas (Multi-gas) and Moisture Analyser (Applicable as per BPS)

1.1. Online Dissolved Gas (Multi-gas) and Moisture Analyser along with all required accessories including inbuilt display shall be provided with each Transformer for measurement & analysis of dissolved gases and moisture in the oil. Interpretations shall be as per IEC 60599-1999.

1.2. The equipment shall detect, measure and analyse the following gases:

Gases & Moisture Parameters	Typical Detection Range
H_2	5 – 5,000 ppm
CH_4	5 – 5,000 ppm
C_2H_6	5 – 5,000 ppm
C_2H_4	3 – 5,000 ppm
C_2H_2	1 – 3,000 ppm
CO	10 – 10,000 ppm
CO_2	20 – 30,000 ppm
H_2O	– 100 % RS should have facility for measurement of moisture in oil in ppm

1.3. The analyser should measure (not calculate) all above gases and should have 100% sensitivity. The equipment shall be capable of transferring data to sub-station automation system confirming to IEC 61850. Necessary interface arrangement shall be provided by the contractor for integration with automation system. The necessary type test report for such confirmation shall be submitted during detailed engineering.

1.4. Equipment shall havefacility to give SMS alert to at least three users whenever any fault gas violates the predefined limit.

1.5. Equipment should work on station auxiliary supply. In case other supply is required for the equipment then suitable converter shall be included. All the necessary power and control cables, communication cables, cable accessories as required shall be provided by the supplier.

1.6. Online DGA shall be installed out door on Transformer in harsh ambient and noisy condition (Electromagnetic induction, Corona, and capacitive coupling). Equipment shall be mounted separately on ground. Suitable arrangement shall be provided to support and protect the inlet and outlet piping arrangement. The connecting oil lines must be of Stainless Steel rigid pipes or flexible hoses.The equipment shall be suitable for proper operation in EHV substation (800kV) environment where switching takes place in the EHV/HV System. The suitable indications for power On, Alarm, Caution, normal operation etc. shall be provided on the front panel of the equipment. The equipment shall have IP55 Stainless Steelenclosure, suitable for 55 ^{0}C ambient temperature and EMI and EMC compatibility.The Equipment must carry a minimum of five (5) years manufacturer's Warranty.

1.7. The equipment shall display all the individual gas and moisture concentration on its display unit and shall have facility to download all the stored the data from the unit for further analysis. The sampling rate shall be selectable as 2 or 4 or 6 or 12 hours

etc. The equipment shall have inbuilt memory to store these results for complete one year even if sampling is done at the lowest interval. The carrier and calibration gas (if applicable) shall have minimum capacity to work for at least three years without replacement. All the consumable (if any) upto warrantee period shall be included in the scope of supply

1.8. The Equipment must have an automatic Calibration facility at fixed intervals. For calibration if anything required including cylinder must be mounted with the Equipment.

1.9. The technical feature of the equipment shall be as under:

Accuracy	± 10%
Repeatability	±3% to 10% depending upon gases
Oil temperature range	- 20^0 C to + 120^0 C
External Temp. Range	- 20^0 C to + 55^0 C (External temp range of 55^0 C is important and should not be compromise due to Indian ambient & operating conditions.)
Humidity range	10 to 95 %
Operating Voltage	230 Vac; 50 Hz (±20% variation)
Communications	USB&IEC 61850 compliant

1.10. Software for fault indication and fault diagnostics shall include following:
Fault indication:

i) IEEE, IEC or user configurable levels of dissolved gases
ii) Rate of change trending

Fault Diagnosis:

i) Key gases
ii) Ratios (Rogers, IEC. etc.)
iii) Duval's Triangle

1.11. The equipment shall be supplied with all necessary accessories required for carrying out DGA of oil sample complete in all respect as per the technical specification. The following shall be also form a part of supply.

i) Software
ii) Operation Manual (2 set for every unit),
iii) Software Manual and
iv) Compact disc giving operation procedures of Maintenance Manual & Trouble shooting instructions.

1.12. The installation and commissioning at site shall be done under the supervision of OEM representative or OEM certified representative.

ANNEXURE - K

On Line Dissolved Hydrogen and Moisture Monitor (Applicable as per BPS)

1.0 Online Dissolved Hydrogen and Moisture Analyser along with all required accessories including inbuilt display shall be provided with each Transformer for measurement & analysis of dissolved gases and moisture in the oil. Interpretations shall be as per IEC 60599-1999

2.0 The equipment shall be capable of transferring data to sub-station automation system confirming to IEC 61850. Necessary interface arrangement shall be provided by the contractor for integration with automation system. The necessary type test report for such confirmation shall be submitted during detailed engineering

3.0 Equipment should work on station auxiliary supply. In case other supply is required for the equipment then suitable converter shall be included. All the necessary power and control cables, communication cables, cable accessories as required shall be provided by the supplier

4.0 Equipment shall be installed out door on Transformer in harsh ambient and noisy condition (Electromagnetic induction, Corona, and capacitive coupling). Equipment shall be mounted separately on ground. Suitable arrangement shall be provided to support and protect the inlet and outlet piping arrangement. The connecting oil lines must be of Stainless Steel rigid pipes or flexible hoses.The equipment shall be suitable for proper operation in EHV substation (800kV) environment where switching takes place in the EHV/HV System. The suitable indications for power On, Alarm, Caution, normal operation etc. shall be provided on the front panel of the equipment. The equipment shall have IP55 Stainless Steelenclosure, suitable for 55 ^{0}C ambient temperature and EMI and EMC compatibility.The Equipment must carry a minimum of five (5) years manufacturer's Warranty

5.0 The equipment shall display H_2 and moisture concentration on its display unit and shall have facility to download all the stored the data from the unit for further analysis. The sampling rate shall be selectable as 2 or 4 or 6 or 12 hours etc. The equipment shall have inbuilt memory to store these results for complete one year even if sampling is done at the lowest interval. All the consumable (if any) upto warrantee period shall be included in the scope of supply

6.0 The monitor shall also be suitable to detect Water Content measured in ppm or % RS (Relative Saturation). The sensors shall be able to withstand pressure from vacuum to 10 psi.

7.0 Technical Parameters:

Sr. No.	**Parameters**	**Requirements**	
a)	The measurement range / Output:		
	Hydrogen Dissolved in oil	0 to 2000 ppm,	with 4 – 20 mA
		output	
	Water Dissolved in oil	0 to 95% RS, with 4 – 20 mA output	
b)	Alarms/Indication (High & Very High)		
	Hydrogen	Programmable NO/NC contacts,	
	Water	Programmable NO/NC contacts,	
c)	Environment		
	Operating Ambient Temperature	– 20 to + 55 deg C	
	Operating Oil Temperature	– 20 to + 105 deg C	
d)	Pressure Withstand, (Oil side)	Full Vacuum to 10 psi.	
e)	Communications	USB&IEC 61850 compliant	

Equipment shall be mounted separately to avoid effect of vibration. Suitable arrangement shall be provided support and protect the inlet and outlet piping arrangement.

8.0 Software for fault indication and fault diagnostics shall include following:
Fault indication:

iii) IEEE, IEC or user configurable levels of dissolved gases
iv) Rate of change trending

9.0 The equipment shall be supplied with all necessary accessories required for carrying out DGA of oil sample complete in all respect as per the technical specification. The following shall be also form a part of supply.

v) Software
vi) Operation Manual (2 set for every unit),
vii) Software Manual and
viii) Compact disc giving operation procedures of Maintenance Manual & Trouble shooting instructions.

10.0 The installation and commissioning at site shall be done under the supervision of OEM representative or OEM certified representative.

On-line insulating oil drying system (Cartridge type) (if specified in BPS)

In addition to provision of air cell in conservators for sealing of the oil system against the atmosphere, each Transformer shall be provided with an on line insulating oil drying system of adequate rating with proven field performance. This system shall be separately ground mounted and shall be housed in metallic (stainless steel) enclosure. The bidder shall submit the mounting arrangement. This on line insulating oil drying system shall be

i. Designed for very slow removal of moisture that may enter the oil system or generated during cellulose decomposition. Oil flow to the equipment shall be controlled through pump of suitable capacity (at least 5 LPM).

ii. The equipment shall display the moisture content in oil (PPM) of the inlet and outlet oil from the drying system.

iii. In case, drying system is transported without oil, the same shall be suitable for withstanding vacuum to ensure that no air / contamination is trapped during commissioning.

In case, drying system is transported with oil, the oil shall conform to EMPLOYER specification for unused oil. Before installation at site, oil sample shall be tested to avoid contamination of main tank oil.

iv. Minimum capacity of moisture extraction shall be 10 Litres before replacement of cartridge. Calculation to prove the adequacy of sizing of the on line insulating oil-drying system along with make and model shall be submitted for approval of purchaser during detail engineering.

v. The installation and commissioning at site shall be done under the supervision of OEM representative or OEM certified representative.

vi. The equipment shall be capable of transferring data to substation automation system confirming to IEC 61850 through FO port. Necessary interface arrangement shall be provided by the contractor for integration with automation system.

The equipment shall be supplied with Operation Manual (2 set for every unit), Software (if any), and Compact disc giving operation procedures of Maintenance Manual & Trouble shooting instructions.

Nitrogen Injection Type Fire Prevention & Extinguishing System

1.1 Nitrogen Injection Type Fire Protection System (NIFPS) shall be designed to prevent explosion of transformer/reactor tank and the fire during internal faults resulting from arc.

The system shall work on the principle of Drain & stir. On activation, it shall drain a pre-determined quantity of oil from the tank top through drain valve to reduce the tank pressure, isolate conservator tank oil and inject nitrogen gas at high pressure from the bottom side of the tank through inlet valves to create stirring action and reduce the temperature of oil below flash point to extinguish the fire. On operation, the quantity of oil removed from the tank shall be such that adequate amount of oil shall remain to cover active part (i.e. core coil assembly).

Electrical isolation of transformer shall be an essential pre-condition for activating the system.

1.2 Operational Controls

The system operation shall be fully automatic and activate from the required fire and other trip signals. In addition to automatic operation, remote operation from control room/ remote centre and local manual control in the fire extinguishing cubicle shall also be provided. System shall operate on following situations:

1.2.1 Prevention of transformer from explosion and fire

To prevent transformer from explosion and fire in case of an internal fault, signals given by operation of Electrical protection relays and tripping of circuit breaker of transformer and operation of either Buchholz relay or pressure relief valve (PRV) shall be used to activate the system. The exact logic for system activation shall be finalized during detailed engineering.

1.2.2 Prevention of transformer from fire

In case of fire, sensed by fire detectors, the system shall be activated only after electrical isolation of the transformer, confirmed by breaker trip. If the fire detection is not associated with any other fault, the system activation shall be only manual. Manual operation switch shall be provided in the control room with a cover to avoid accidental operation of it.

1.3 Operation of System

On receiving activation signal, the following shall take place:

i) Open the quick opening drain valve to drain the top layer oil

ii) Shut off the conservator isolation valve to prevent flow of oil from the Conservator tank to the main tank

iii) Open the Nitrogen regulator valve to inject Nitrogen into the transformer tank to create stirring of oil.

There shall be interlock to prevent activation of the system if the transformer is not electrically isolated.

There shall also be provision for isolating the system during maintenance and/or testing of the transformer.

1.4 Technical Particulars

The contractor shall be responsible for the design of the complete system and shall submit the drawings and design calculations for the number of fire detectors, pipe sizing of drain pipe and Nitrogen injection pipe, Nitrogen cylinder capacity, number of injection points, etc. and get approval from RECTPCL.

Facility shall be provided to test the system when the transformer is in service, without actually draining the oil and injecting Nitrogen.

The Nitrogen regulator valve shall be designed in such a way that the Nitrogen shall not enter the transformer tank even in case of passing/ leakage of valve.

Owner shall provide two distinct station auxiliary DC feeders for control purposes. The system shall work on station DC supply with voltage variation defined in GTR .The control box of fire protection system shall have facility to receive these feeders for auto changeover of supply. It shall be the contractor's responsibility to further distribute power to the required locations. In case auxiliary DC power supply requirement is different than station auxiliary DC supply, then all necessary DC-DC converters shall be provided by the Contractor.

Following minimum indications and alarms shall be provided in the local cubicle as well as in the control box:-

- Nitrogen cylinder pressure indication - manometer with sufficient number of adjustable NO contacts
- Nitrogen cylinder pressure low
- Fire in Transformer/ Reactor
- Oil drain started
- Conservator oil isolation valve closed
- Nitrogen injection started
- DC supply fail
- Oil drain valve closed
- Gas inlet valve closed

1.5 Details of Supply of System Equipments and Other Related Activities:

The scope of supply shall include the following items and any other items required for safe and trouble free operation of the system.

i) Fire extinguishing cubicle with base frame and containing at least the following:

- Nitrogen gas cylinder of sufficient capacity with pressure regulator and manometer with sufficient number of adjustable NO contacts.

- Oil Drain Assembly including oil drain pipe extension of suitable size for connecting pipes to oil pit
- Mechanical release device for oil drain and nitrogen release

- Limit switches for monitoring of the systems
- Panel lighting
- Flanges on top of the panel for connecting oil drain and nitrogen injection pipes for transformer
- Back up pressure switch to operate nitrogen gas valve
- Pressure indicators for Nitrogen pressure of the cylinder and actual injection through Nitrogen regulator

ii) Control box to be installed in the control room of the station for monitoring system operation, automatic control and remote operation, with alarms, indications, switches, push buttons, audio signal, suitable for tripping and signalling.

iii) Required number of fire detectors to be located in strategic locations to be finalized during detailed engineering.

iv) All controls, alarms, panels, cables, cable trays (if required), junction boxes etc.

1.6 Under Ground Oil Storage Tank

Each transformer unit shall be provided with an underground oil storage tank. The oil storage tank shall have Non Corrosive, water proof, epoxy coated (from Inside) mild steel (minimum thickness 6 mm) to store drained out oil on operation of NIFPS. The tank shall be painted from outside as per **Annexure – F** . The total capacity of storage tank shall be at least 10% of transformer tank oil to avoid overflowing of oil considering that drained oil volume shall be around 10% of transformer tank oil. Necessary arrangement shall be made on underground storage tank so as to take out the drained oil from the tank for further processing and use. All the pipe and physical connection from transformer to oil pit shall be in the scope of contractor.

This storage tank shall be placed in the pit made of brick walls with PCC (1:2:4) flooring with suitable cover plates to avoid ingress of rain water. The design of tank and pit shall be finalised during detailed engineering.

1.7 Installation and pre-commissioning test

After installation the system pre-commissioning tests shall be carried out jointly with the Owner's representative before the system is put in service.

1.8 NIFPS based on alternate proven technology shall also be acceptable.

Oil sampling bottles (Applicable as per BPS)

Oil sampling bottles (if specified in BPS) 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.

Oil sampling bottles shall be made of stainless steel having a capacity of 1litre. Oil Sampling bottles shall be capable of being sealed gas-tight and shall be fitted with cocks on both ends.

The design of bottle & seal shall be such that loss of hydrogen shall not exceed 5% per week.
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.

The scope of oil sampling bottles shall be included in the bid price as per the quantity indicated in the bid price schedule.

Oil Syringe (Applicable as per BPS)

If specified in BPS, the glass syringe of capacity 50ml (approx) and three way stop cock valve shall be supplied. The syringe shall be made from Heat resistant borosilicate Glass. The material and construction should be resistant to breakage from shock and sudden temperature changes, reinforced at luer lock tip Centre and barrel base.

The cylinder-Plunger fitting shall be leak proof and shall meet the requirement of IEC-60567. Plunger shall be grounded and fitted to barrel for smooth movement with no back flow. Barrel rim should be flat on both sides to prevent rolling and should be wide enough for convenient finger tip grip. The syringe shall be custom fit and uniquely numbered for matching. The syringe shall be clearly marked with graduations of 2.0 ml and 10.0 ml and shall be permanently fused for life time legibility.

Oil Storage Tank (Applicable as per BPS)

1. Oil storage tank shall be of minimum capacity (as per BPS) along with complete accessories. The oil storage tank shall be designed and fabricated as per relevant Indian Standards e.g. IS: 803 or other internationally acceptable standards. Transformer oil storage tanks shall be towable on pneumatic tyres and rested on manual screw jacks of adequate quantity & size. The tank shall be cylindrical in shape and mounted horizontally and made of mild steel plate of adequate thickness. Diameter of the tank shall be 2.0 meter approximately. The tank shall be designed for storage of oil at a temperature of 100□C.

2. The maximum height of any part of the complete assembly of the storage tank shall not exceed 4.0 metres above road top.

3. 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.

4. The tank shall also be fitted with manhole, outside & inside access ladder, silica gel 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. The engine capacity in horse power to pull one tank completely fitted with oil shall be indicated. 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. Solenoid valve (Electro-mechanically operated) with Centrifugal pump shall be provided at bottom inlet so that pump shall be utilised both ways during oil fill up and draining. Suitable arrangement shall also be provided to prevent overflow and drain form the tank.

5. The following accessories shall also form part of supply along with each Oil storage tank.

5.1 Four numbers of 50NB suitable rubber hoses for Transformer oil application up to temperature of 100□C, full vacuum and pressure up to 2.5 Kg/ cm2 with couplers and unions each not less than 10 metre long shall be provided.

5.2 Two numbers of 100NB suitable for full vacuum without collapsing and kinking vacuum hoses with couplers and unions each not less than 10 metre long shall also be provided.

5.3 One number of digital vacuum gauge with sensor capable of reading up to 0.001 torr, operating on 240V 50Hz AC supply shall be supplied. Couplers and unions for sensor should block oil flow in the sensor. Sensor shall be provided with at-least 8 meter cable so as to suitably place the Vacuum gauge at ground level.

5.4 The painting of oil storage tank and its control panel shall be as per technical specification.

5.5 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 cubicle with IP-55 enclosure.

TECHNICAL SPECIFICATION
VOL-II, SEC-XXI
TELECOMMUNICATION SYSTEMS

SECTION-XXI
TELECOMMUNICATION SYSTEMS

1.1 General

This section describes the Fiber Optic Communication equipment characteristics for communication system to be installed under the project. The sub-systems addressed within this section are:

(1) Fiber Optic Transmission System (FOTS)
(2) DDF and Cabling
(3) Craft Terminal based Network Management System (NMS)
(4) FO Approach Cable
(5) FODP

The equipment supplied shall support existing communication network for Power system operational requirements.

The security related requirements of the equipment shall be as per DoT (Department of Telecommunication) guidelines and all similar security requirements as amended by DoT on time to time basis shall be followed/complied by the vendor at no additional cost to Employer till the implementation of the project.

The manufacturer shall allow the Employer and/or its designated agencies to inspect the hardware, software, design, development, manufacturing, facility and supply chain and subject all software to a security /threat check any time during the supplies of equipment

The contractor shall ensure that the supplied equipments have been got tested as per relevant contemporary Indian or International Security Standards e.g. IT and IT related elements against ISO/IEC 15408 standards, for Information Security Management System against ISO 27000 series Standards, Telecom and Telecom related elements against 3GPP security standards, 3GPP2 security standards etc. from any international agency/ labs of the standards e.g. Common Criteria Labs in case of ISO/IEC 15408 standards until 31st March 2013. The certification shall be got done from authorized and certified agency/lab in India.

In case of any deliberate attempt for a security breach at the time of procurement or at a later stage after deployment/installation of the equipment or during maintenance, liability and criminal proceedings can be initiated against the Contractor as per guidelines of DoT and any other Government department.

The primary function of the equipment is to provide a highly reliable voice and data communication system for grid operation in support of the SCADA/EMS, RTUs, Teleprotection & PMUs and for new technological requirements of Power System Operation such as Special Protection Scheme, Grid Security Expert System, Load Management,

Advanced Protection System & Substation Automation System. A brief summary of the system requirements is as follows:

(a) High speed E1 channel support

(b) 64kbps & nx64kbps data channel support as required

(c) Low speed (300 -1200 bps) data channel support as required

(d) Voice (2 wires, 4 wires) channel support and integration with Employer's/RLDC's EPABX system. The details of EPABX System shall be provided during detailed engineering.

(e) Data transport supporting Network Management channels

(f) The connectivity envisaged between Substation and Control Centre over TCP-IP using Ethernet interface for various services of data and voice such as for PMUs, RTUs , VOIP etc.

2.1 Fibre Optic Transmission System

2.1.1 General Network Characteristics

The SDH node shall be used for interconnection of terminal Substation to the fibre optic network and shall be based on the Synchronous Digital Hierarchy (SDH) having bit rate of STM-4/16 as specified in BPS.

The FO Communication equipment to be supplied shall be a complete SDH node (add-drop multiplexer) providing all the features e.g. protection and performance monitoring. This will be used for delivering E1 as per ITU-T G.703 and Giga/fast Ethernet services except repeater stations. In case other interface such as Asynchronous Sub-channel data card (RS232/V.24/V.28), Synchronous data card (V.35/X.21), 2 wire voice channel card or 4 wire (E&M) voice channel card as required, shall be supplied either in the same equipment or as independent PDH equipment.

The Contractor shall supply the equipment as per the technical specification. The deliverables shall include all installation materials necessary for successful installation and commissioning of the equipment viz. AC & DC power supply cabling, Krone type/120Ω balanced type Digital Distribution Frame (DDF) in enclosure, optical patch cords for FODP-to-equipment and equipment-to-equipment connection, optical attenuator (5dB/10dB), flexible conduits etc. as per site requirement. Additionally one (1) pair of optical patch cord per SDH node will be supplied as spare. User Manual, System Guide shall be delivered with each equipment. The Contractor shall provide all required minor civil works necessary for

full connectivity as required.

Equipment redundancy and Automatic Protection Schemes (APS) are specified in the Table 1. The failure of one element shall not prevent the use of any other that has not failed.

Table 1
Equipment Redundancy Requirements Summary

Fiber Optic transmission Equipment :	
Power Supply & Converters ----------	1:1 APS or distributed power supply
Common Control* Cards ----------	1:1 APS
*** = Common control cards which are essentially required for operation of the equipment.**	

The offered equipment shall support automatic switchover function between the redundant modules and all required modules and hardware to support the automatic switch over shall be provided by the Contractor.

At any digital signal level, reapplication of a lost signal shall result in automatic resynchronization and full restoration to normal operation without manual intervention. All alarms incident to the signal failure, shall be automatically cleared at the equipment, rack and monitoring levels and normal operation indications restored and reported if applicable.

The offered transmission equipment (SDH node) shall support optical link of at least 250 Km for STM-4 and 225Km for STM-16 without any repeater station in between. If required, wavelength translator/ optical amplifier shall be provided by the contractor.

2.1.2 Features of Transmission Equipment

- Aggregate interface shall be STM-4/16, with three (3)/Five (5) MSP protected directions (as required in BPS). If bidder is offering equipment with multifunction cards such as cross-connect or control card with optical interface/SFP or tributary interface, such type of multifunction card shall be considered as Common control card and shall be the part of base equipment. In case optical interface/SFP is embedded with control card, the adequate number of optical interface/SFPs shall be offered to meet the

redundancy requirements of the specifications. Further, main and protection channel shall be terminated on separate cards. Aggregate interface of STM-4/16 shall have FC/PC or SC or LC connector.

- All software and hardware shall support IPv4 and IPv6 simultaneously (dual stack).

- SDH equipment shall support dual power feed with redundancies for Power supply unit and Control unit in each rack.

- Minimum 16 nos. x 2 Mbit/s per card, 120Ω tributary interface compliant to ITU-T G.703, G.704 with suitable connector

- Ethernet interface shall have minimum 8 nos. per card of RJ-45 port for ingress and egress of Ethernet data (Ethernet over SDH) at 10/100/1000 Base-T speeds/standards (ITU-T G.7041GFP capsulation). Ethernet shall support LCAS feature. It shall support full throughput upto 1000 Mbps on Ethernet port by virtual concatenation of requisite no. of VC-12.There shall be the provision of "Auto Negotiation" and "Flow control" Enabling/disabling through NMS of the system. Also there shall be provision of configuring the equipment for unrestricted nxVC12 bandwidth (upto 1000Mbps). The Ethernet interface shall support VLAN (IEEE 802.IP/Q), spanning tree (IEEE 802.ID) quality of service. The protection scheme for Ethernet traffic should be VLAN/ERPS based.

- Services channel shall be provided as a function of the SDH equipment and shall be equipped with Service Channel Muldems that shall provide at a minimum: One voice channel (order wire) with analog interface (0.3 to 3.4 kHz) and one data channel. There shall be a facility to extend the line system order-wire to any other system or exchange lines.

- ADM configuration for traffic protection by using SNCP & MSP.

- Synchronization: The synchronization of the FO equipment shall be as per ITU-T standard G.811. The substation GPS can be used for extending synchronization to equipment. Alternately existing network Master Clock can be used for synchronization.

- ISM (In Service Monitoring) circuitry shall be provided as a function of the SDH equipment. Local visual alarm indicators shall be provided on the equipment, as a rack summary alarm panel. Alarms shall be as per ITU-T Standards G.774, G.783 and G.784.

- Downloading of software shall be possible from remote.

- Shall have Embedded Communication Channel (ECC), ports (Ethernet/RS232) for craft terminal and management interface and shall support DCC pass trough.

- DCN implementation through protected VC12. Support DCN grooming in VC12.

- Pre-connectorised Optical patch cords shall be of G.625D fibre. The Patch cord return loss shall be equal to or better than 40 dB and insertion loss equal to or less than 0.5 dB. Fiber jumpers shall be of sufficient lengths as to provide at least 0.5m of service loop.

- Shall be operated with -48 V DC Power Supply. DC power interface shall be suitable to work on a nominal voltage of -48V ± 20%.

- Compact design suitable for installation in 19" rack.

2.1.2.1 Network Monitoring (Craft Terminal based)

- Manageable by Craft Terminal programme. It shall support performance monitoring, remote software upgrade, configuration management from remote as well as local craft terminal. The craft terminal shall have minimum configuration of 2.4 GHz, 2 GB RAM, 256 MB Video Graphics Memory, DVD RW drive, 160 GB Hard Disk Drive, keyboard, mouse/trackball etc., serial/USB (2.0) ports to accommodate printers, IEEE 802.11a/b/g wireless LAN, Bluetooth, Internal/external Data/Fax modem and a battery back-up of at least 3 hours. VDUs shall be 15" TFT active matrix color LCD with a minimum resolution of 1024 X 768.
- Local Craft Terminal will be provided with requisite software for performing all element level management functions viz. configuration management, fault management, performance management etc.

- Provision shall be there in the Local Craft Terminal for integration with full fledged NMS server .

2.1.3 Optical Link Budget Calculations

The fibre optic link budget calculations shall be calculated based upon the following criteria:

(1) Fibre attenuation: The fibre attenuation shall be taken to be the guaranteed maximum fibre attenuation i.e. 0.21 dB/Km @1550nm and 0.35 dB/km @1310nm.
(2) Splice loss: Minimum 0.05 dB per splice. One splice shall be considered for every 3 kms.
(3) Connector losses: Losses due to connectors shall be considered to be minimum 1.0 dB per link.
(4) Equipment Parameters: The equipment parameters to be considered for link budget calculations shall be the guaranteed "End of Life (EOL)" parameters. In case, the End of Life parameters are not specified for the SDH equipment, an End of Life Margin of at least 2 dB shall be considered and a similar margin shall be considered for optical amplifiers.
(5) Optical path Penalty: An optical path penalty of at least 1 dB shall be considered

to account for total degradations due to reflections, inter symbol interference, mode partition noise and laser chirp.

(6) Maintenance Margin: A maintenance margin of at least 2.5 dB/100Km shall be kept towards cabling, repair splicing, cable ageing and temperature variations etc.

(7) Other losses: Other losses, if any required specifically for system to be supplied shall also be suitably considered.

(8) Dispersion: The fibre dispersion shall be taken to be the guaranteed maximum dispersion i.e. 18 ps/nm.Km @1550 nm & 3.5 ps/nm.km @ 1310 nm for DWSM fibres.

(9) Bit Error Rate: The link budget calculations shall be done for a BER of 10-10.

The bidders shall determine the total link loss based on the above parameters and shall submit the system design (including link budget calculations) for each fibre optic link during detailed engineering.

For finalising the FOTS system design & BOQ, above methodology shall be adopted taking into account fibre attenuation, dispersion and splice loss determined during the detailed engineering. Accordingly, additions and deletions from the contract shall be carried out based on unit rates indicated in the contract.

2.2 Fibre Optic Approach Cable

For purposes of this specification, a fibre optic approach cable is defined as the Armoured underground fibre optic cable required to connect Overhead Fibre Optic Cable (OPGW) between the final in line splice enclosure on the gantry / tower forming the termination of the fibre cable on the power line and the Fibre Optic Distribution Panel (FODP) installed within the building. The estimated fibre optic approach cabling length requirements are indicated in the appendices. However, the Contractor shall supply & install the optical fibre approach cable as required based on detailed site survey to be carried out by the Contractor during the project execution and the Contract price shall be adjusted accordingly. Approach Cable shall consist G.652D DWSM Fibers.

2.2.1 Basic Construction

The cable shall be suitable for direct burial, laying in trenches & PVC/Hume ducts, laying under false flooring and on indoor or outdoor cable raceways. The jacket shall conform to ASTM D1248 for density.

2.2.2 Optical Electrical and Mechanical Requirements

Approach cable shall contain fibres with identical optical/ physical characteristics as those in the OPGW cables. The cable core shall comprise of tensile strength member(s), fibre support/bedding structure, core wrap/bedding, and an overall impervious jacket.

2.2.3 Installation Of Approach Cable

The existing cable trenches/ cable raceways proposed to be used shall be identified in the survey report. The Contractor shall make its best effort to route the cable through the existing available cable trenches. Where suitable existing cable trenches are not available, suitable alternatives shall be provided after Employer approval.

Suitable provisions shall be made by the Contractor to ensure adequate safety earthing and insulated protection for the approach cable.

All required fittings, supports, accessories, ducts, inner ducts, conduits, risers and any item not specially mentioned but required for laying and installation of approach cables shall be supplied and installed by the Contractor.

2.3 Optical Fibre Termination and Splicing

Optical fibre terminations shall be done in Fibre Optic Distribution Panels (FODP) designed to provide protection for fibre splicing of preconnectorized pigtails and to accommodate connectorized termination and coupling of the fibre cables. The Contractor shall provide rack /wall mounted Fibre Optic Distribution Panels (FODPs) sized as indicated in the appendices and shall terminate the fibre optic cabling up to the FODPs. The location of FODP rack shall be fixed by the Contractor, with the Employer's approval.

2.3.1 Fibre Optic Distribution Panel

At each location requiring the termination of at least one fibre pair within a cable, all fibres within that cable shall be connectorized and terminated in Fibre Optic Distribution Panels in a manner consistent with the following:

(a) All fibre optic terminations shall be housed using FODPs provisioned with splice organizers and splice trays. All fibres within a cable shall be fusion spliced to preconnectorized pigtails and fitted to the "Back-side" of the provided fibre optic couplings.

(b) FODPs shall be suitable for use with each of the cable types provided as part of this contract. FODPs shall accommodate pass-through splicing and fibre terminations.

(c) FODPs for indoor use shall be supplied in suitable cabinets/racks with locking arrangement.

(d) The FODP shall be of corrosion resistant, robust construction and shall allow both top or bottom entry for access to the splice trays. Ground lugs shall be provided on all FODPs and the Contractor shall ensure that all FODPs are properly grounded. The FODP shall meet or exceed ingress protection class IP55 specifications.

(e) Flexible protection shall be provided to the patch cord bunches going out from FODP cabinet to other equipment cabinet.

3.1 Environmental, EMI, Power Supply Cabling and Earthing Requirements

- Equipment shall operate in accordance with the Environmental Operating limits as shown in Table-2:

Table -2
Environmental Operating Limits

Temperature Range:	(Un Controlled Environment)
Specification	0 to 45°C
Operation without damage	-10 to 55°C
Shipping/storage	-40 to 60°C
Relative Humidity, non-condensing	Upto 90%
Elevation:	
Operating	to 3,000 m
Non-operating	to 10,000 m

- Equipment shall be properly shielded against radiated emissions at each location.

- Power Distribution and Protection: Power supplies/converters for communications equipment shall use -48Vdc uninterrupted primary source power. The Employer will furnish only one power source. Contractor shall provide required distribution panels, circuit breakers, appropriate panel disconnects and all cabling, fusing, switching required. Distribution Panel feeders, Panel Disconnects, distribution panels and circuit breakers shall be sized and equipped to support at least 100% expanded load requirements.

- Contractor shall provide equipment and rack safety earthing in full compliance with EMI/EMC requirements as per relevant international standards.

- Equipment cabinet (enclosure) shall be designed 19 inch, free standing but shall be mounted on the floor. The dimensions of the cabinet shall be minimum 2200mmx600mmx600mm. All doors and removable panels shall be fitted with long life synthetic gaskets Neoprene/EPDM conforming with provision of IS 11149. All panels shall be fabricated from minimum 2.0mm thickness steel sheet. However, for racks with load bearing Aluminium extrusion frame, door panels and side panels may be fabricated from minimum 1.6mm thickness steel sheet and the top & bottom panels shall be fabricated from minimum 2.0mm thickness steel sheet. The exterior and interior colour of the paint shall be RAL 7032. Equipment cabinet (enclosure) shall be dust and moisture proof as per IP41 specification or better (supporting certificates/documents shall be submitted during detailed engineering).

- The Contractor shall provide all required minor civil works necessary for full connectivity as required in the Contractor's scope of work.

- Any other miscellaneous items which may be required for successful interfacing for establishment of end-to-end communication is deemed to be included in the scope of the Contractor.

4.1 TESTING

All materials furnished and all work performed under this Contract shall be inspected and tested. The entire cost of testing for factory & site acceptance, routine tests, production tests and other test during manufacture & site activities specified herein shall be treated as included in the quoted unit price of materials, except for the expenses of Inspector/Employer's representative. All tests shall be witnessed by the Employer and/or its authorized representative (hereinafter referred to as the Employer) unless the Employer authorizes testing to proceed without witness.

"Type Tests" shall be defined as those tests which are to be carried out to prove the design, process of manufacture and general conformity of the materials to this Specification. All equipment being supplied shall conform to type tests as per Annexure-I of technical specification. The test reports submitted shall be of the tests conducted within last five (5) years. In case the test reports are older than five (5) years, the Contractor shall repeat these tests at no extra cost to the purchaser. In the event of any discrepancy in the test reports or any type tests not carried out, same shall be carried out by Contractor without any additional cost implication to the Employer. Type Tests shall be certified or performed by reputed laboratories using material and equipment data sheets and test procedures that have been approved by the Employer.

Equipments to be delivered shall be tested at factory before despatch as per approved procedure. Factory Acceptance Test shall demonstrate the technical characteristics of the equipment in relation to this specification and approved drawings and documents. The Contractor shall provide procedures for installation and site acceptance test. The site acceptance testing will comprise of end- to-end testing between the terminal stations and RLDC/SLDC and RTAMC/other CC end.

The detailed requirements for Type Test, Factory Acceptance Test and Site Acceptance Test are attached at 'Annexure – I

5.1 TRAINING

The Contractor will provide a training of suitable duration on supplied SDH equipment for Employer's personnel to provide working knowledge of the equipment, operation and diagnostic tools, supervision and monitoring using local craft terminal. The training may be provided by the Contractor or its sub-vendor at the site itself, preferably during installation, and will include training materials and

presentation equipment. No separate charges for training shall be payable to the Contractor.

6.1 SUPPORT SERVICES

Throughout design, implementation, factory testing, and field installation and testing, the Contractor shall supply consulting assistance, as required by the Employer for site preparation, field installation, and other areas where technical support may be required.

The Contractor shall be responsible for minor facility renovation, and maintenance of the supplied system up to and including successful completion of the Site Acceptance Test.

After final acceptance of the communications equipment, the Contractor shall offer continuing technical support and spare parts for the designed life of the equipment or 7 years after the declaration of withdrawal of equipment from production whichever is earlier. However the termination of production shall not occur prior to Operational Acceptance of the system by the Employer. Some locations have existing SDH & MUX equipment. The traffic may be switched over to new fibre optic communication equipment in phase manner. The Contractor shall review the Employer existing equipment make, integration & switch over recommendation and prepare a detailed field implementation plan.

6.1.1 Technical Support

Consultation with Contractor's technical support personnel and trained field service personnel shall be readily available on a short-term/long-term basis to assist the Employer personnel in maintaining, expanding, and enhancing the telecommunication network upon expiration of the warranty period.

6.1.2 Contractor's Future Hardware/Software Changes

The Employer shall be informed of all alterations or improvements to the hardware supplied under this Specification. The Employer shall be placed on the Contractor's mailing list to receive announcements of the discovery, documentation, and solution of hardware/software problems as well as other improvements that could be made on supplied equipment. The service shall begin at the time of contract award, and shall continue for the designed life of the equipment. The Contractor shall also include a subscription to the hardware subcontractors' change notification service from the time of contract award through the warranty period, with a Employer renewable option for extended periods.

6.1.3 Mandatory Spare Parts

The Contractor shall be required to supply minimum spares for each subsystem as per BPS. The subsystem set of spare parts is defined to include all equipment modules, subunits and parts required to effect replacement, repair and restoration to full operational status of a defined unit of a subsystem (i.e. SDH equipment.).

6.1.4 Warranty Period

The one year period commencing immediately after the operational acceptance is called the Warranty Period/Defect liability Period. In addition to the responsibilities covered under Vol-I Condition of Contracts during Defect Liability Period, the Contractor shall also be responsible for maintenance of the Fibre Optic Transmission System etc. supplied under this Package.

6.1.5 Miscellaneous Supplies

The Contractor shall provide all required consumable and non-consumable supplies necessary to support all installation and test activities through final operational acceptance. However, if there are any problems in the SAT and additional consumables are required, the same shall also be supplied by the Contractor at no additional cost.

7.1 Documentation

The Contractor shall submit following documents during detailed engineering:

(a) Data Requirement sheets
(b) Link Budget calculations
(c) MQP, FQP
(d) Bill of Quantity including mandatory spares
(e) Previous Type test reports
(f) Factory Test report
(g) Manuals for each equipment
(h) Schematic drawing
(i) Numbering, Marking, labelling document
(j) Synchronization plan
(k) Test schedule
(l) Training manual
(m) Configuration diagram
(n) Transportation & handling Procedure
(o) Installation Manuals
(p) Maintenance Manua

Testing Requirement of Communication Equipment

1.1 List of type test to be conducted on Telecom equipment

The type tests for Telecom Equipment with all types of cards are described below:

1.1.1 Temperature and Humidity Tests

The tests listed below are defined in IEC Publication 60068.

(a) Low Temperature Test: Operation to Specifications

Low temperature tests shall be conducted as defined in IEC Publication 60068-2-1, test method Ad, with the following specifications:

(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for sixteen (16) hours. Its performance is checked during the test.
(2) Degree of Severity: Test shall be done at 0°C
(3) Acceptance Criteria: No degradation of performance during and after the test.

(b) Low Temperature Test : Operation without Damage

Low temperature tests shall be conducted as defined in IEC Publication 60068-2-1, test method Ad, with the following specifications:

(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 72 hours. Its performance is checked during the test and after the test as soon as the thermal equilibrium is reached at the room temperature (*Post-test*).
(2) Degree of Severity: Test shall be done at -10° C
(3) Acceptance Criteria: Degradation of performance is allowable during the test, however there shall be no degradation of performance in the *post-test*.

(c) Dry Heat Test: Operation to Specifications

Dry heat test shall be done as defined in IEC Publication 60068-2-2, test method Bd, with the following specifications:

(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 96 hours. Its performance is checked during the test.
(2) Degree of Severity: operation to specification range.
(3) Acceptance Criteria: No degradation of performance during and after the test.

(d) Dry Heat Test: Operation without Damage

Dry heat tests shall be done as defined in IEC Publication 60068-2-2, test method Bd, with the following specifications:

(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 96 hours. Its performance is checked during the test and after the test as soon as the thermal equilibrium is reached at the room temperature (*Post-test*).
(2) Degree of Severity: Test shall be done at 55ºC.
(3) Acceptance Criteria: Degradation of performance is allowable during the test, however there shall be no degradation of performance in the *post-test*.

(e) Damp Heat Test

Damp heat testing reveals aging with respect to the humidity level and applies basically to electronic equipment. This test shall be done as defined in IEC Publication 60068-2-3 with the following specifications:

(1) Test Duration: The equipment is started up as soon as thermal equilibrium has been reached and operated for 10 days. Its performance is checked during the test.
(2) Degree of Severity: Test shall be done at (40 ± 2) °C & (93 ± 3) % RH

(3) Acceptance Criteria: The equipment shall meet the specified requirement and there shall not be any degradation in BER.

(f) Temperature Variation Test

Temperature variation testing shall be as per IEC Publication 60068-2-14 (Gradual Variations, Method Nb). The equipment shall be powered on and various parameters shall be monitored continuously during the test period.

(1) Number of cycles required is five (5)
(2) The degree of severity: temperature TL:0°C, TH: (Operation to specification range)
(3) Cycle duration for each temperature is three (3) hours.
(4) Ramp : 1 ^{o}C/minute.
(5) Acceptance Criteria: The equipment shall meet the specified requirement and there shall not be any degradation in BER.

1.1.2 Power Supply and EMI/EMC tests

The test procedure and acceptance criteria shall be as defined in IEC 60870-2-1.

(a) Immunity Tests

The list of Immunity tests are specified below in Table 1:

Table 1: Recommended Immunity Tests

S. No.	Immunity Test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para-metres
1	Voltage Fluctuations	Yes	Yes	N/A	N/A	Table 11 of IEC 60870-2-1: 1995 - Level : 1
2	Voltage dips and Interruptions	Yes	Yes	N/A	N/A	
3	1.2/50 - 8/20 μs surges	Yes	Yes	Yes	N/A	Table 12 of IEC 60870-2-1: 1995 - Level : 4
4	Fast transient bursts	Yes	Yes	Yes	Yes	
5	Damped oscillatory waves	Yes	Yes	Yes	Yes	
6	10/700 μs surges	N/A	N/A	N/A	Yes	
7	Electrostatic discharge	Yes				Table 13 of IEC 60870-2-1: 1995 - Level : 4
8	Power frequency magnetic field	Yes				Table 14 of IEC 60870-2-1: 1995 - Level : 4
9	Damped oscillatory magnetic field	Yes				
10	Radiated electromagnetic field	Yes				Table 15 of IEC 60870-2-1: 1995 - Level : 4
11	Power Frequency voltage on control and signal lines	N/A	N/A	Yes	Yes	IEC 61000-4-16 : 2002-07 Level : 4
12	DC voltage on control and signal lines	N/A	N/A	Yes	N/A	IEC 61000-4-16 : 2002-07 Level : 4

Table 1: Recommended Immunity Tests

S. No.	Immunity Test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para-metres
-End of Table-						

(b) Emission Tests

The list of Emission tests are specified below in Table 2

Table 2:
Recommended Emission Tests

S. NO.	Emission test	AC Power Supply	DC Power Supply	Control & Signal	Telecom Line	Para-metres
1	LF disturbance voltages CCITT recommendation P.53	N/A	Yes	N/A	N/A	Table 17 of IEC 60870-2-1: 1995 - Class : B
2	RF disturbance voltages CISPR 22	Yes	Yes	N/A	N/A	
3	RF disturbance currents CISPR 22	N/A	N/A	N/A	Yes	
4	RF radiated fields CISPR 22	Yes				
-End Of Table-						

(c) Insulation Withstand Voltages

As per section 6 of IEC 870-2-1. Recommended class : VW1 of Table 18.

1.1.3 Mechanical Tests

(a) Mechanical Vibration Test

The procedure for this test is described in IEC Publication 60068-2-6. The testing procedure shall be carried out in the sequence 8.1 + 8.2.1 + 8.1 as described in document 60068-2-6. For the vibration response investigation (clause 8.1 of 60068-2-6), the test shall be carried out over a sweep cycle under the same conditions as for the endurance test (described later), but the vibration amplitude and the sweep rate may be decreased below these conditions so that the determination of the response characteristics can be obtained.

The endurance tests conditions are selected according to the vibration withstand requirements.

Transportation tests shall be performed with the equipment packed according to the Contractor's specifications.

(b) Shock Test

The procedure of this test is defined in IEC Publication 60068-2-27 (each test) with a semi-sinusoidal shape (clause 3.1.1.2).

The recommended severity shall be A = 294 m/s^2, D = 18 ms. Three shocks per axis per direction shall be applied to the equipment packed according to the Contractor's specifications.

Or Free Fall Test

This test could be performed as an alternative to the shock or Bump test. The procedure is defined in IEC publication 60068-2-32. The equipment shall be packed according to the Contractor's specifications. The drop height shall be defined in accordance with IEC 68-2-32. The surface of the packing case which comes into contact with the ground is the surface on which the packing case normally rests; if the packing does not have any features (inscription, special shape, etc.) identifying this surface, the test is carried out successively on all the surfaces of the packing.

Or Bump Test

This test could be performed as an alternative to Shock test or Free Fall test. The procedure is defined in IEC 60068-2-29.

1.2 Type tests for Optical Fibres

The type tests listed below in Table 3 shall be conducted on DWSM fibres to be supplied as part of Approach cable. The tests specific to the cable type are listed in subsequent sections.

Table 3
Type Tests For Optical Fibres

S. No.	Test Name	Acceptance Criteria	Test procedure
1	Attenuation	As per Standard	IEC 60793-1-40 Or EIA/TIA 455-78A
2	Attenuation Variation with Wavelength	As per Standard	IEC 60793-1-40 Or EIA/TIA 455-78A
3	Attenuation at Water Peak	As per Standard	IEC 60793-1-40 Or EIA/TIA 455-78A
4	Temp. Cycling (Temp dependence of Attenuation)		IEC 60793-1-52 Or EIA/TIA 455-3A, 2 cycles
5	Attenuation With Bending (Bend Performance)		IEC 60793-1-47 Or EIA/TIA 455-62A
6	Mode Field dia.		IEC 60793-1-45 Or EIA/TIA 455-164A/167A/174
7	Chromatic Dispersion		IEC 60793-1-42 Or EIA/TIA 455-168A/169A/175A
8	Cladding Diameter		IEC 60793-1-20 Or EIA/TIA 455-176
9	Point Discontinuities of attenuation		IEC 60793-1-40 Or EIA/TIA 455-59
10	Core -Clad concentricity error		IEC 60793-1-20 Or EIA/TIA 455-176
11	Fibre Tensile Proof Testing		IEC 60793-1-30 Or EIA/TIA 455-31B
-End Of table-			

1.3 Type tests for Fibre Optic Approach Cable

The type tests to be conducted on the Fibre Optic Approach cable are listed in Table 4: Type Tests for Fibre Optic Approach Cable. Unless specified otherwise in the technical specifications or the referenced standards, the optical attenuation of the specimen, measured during or after the test as applicable, shall not increase by more than 0.05 dB/Km.

Table 4:
Type Tests Fibre Optic Approach Cable

S.NO.	Test Name	Test Procedure
1	Water Ingress Test	(IEC 60794-1-F5 / EIA 455-82B) Test duration : 24 hours
2	Seepage of filling compound	(EIA 455-81A) Preconditioning : 72 hours, Test duration : 24 hours.
3	Crush Test	(IEC 60794-1-E3/ EIA 455-41)
4	Impact Test	(IEC-60794-1-E4/ EIA 455-25A)
5	Stress strain Test	(EIA 455-33A)
6	Cable Cut-off wavelength Test	(EIA 455-170)
7	Temperature Cycling Test	(IEC60794-1-F1/EIA-455-3A) – 2 cycles
-End Of Table-		

1.4 Factory Acceptance Test Requirement

Table 5:
Factory Acceptance Testing for Fibre Optic Transmission System

Item:	Description:
1.	Physical inspection for conformance to DRS, BOQ, drawings and appearance of equipment
2.	Optical output power
3.	Transmitter lightwave spectral analysis
4.	Low receive level threshold
5.	Generation of bit error rate curve
6.	Measurement of analog and digital service channel parameters as well as service channel functionality
7.	Performance of supervision, alarm, Craftsperson interface, diagnostics, loop backs etc.
8.	Electrical interface tests which include: output and input jitter, bit error rate, pulse shape, cable compensation, and line rate tolerance for multiplexers
9.	At a minimum tests on Ethernet interface shall include demonstration of ping test, throughput test, Latency test, Packet Loss test as per RFC 2544
11.	Simulation of failure conditions and failover of each redundant unit.
12.	VLAN (Layer-2 switching) feature testing configuration.
13.	Protection scheme for Ethernet Traffic (ERPS)
14.	Test of spare card slots
15.	Checks of power supply/converter voltage margins
16.	Random inspections to verify the accuracy of documentation
17.	Test of spare parts/modules/cards as per applicable tests

Table 6 FAT on NMS (Craft Terminal)	
1	Physical inspection of NMS hardware (Craft Terminal) for conformance to approved BoQ, DRS & drawing
2	Testing of NMS to demonstrate proper operation of all functions: Configuration Management, Performance Management, Fault Management and Security Management.

Table 7 **Factory Acceptance Tests On Approach Cable**
Factory Acceptance Test
Attenuation Co-efficient at 1310 nm and 1550 nm
Point discontinuities of attenuation
Visual Material verification and dimensional checks as per approved DRS/Drawings

Table 8 Factory Acceptance Test
Visual check of Quantities and Specific Component Number for each component of FODP and dimensional checks against the approved drawings.

1.5 Site Acceptance Tests

All equipment shall be tested on site under the conditions in which it will normally operate.

The tests shall be exhaustive and shall demonstrate that the overall performance of the contract works satisfies every requirement specified. At a minimum Site Acceptance Testing requirement for Telecom equipment, NMS etc. is outlined in following section. This testing shall be supplemented by the Contractor's standard installation testing program, which shall be in accordance with his quality plan(s) for Telecom equipment installation.

During the course of installation, the Employer shall have full access for inspection and verification of the progress of the work and for checking workmanship and accuracy, as may be required. On completion of the work prior to commissioning, all equipment shall be tested to the satisfaction of the Employer to demonstrate that it is entirely suitable for commercial operation.

1.5.1 Phases for Site Acceptance Testing

The SAT shall be completed in following phases:

1.5.1.1 Installation Testing

The field installation test shall be performed for all equipment at each location. If any equipment has been damaged or for any reason does not comply with this Specification, the Contractor shall provide and install replacement parts at its own cost and expense.

In the installation test report, the Contractor shall include a list of all hardware or components replaced or changed between the completion of factory tests and the start of field tests and show that documentation and spare parts have been updated.

The minimal installation testing requirements for fiber optic transmission subsystem are provided in the table below:

Table 9
Fibre Optic Transmission system Installation Testing

Item:	Description:
1.	Physical Inspection for conformance to drawings, rack elevations and appearance of equipment and cabling
2.	Equipment power supply (DC-DC converter) output voltage measurements
3.	Terminal transceiver performance testing (Tx power, Tx spectrum, receive signal strength, connector losses etc.)
4.	Service channel performance
5.	Craftsperson interface, alarm and control functional performance
6.	Rack and local alarms: No alarms shall be present and all alarms shall be demonstrated to be functional
7.	Network management interface and supervision performance
8.	Correct configuration, level setting & adjustments and termination of Input/ output interfaces
9.	Proper establishment of Safety and signalling earthing system and resistance to ground to be checked.
10.	Simulation of failure conditions and failover of protected components.

1.5.1.2 Link Commissioning Tests

The commissioning tests shall verify that communication can be performed over the fiber optic link under test. Delay measurement, Bit Error measurements & service channel performance monitoring shall be made on the fibre optic links to verify compliance with designed link performance.

For Ethernet interface: At a minimum the following test requirements shall be demonstrated as per RFC 2544:

a) Ping test
b) Throughput test
c) Latency test
d) Packet Loss

The links shall be tested for 12 Hour. In case any link does not meet the performance requirements during 12 hour, then the cause of failure shall be investigated and the test shall be repeated after rectifying the defects.

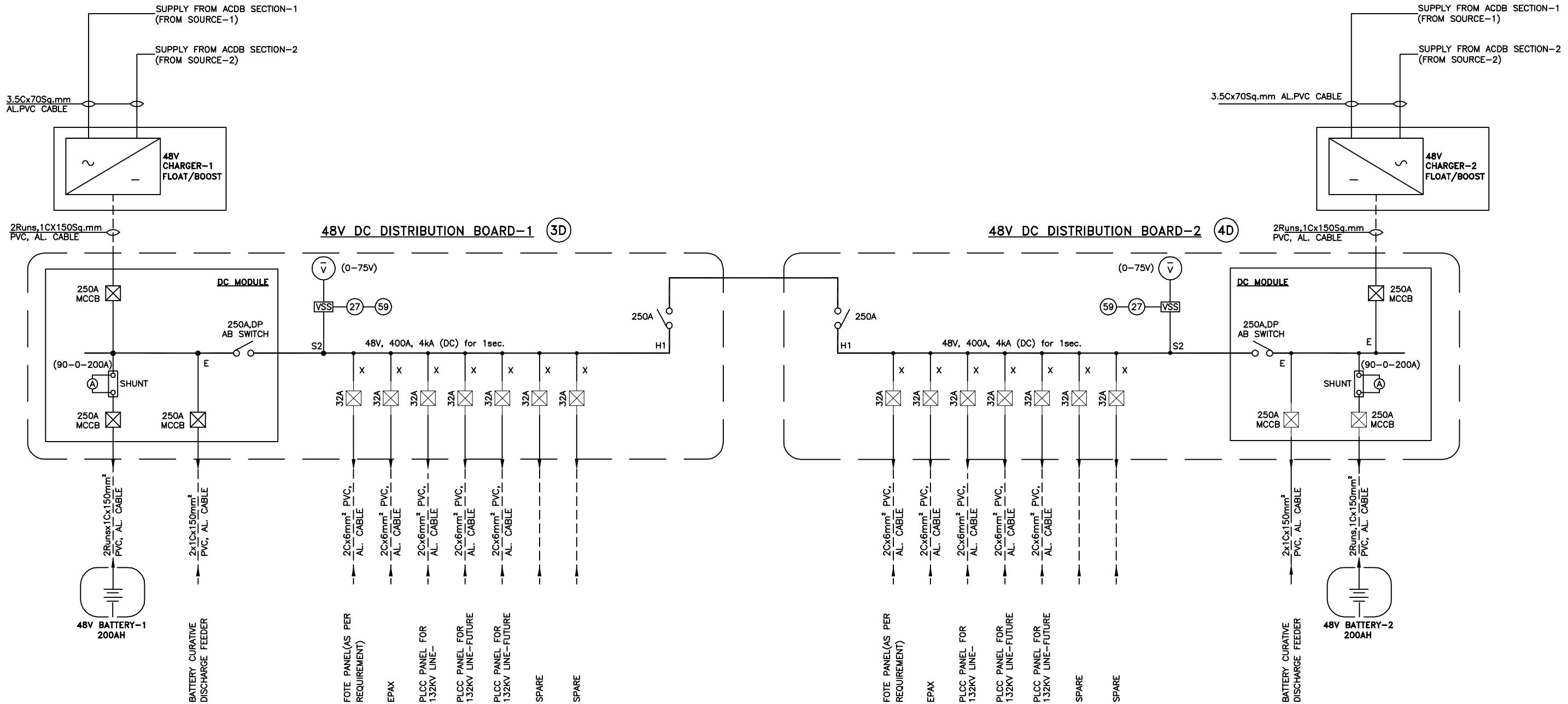
This phase of testing shall be conducted by the Contractor and witnessed by the Employer. Field adjustments shall be made to meet established standard, however if the field adjustments fail to correct the defects the equipments may be returned to the Contractor for replacement at his own expense. In case any adjustments are required to be made during the interval of the test then the test shall be repeated.

1.5.1.3 Integrated Testing

Prior to commencement of integrated testing the overall system shall be configured as required to provide all the data and voice channel required to interconnect to control centres and other nodes in existing system. The integrated testing shall include end-to-end testing of communication.. The intent of integrated testing is to demonstrate that the equipment is operational end to end under actual conditions, that all variances identified during factory and field installation and communications testing have been corrected, and that the communication equipment is compatible with other equipment. The Integrated System Test shall include all fibre optic transmission equipment, the network management subsystem (Craft Terminal) and other components.

At a minimum the following tests shall be included in the integrated testing:

(1) Equipment configuration shall be checked to establish that it supports the channel routing.
(2) End to end testing of all individual voice circuits (VOIP) and to demonstrate proper operation of channels over wideband systems. Operation shall be checked in terms of quality of voice, call initiation and call termination processes.
(3) End-to-end testing of all individual Data Circuits (Ethernet) and E1 channel routing. Individual port of each tributary card to be checked. Operation shall be checked in terms of monitoring of BER/packet loss.
(5) Testing of NMS (Craft Terminal) to demonstrate proper operation of all functions. All the standard features of the NMS (Craft Terminal) shall be demonstrated for proper functioning.
(6) Demonstration of Protection switching and synchronization of equipment.



LEGEND:-

SYMBOL	DESCRIPTION
⊠	DOUBLE POLE MCCB
(A)	AMMETER
(V)	VOLTMETER
VSS	VOLTMETER SELECTOR SWITCH
(27)	U/V RELAY
(59)	O/V RELAY

NOTES:-

1. DCDB SHALL MEET REQUIREMENT AS PER SECTION LT SWITCHGEAR OF TECHNICAL SPECIFICATION.
2. ALL DIGITAL/ANALOGUE INPUT/OUTPUTS REQUIRED FOR SAS SYSTEM SHALL BE CONSIDERED BY THE LT SWITCHGEAR MANUFACTURER.

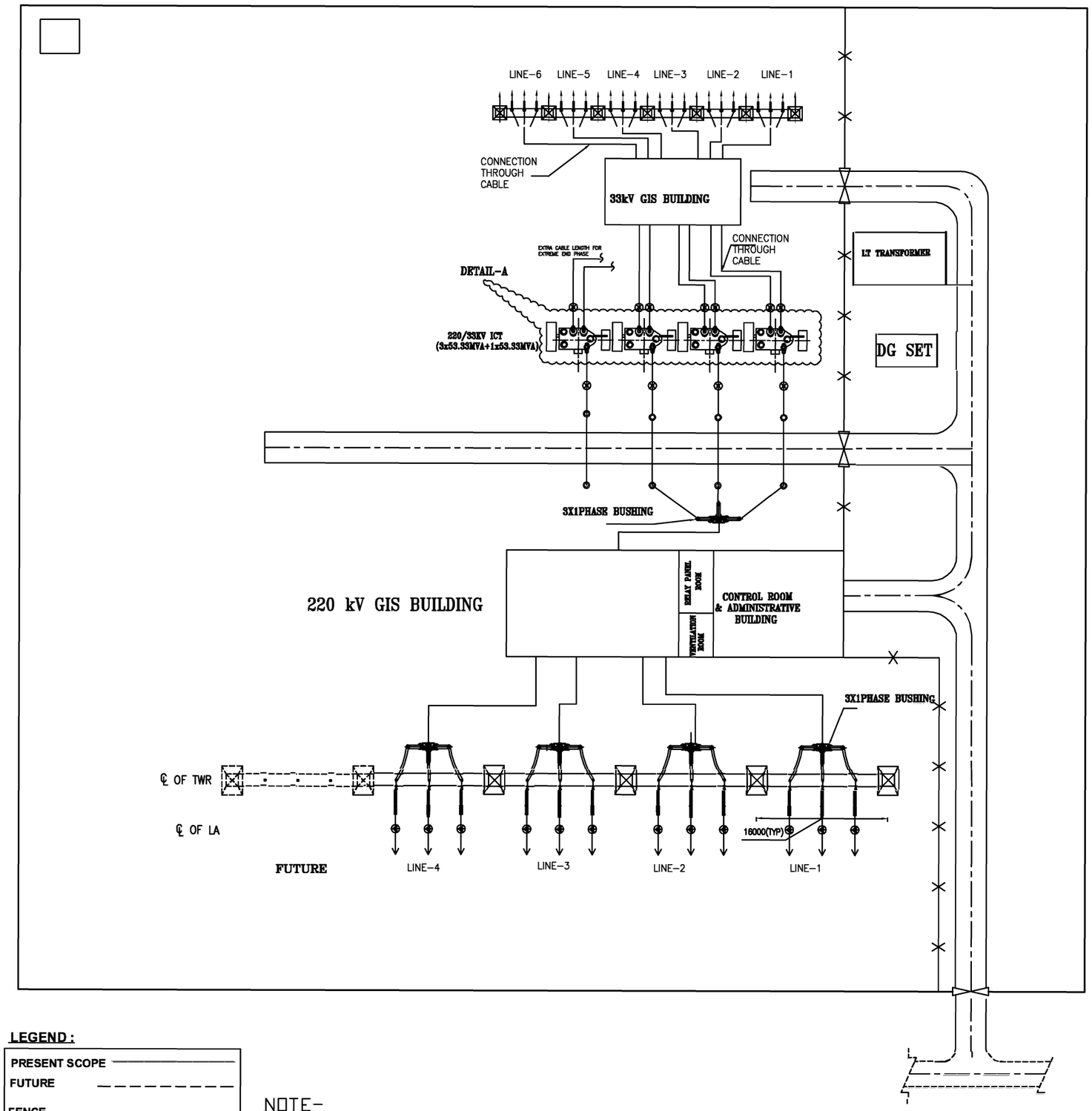
RELEASED FOR TENDER

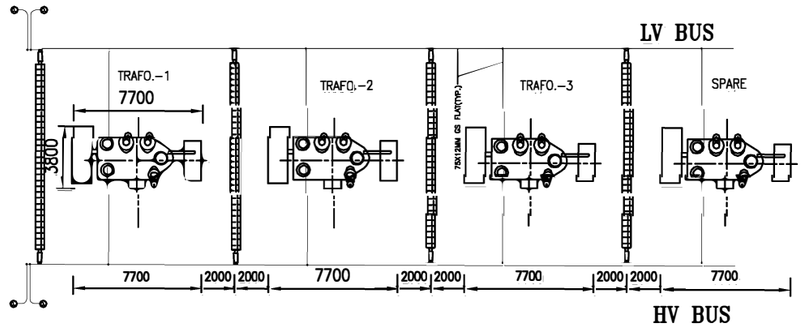
REC TRANSMISSION PROJECTS COMPANY LTD.

PROJECT :	220/33kV GIS LASSIPORA SS
TITLE :	SINGLE LINE DIAGRAM FOR 48V DCDB
SHEET 1 OF 1	

130000

120000





DETAIL-A

LEGEND :

PRESENT SCOPE

FUTURE

FENCE

NOTE-

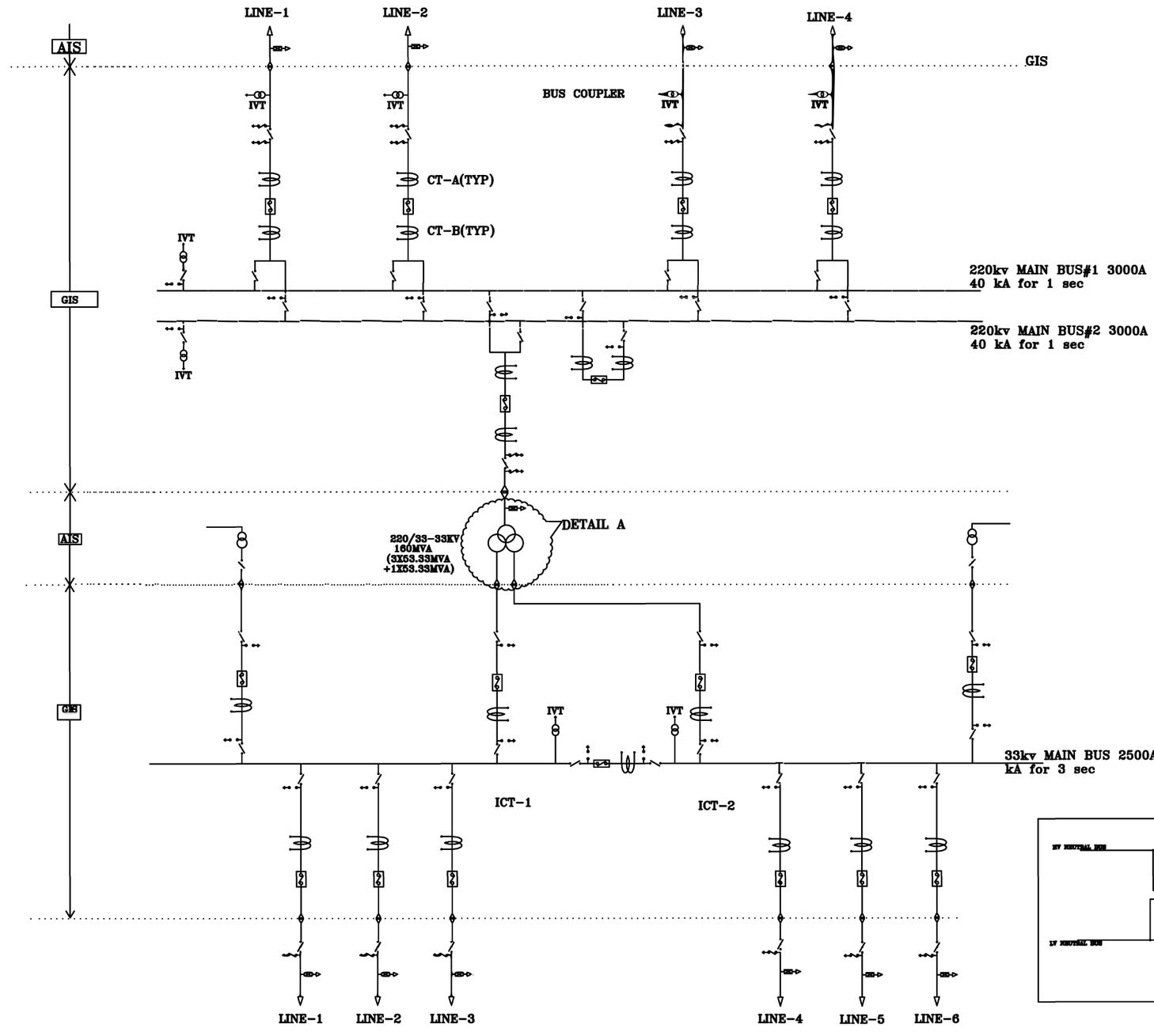
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

REC TRANSMISSION PROJECTS COMPANY LTD.

PROJECT:
160MVA,220/33kV GIS SUBSTATION AT LASSIPORA

TITLE: GENERAL ARRANGEMENT

DRG. NO. | TND | REC | J&K | DRG | GA | 04 |



TYPICAL 220kV CT DETAILS:

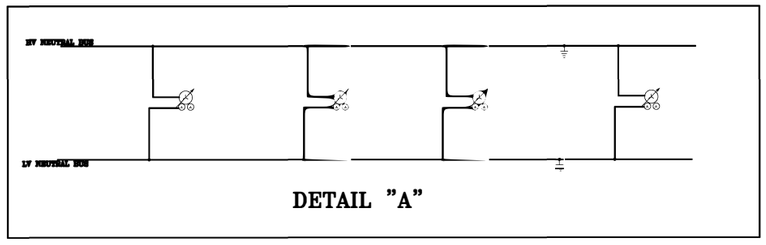
CT-A : CORE 1-FEEDER PROTECTION
CORE 2-FEEDER PROTECTION
CORE 3-METERING

CT-B : CORE 1- BUS BAR PROTECTION
CORE 2-BUSBAR PROTECTION

LEGEND:

——— – UNDER PRESENT SCOPE

– – – – – FUTURE/EXISTING



DETAIL "A"

NOTE: For Spare Transformer Switching Scheme, Please refer clause no. 4.1.1 (b7) & 4.1.1 (c) of Section – Project.

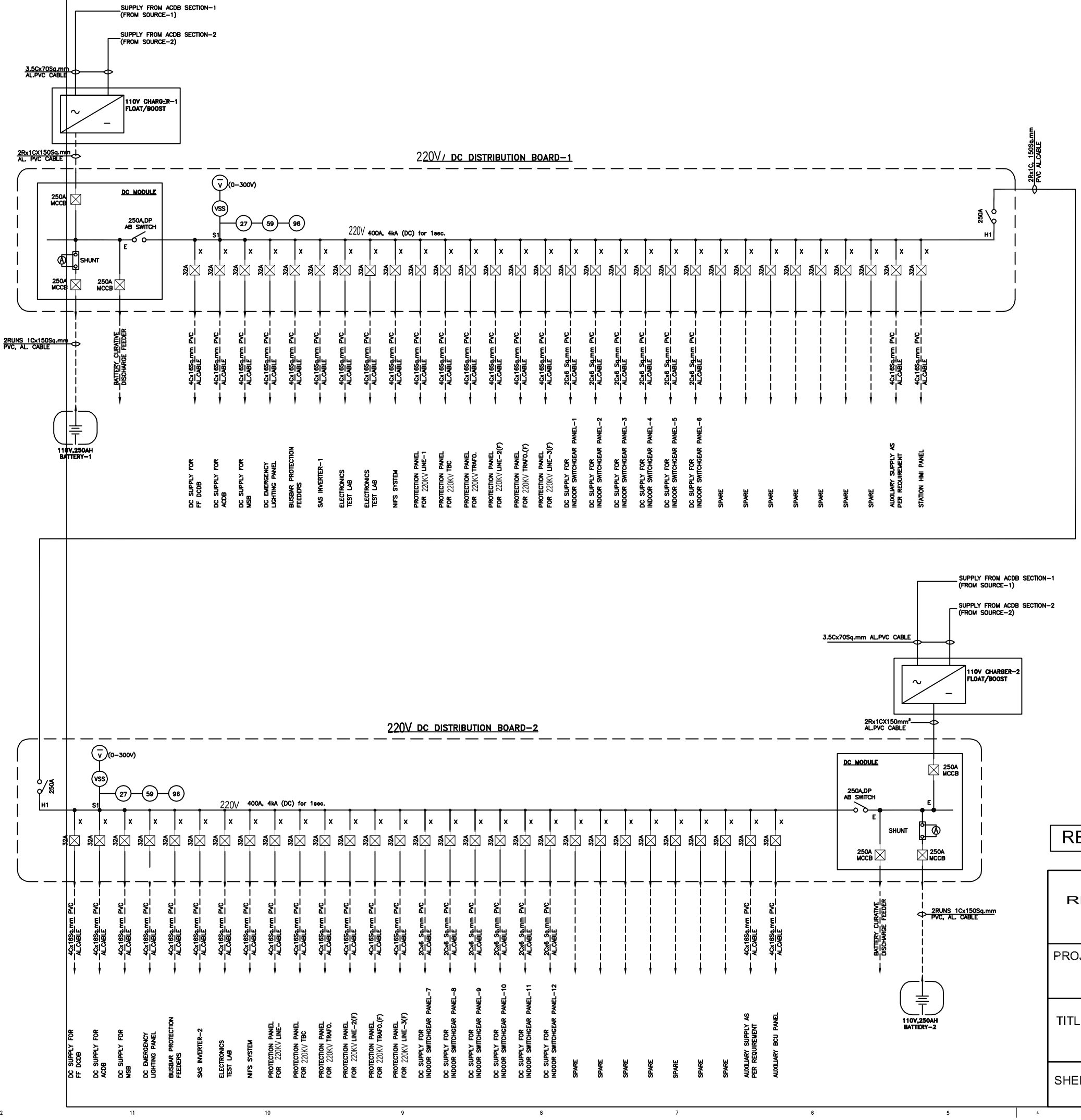
FOR TENDER PURPOSE ONLY.

REC TRANSMISSION PROJECT COMPANY LTD.

PROJECT:

160MVA, 220/33kV GIS SUBSTATION AT LASSIPORA

TITLE: SINGLE LINE DIAGRAM



LEGEND:-

SYMBOL	DESCRIPTION
⊠	DOUBLE POLE MCCB
	DOUBLE POLE AIR BREAK SWITCH
	DOUBLE POLE MCB
(A)	AMMETER
(V)	VOLTMETER
(VSS)	VOLTMETER SELECTOR SWITCH
(27)	U/V RELAY
(59)	O/V RELAY
(96)	EARTH LEAKAGE RELAY

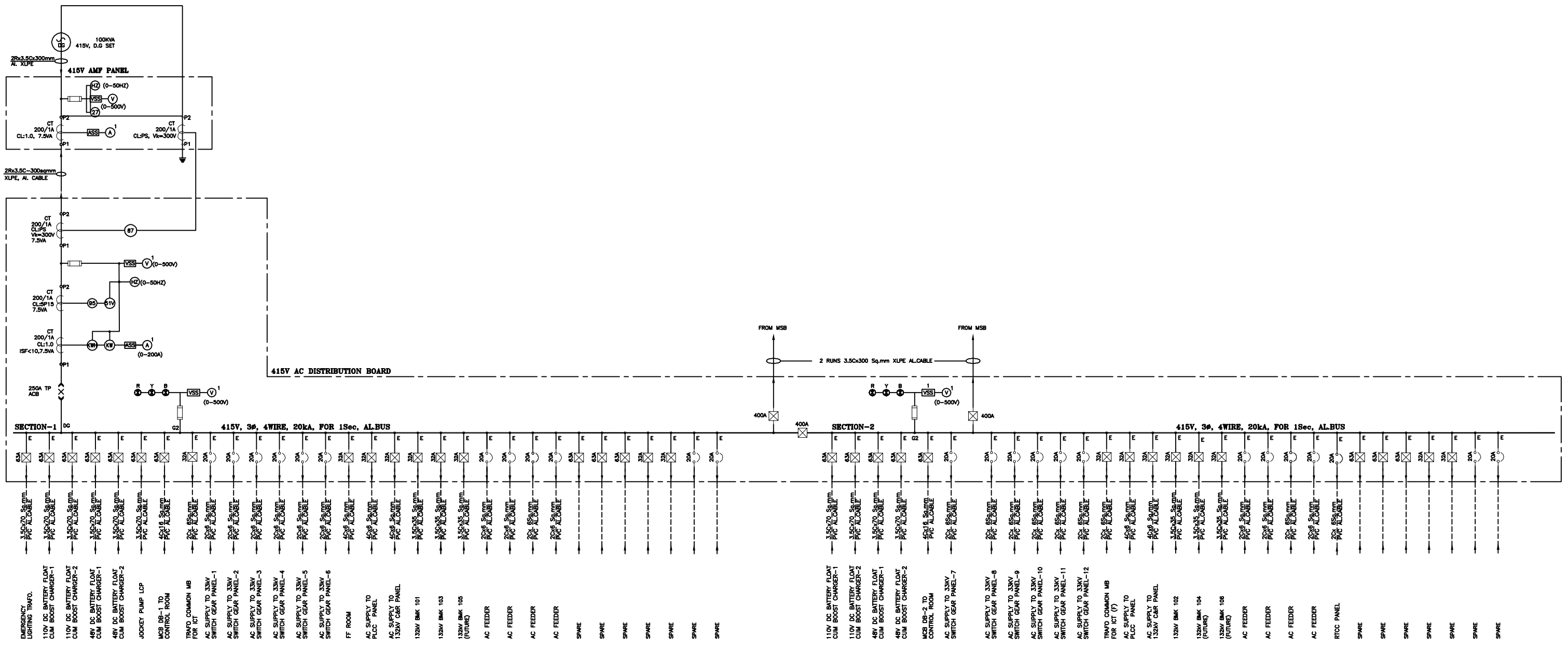
NOTE :-

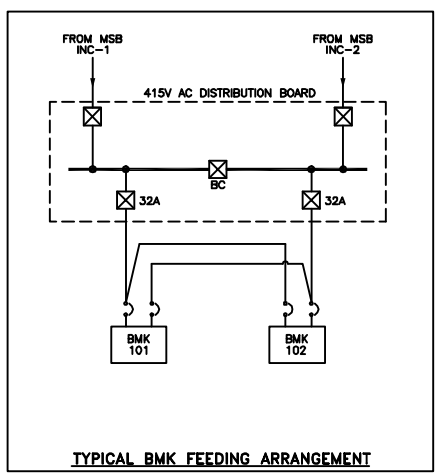
1. NUMBER OF FEEDERS SHALL BE PROVIDED IN EACH BOARD AS PER REQUIREMENT OF SUB-STATION.
2. ONE DC 'X' TYPE MODULE IN EACH 110V DCDB SHALL BE PROVIDED FOR EACH LINE, TRANSFORMER, BUS REACTOR, TBC, BC BAY INCLUDING FUTURE BAYS AS SHOWN IN SUBSTATION SLD.
3. RATING OF BUS BARS/FEEDERS INDICATED IN THIS DRAWING ARE MINIMUM REQUIREMENT AND MAY BE INCREASED DURING DETAILED ENGINEERING IF FOUND INADEQUATE RESPECT TO OFFERED LOADS / SYSTEM.
4. ALL DIGITAL/ANALOGUE, INPUT/OUTPUTS REQUIRED FOR SAS SYSTEM SHALL BE CONSIDERED BY THE LT SWITCHGEAR MANUFACTURER.
5. AS PER VENDOR DRAWINGS OF 33kV GIS PANEL ONLY ONE DC SUPPLY IS USED. HENCE WE HAVE INDICATED SIX GIS PANELS IN DCDB-I & ANOTHER SIX PANELS IN DCDB-II.

RELEASED FOR TENDER

REC TRANSMISSION PROJECTS COMPANY LTD.	
PROJECT :	220/33KV GIS LASSIPORA SS
TITLE :	SINGLE LINE DIAGRAM FOR 110V DCDB
SHEET 1 OF 1	

841 X 594 – A1





TYPICAL BMK FEEDING ARRANGEMENT

LEGEND:-

SYMBOL	DESCRIPTION
VSS	VOLTMETER SELECTOR SWITCH
KW	KILO WATT METER
KWH	KILO WATT HOUR METER
HZ	FREQUENCY METER
27	2 POLE INSTANTANEOUS UNDER VOLTAGE RELAY + AUXILIARY RELAY + TIMER
51	IDMT OVER CURRENT RELAY
51N	IDMT EARTH FAULT RELAY
51V	VOLTAGE CONTROLLED DEFINITE TIME O/C RELAY
87	DIFF. PROTECTION RELAY
	DIESEL GENERATOR SET
95	OVERLOAD ALARM RELAY

LEGEND:-

SYMBOL	DESCRIPTION
	DRAWOUT TYPE 3 POLE AIR CIRCUIT BREAKER (DRAWOUT TYPE)
	4POLE MOULDED CASE CIRCUIT BREAKER (MCCB) (NON DRAWOUT TYPE)
	DOUBLE POLE MCB
	FUSE
	INDICATING LAMP
	CURRENT TRANSFORMER
A	AMMETER
V	VOLTMETER
ASS	AMMETER SELECTOR SWITCH

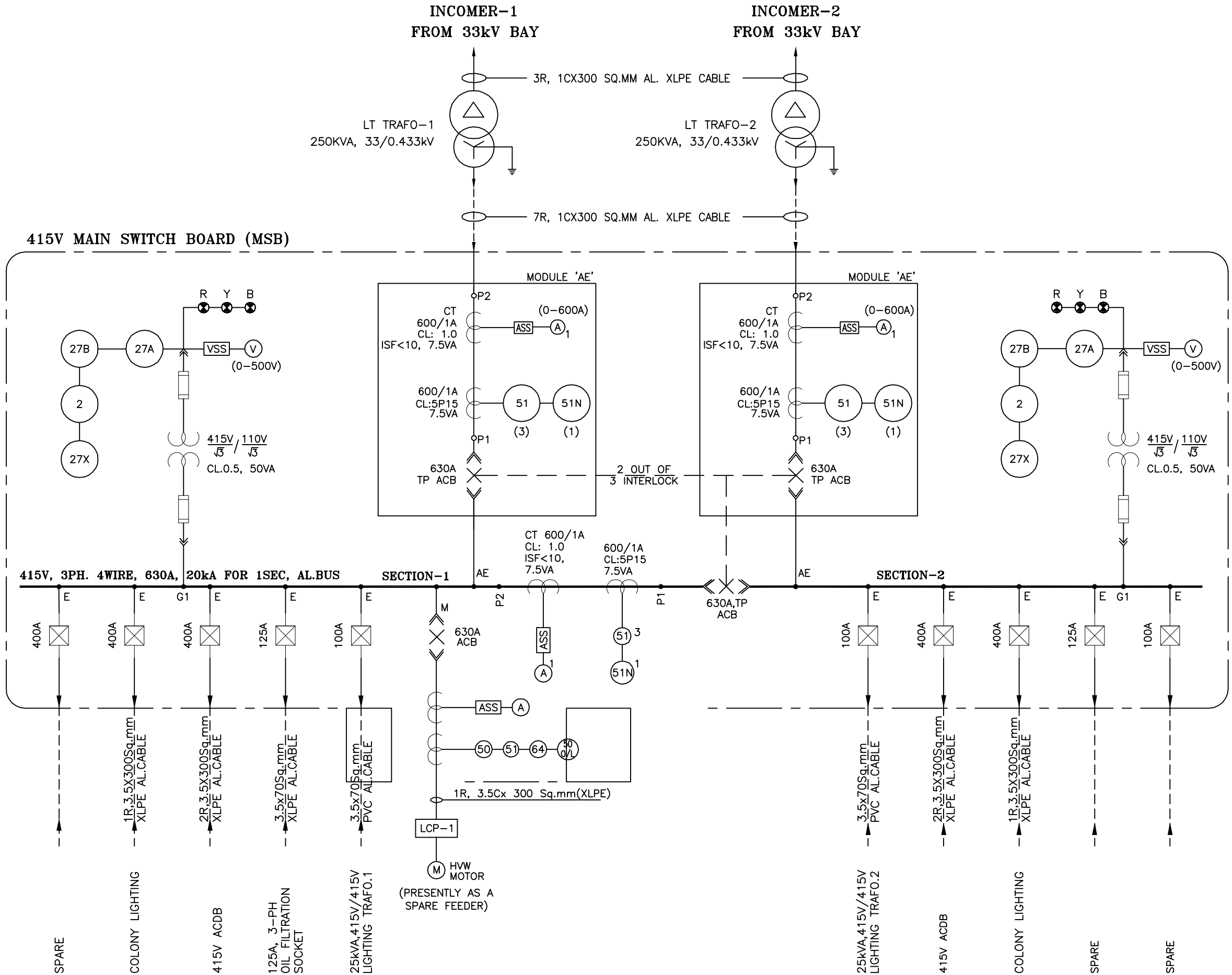
NOTE :-

1. INTERLOCK SHALL BE PROVIDED BETWEEN INC1, INC2 & B/C SUCH THAT ONLY TWO BREAKERS SHALL BE IN SERVICE AT A TIME IN MAIN SWITCHBOARD.
2. NO TWO AC SOURCE SHALL BE PARALLELED AT ANY STAGE.
3. DC SET SHALL BE AUTO START TYPE.
4. EACH BAY MB & TRANSFORMER MB SHALL BE FED BY ATLEAST ONE SOURCE FROM 415V ACDB. SECOND SOURCE SHALL BE LOOPED FROM NEAREST BAY MB & TRANSFORMER MB WHICH SHALL BE FED FROM ANOTHER SOURCE FROM 415V ACDB.
5. 1PH & 3PH AC SUPPLY FOR ALL BAY EQUIPMENTS SHALL BE FED FROM THE BMK.
6. AUTOMATIC SUPPLY CHANGE OVER SHALL BE ACHIEVED AS PER TECHNICAL SPECIFEICATION, SECTION –LT SWITCHGEAR.
7. AS PER VENDOR DRAWINGS OF TRANSFORMER COMMON MARSHALLING BOX AND 33kV GIS PANEL, ONE SINGLE PHASE AC SUPPLY IS REQUIRED. HENCE WE HAVE INDICATED SINGLE PHASE FEEDERS.

RELEASED FOR TENDER

REC TRANSMISSION PROJECTS COMPANY LTD.	
PROJECT :	220/33kV GIS LASSIPORA SS
TITLE :	SINGLE LINE DIAGRAM FOR 415V ACDB
SHEET 1 OF 1	

841 X 594 – A1



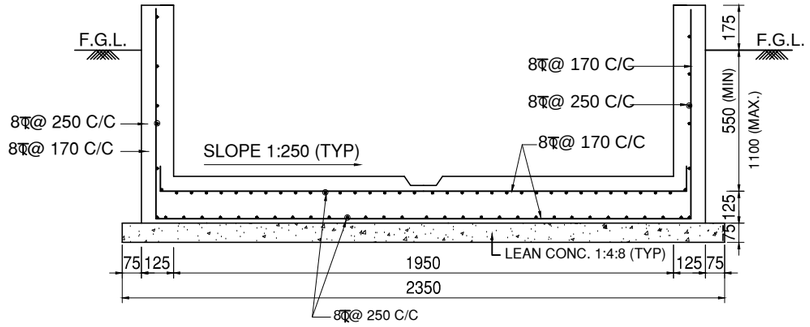
LEGEND:-

SYMBOL	DESCRIPTION
	3 POLE AIR CIRCUIT BREAKER (DRAWOUT TYPE)
	FOUR POLE MOULDED CASE CIRCUIT BREAKER (NON DRAWOUT TYPE)
	FUSE
	INDICATING LAMP
	CURRENT TRANSFORMER
	VOLTAGE TRANSFORMER
A	AMMETER
V	VOLTMETER
ASS	AMMETER SELECTOR SWITCH
VSS	VOLTMETER SELECTOR SWITCH
27A 27B	UNDER VOLTAGE RELAY
27X	VOLTAGE MONITARING RELAY
50	INSTANTANEOUS OVER CURRENT RELAY
50 O/L	OVER LOAD RELAY
51	IDMT OVER CURRENT RELAY
51N	IDMT EARTH FAULT RELAY
2	TIMER
64	EARTH FAULT RELAY

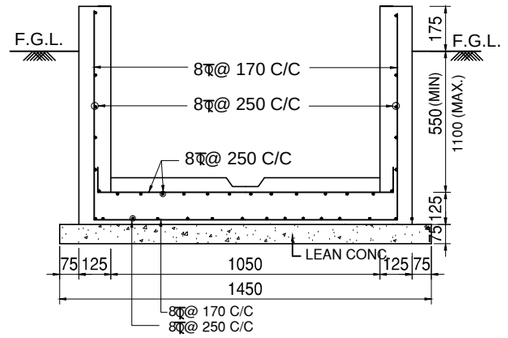
RELEASED FOR TENDER

REC TRANSMISSION PROJECTS COMPANY LTD.	
PROJECT :	220/33kV GIS LASSIPORA SS
TITLE :	**SINGLE LINE DIAGRAM FOR 415V MAIN SWITCH BOARD**
SHEET 1 OF 1	

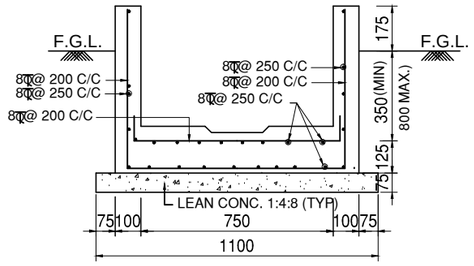
420 X 297 – A3



SECTION 1-1



SECTION 2-2



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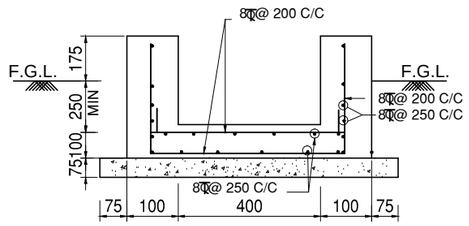
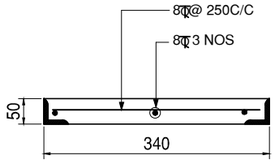
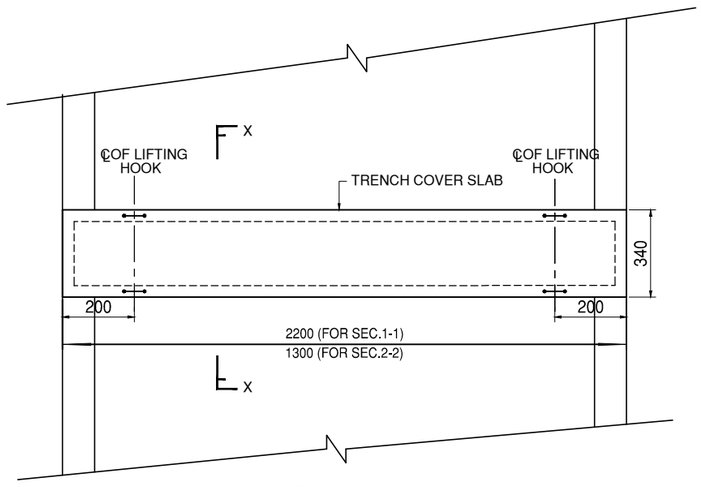


SECTION 4-4

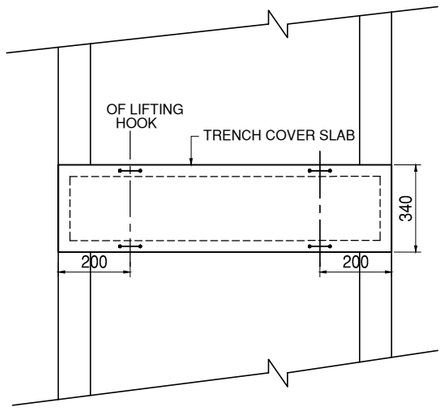


SECTION X-X



PLAN

(DETAIL OF TRENCH COVER FOR SECTION 1-1 & 2-2)



(DETAIL OF TRENCH COVER FOR SECTION 3-3 & 4-4)

NOTE:

1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE SPECIFIED.
2. R.C.C. MIX.SHOULD BE 1:1.5:3 (1 CEMENT: 1.5 COARSE SAND:3 STONE AGGREGATE 20mm NOMINAL SIZE.)
3. LEAN CONC. SHALL BE IN THE RATIO.1:4:8.
4. FOR ALL OTHER NOTES REF. DRG. No. C/ENGG/STD/CT-1(SHEET-2)

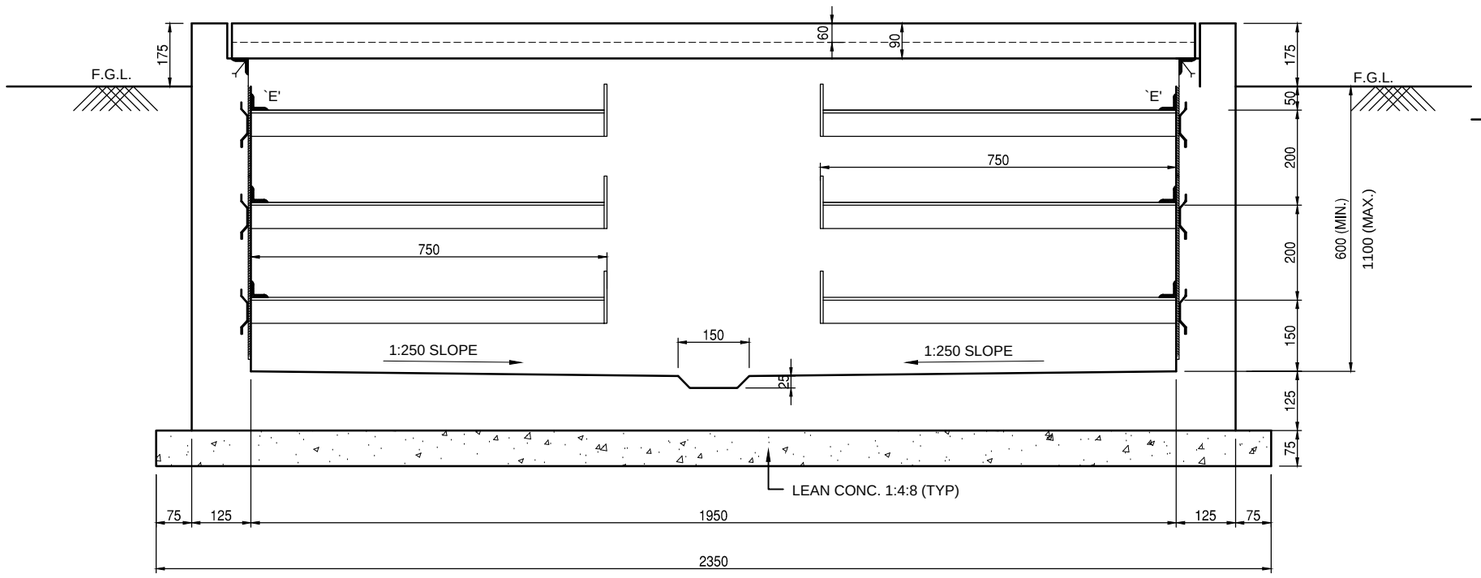
RELEASED FOR TENDER

REC TRANSMISSION PROJECTS COMPANY LTD.

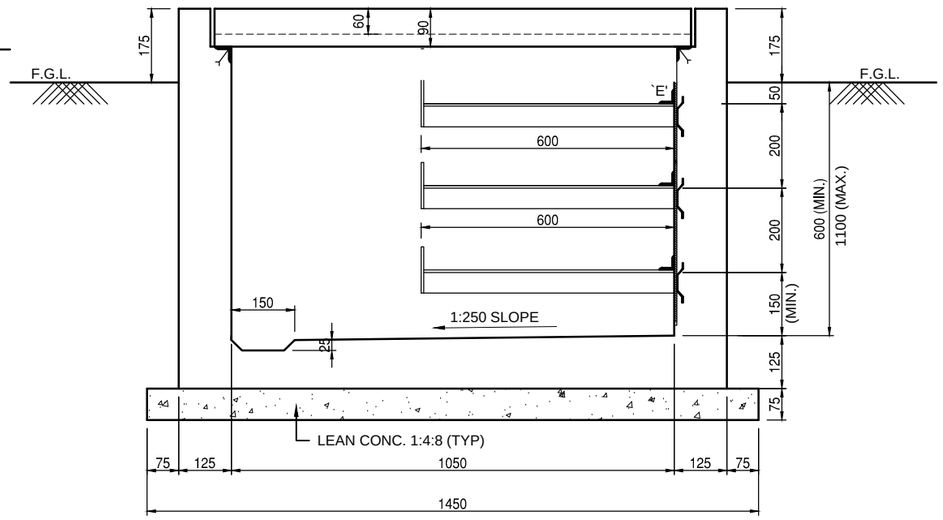
PROJECT : **STANDARD DRAWING FOR CABLE TRENCH**

TITLE : **R.C.C. DETAIL FOR CABLE TRENCH SECTIONS.**

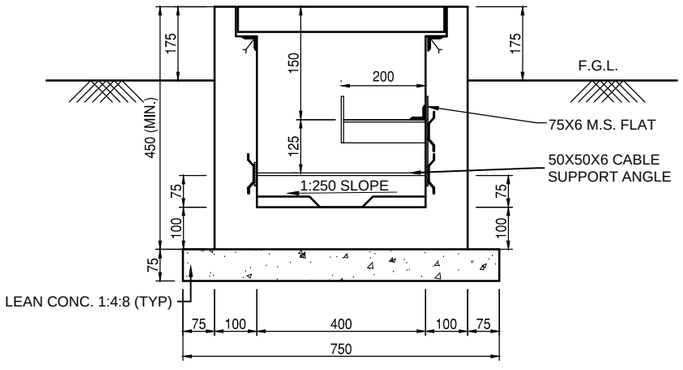
ACDE(ENGG-CIVIL)	CDE(ENGG-CIVIL)	DGM(ENGG-CIVIL)	AGM(ENGG-TL/CIVIL)	GM(ENGG-S/S)	GM(ENGG-TL/CIVIL)	ED(ENGG)	DATE	SCALE	DRAWING NO.	REV
								NTS	C/ENGG/STD/CT-2	R-0



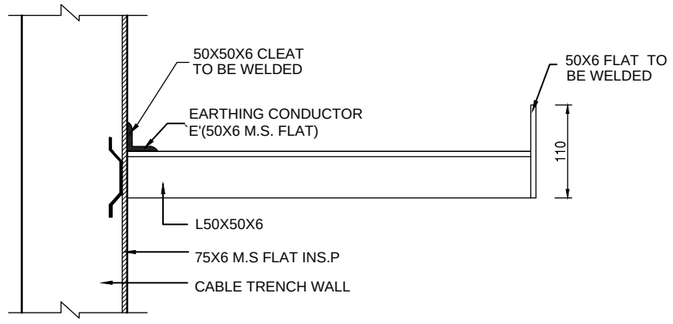
SECTION 1-1



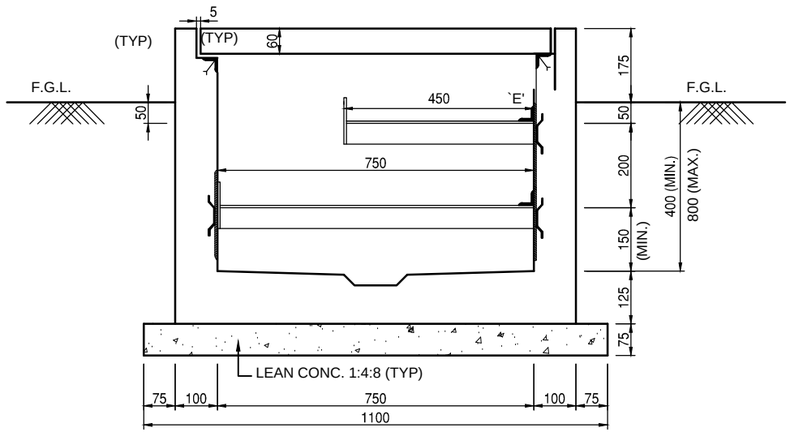
SECTION 2-2



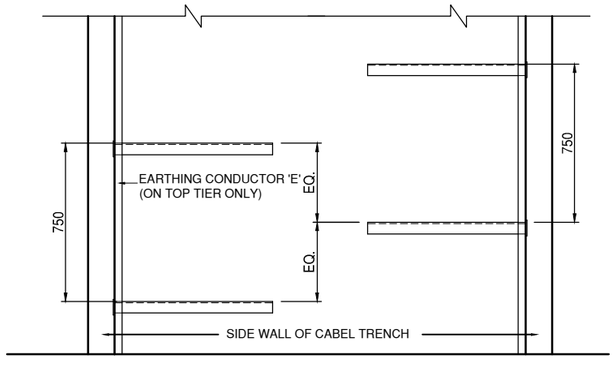
SECTION 4-4



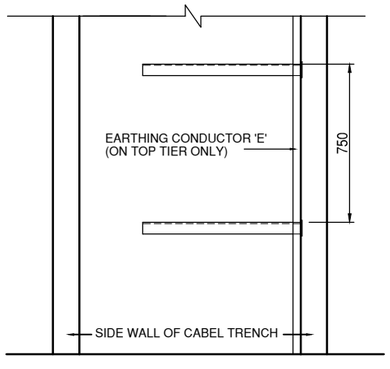
TYPICAL CABLE SUPPORT



SECTION 3-3



PLAN
CABLE TRAY SUPPORT FOR SECTION 1-1



PLAN
CABLE TRAY SUPPORT FOR
SECTION 2-2 & 3-3

RELEASED FOR TENDER

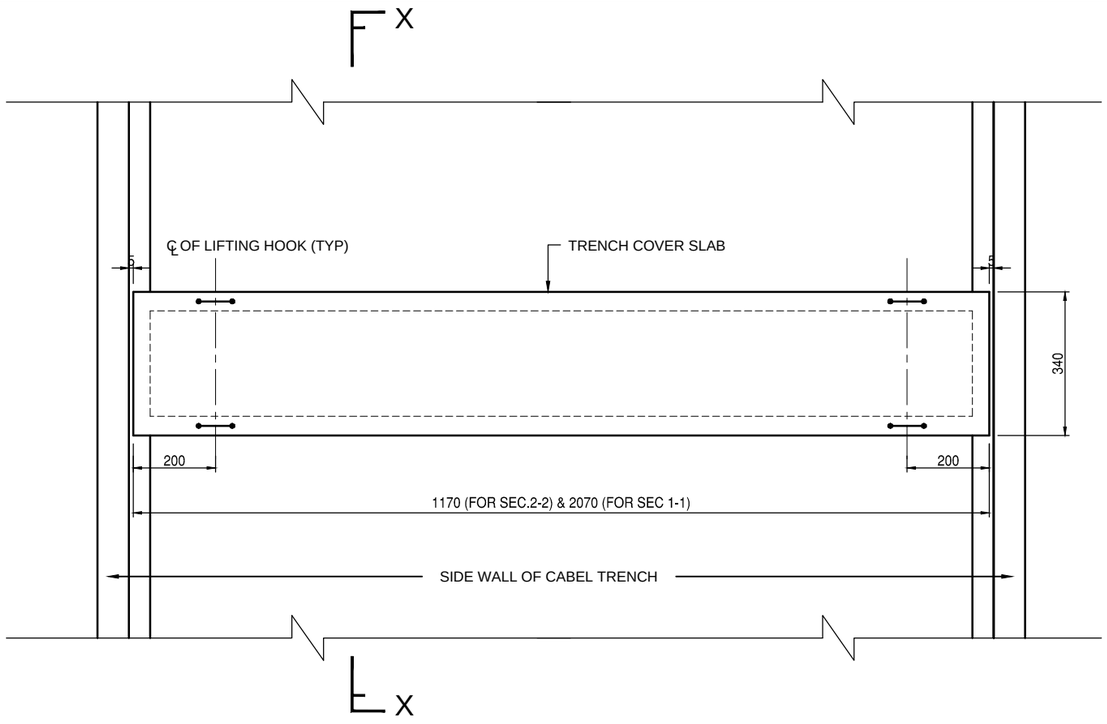
REC TRANSMISSION PROJECTS COMPANY LTD.

PROJECT : **STANDARD DRAWING FOR CABLE TRENCH**

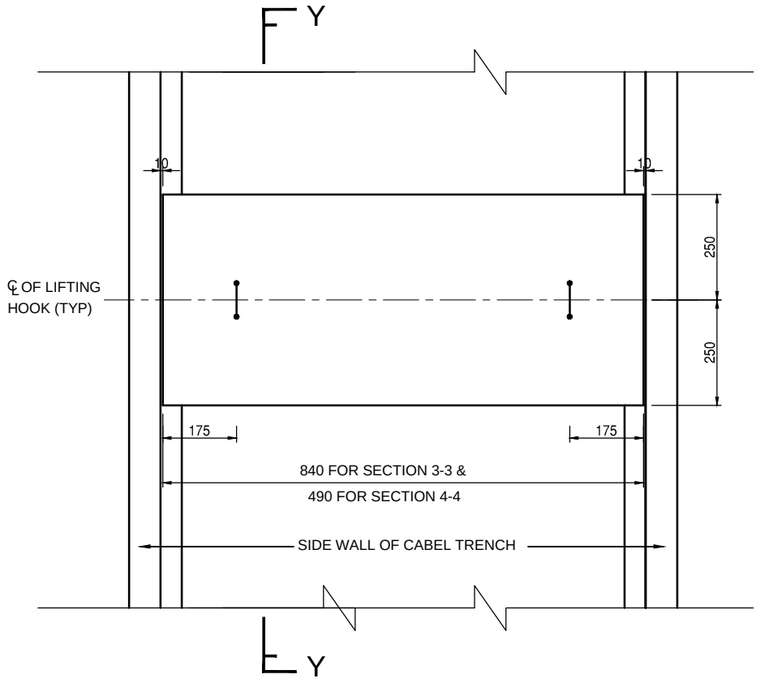
TITLE : **DETAIL FOR CABLE TRENCH SECTIONS.**

REV.	DESCRIPTION	CLEARED BY				
		CIVIL	REVD	ELECT	APPD	DATE
0	RELEASED FOR TENDER & CONSTRUCTION.					

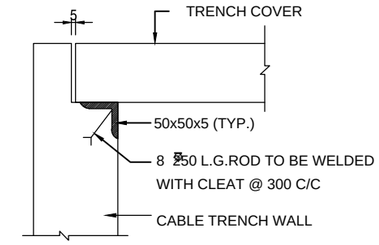
SCALE **NTS** | DRAWING NO. **C/ENGG/STD/CT-1** | SHEET NO - 1 | **REV R-0**



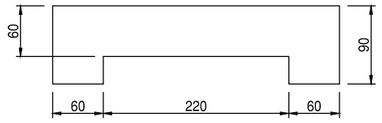
DETAIL OF TRENCH COVER SLAB
FOR SECTION (1-1) & (2-2)



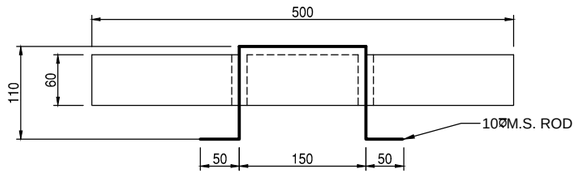
DETAIL OF TRENCH COVER SLAB
FOR SECTION (3-3) & (4-4)



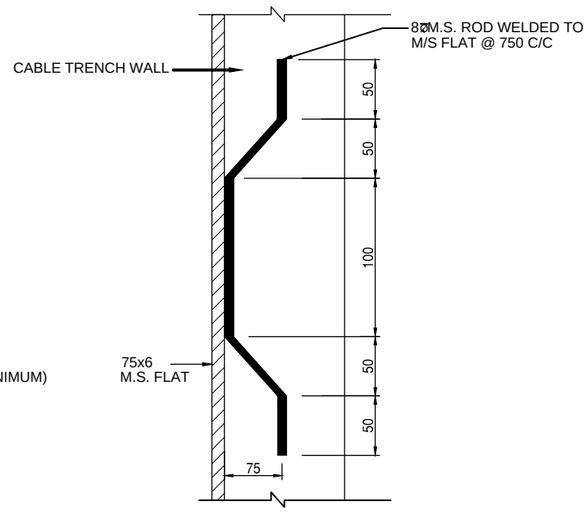
TYPICAL DETAIL OF
SLAB SUPPORT



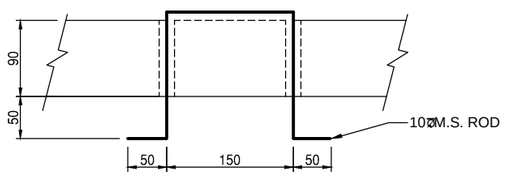
SECTION X-X



SECTION Y-Y



TYPICAL DETIAL OF ANCHORING
75X6 M.S.FLAT



DETAIL OF LIFTING HOOK
FOR SECTION 1-1 & 2-2

NOTE:

1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE SPECIFIED.
2. DO NOT SCALE THE DRG. FOLLOW WRITTEN DIMENSION ONLY.
3. R.C.C. MIX SHALL BE 1:1.5:3
   (1CEMENT:1.5COARSE SAND:3 STONE AGGREGATE)
   20MM NOMINAL SIZE.
4. LEAN CONC. SHALL BE 1:4:8.
5. CLEAR COVER FOR BOTTOM SLAB REINF. ON TOP SIDE IS 25mm.
6. LIFTING HOOK ARE TO BE PROVIDED IN EVERY TENTH SLAB.
7. NECESSARY OPENING SHALL BE PROVIDED AT APPROPROATE
   LOCATION TO TAKE OUT CABLES.
8. FOR ACTUAL DEPTH OF TRENCHES REFER CABLE TRENCH LAYOUT.
9. F.G.L. DENOTES FINISHED GRADED LAVEL (FORMATION LEVEL).
10. F.G.L. TO BE TAKEN FROM LAYOUT DRG.
11. A SLOPE OF 1:250 SHALL BE GIVEN IN THE DIRECTION
    PERPENDICULAR TO THE RUN OF THE TRENCH FOR ALL SECTIONS.
12. ALL CABEL TRENCHES SHALL BE GIVEN A SLOPE OF 1:1000
    IN THE DIRECTION OF MAIN RUN.
13. EARTHING CONDUCTOR `E' 50X6 M.S.FLAT WOULD BE WELDED ON
    THE CABLE SUPPORTING STRUCTURES BEFORE INSTALATION OF CABLE.
14. ALL STEEL STRUCTURE PLATES WOULD BE PAINTED WITH NON
    CORROSIVE PAINT ON A SUITABLE PRIMER BEFORE INSTALLATION
    OF CABLES. EARTHING CONDUCTOR WOULD HAVE RED PAINT.
15. TRENCH WALL SHALL CLEAR THE EQUIPMENT FOUNDATION BY 100mm.(MINIMUM)
16. NECESSARY CONSTRUCTION JOINT SHALL BE PROVIDED AT
    EVERY 30M. MIN OR AS PER SITE REQUIREMENT.
17. 40mm CLEAR COVER FOR WALL AND BOTTOM SLAB REINFORCEMENT
    WHICH IS TOWARDS EARTH SIDE SHALL BE PROVIDED.
18. ALL SUPPORT ANGLE SHALL BE L50X50X6.
19. ANCHORING FLAT (75X6mm)SHALL BE PROVIDED AT EACH
    SUPPORT ANGLE POINT.
20. EARTHING CONDUCTOR MKD.`E' SHALL BE PROVIDED ON THE
    TOP TIER OF EACH CABLE TRENCH SECTIONS.
21. TRENCH WALL SHALL CLEAR THE TOWER FOUNDATION BY 1000mm (MIN.)

REV.	DESCRIPTION	CLEARED BY				
		CIVIL	REVD	ELECT	APPD	DATE
0	RELEASED FOR TENDER & CONSTRUCTION.					

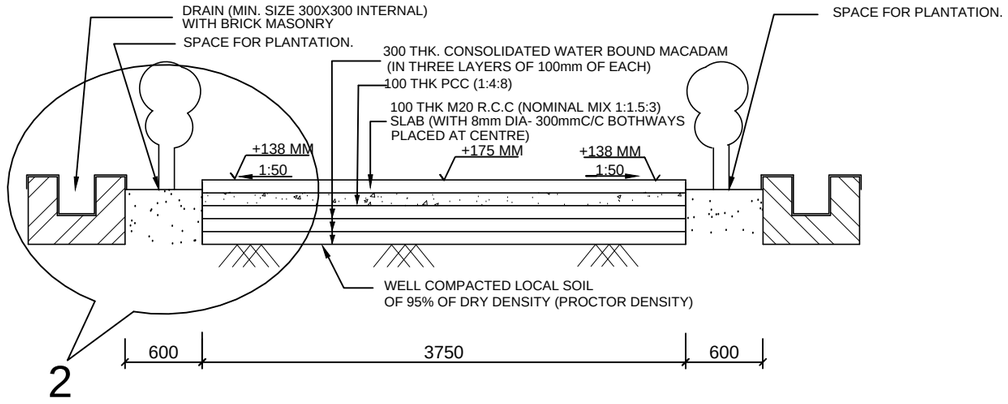
RELEASED FOR TENDER

REC TRANSMISSION PROJECTS COMPANY LTD.

PROJECT : STANDARD DRAWING FOR CABLE TRENCH

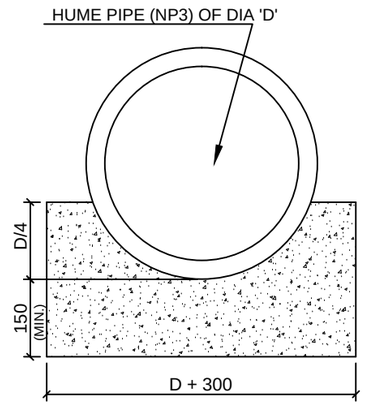
TITLE : DETAIL FOR CABLE TRENCH SECTIONS.

SCALE	DRAWING NO.	REV
NTS	C/ENGG/STD/CT-1 SHEET NO - 2	R-0

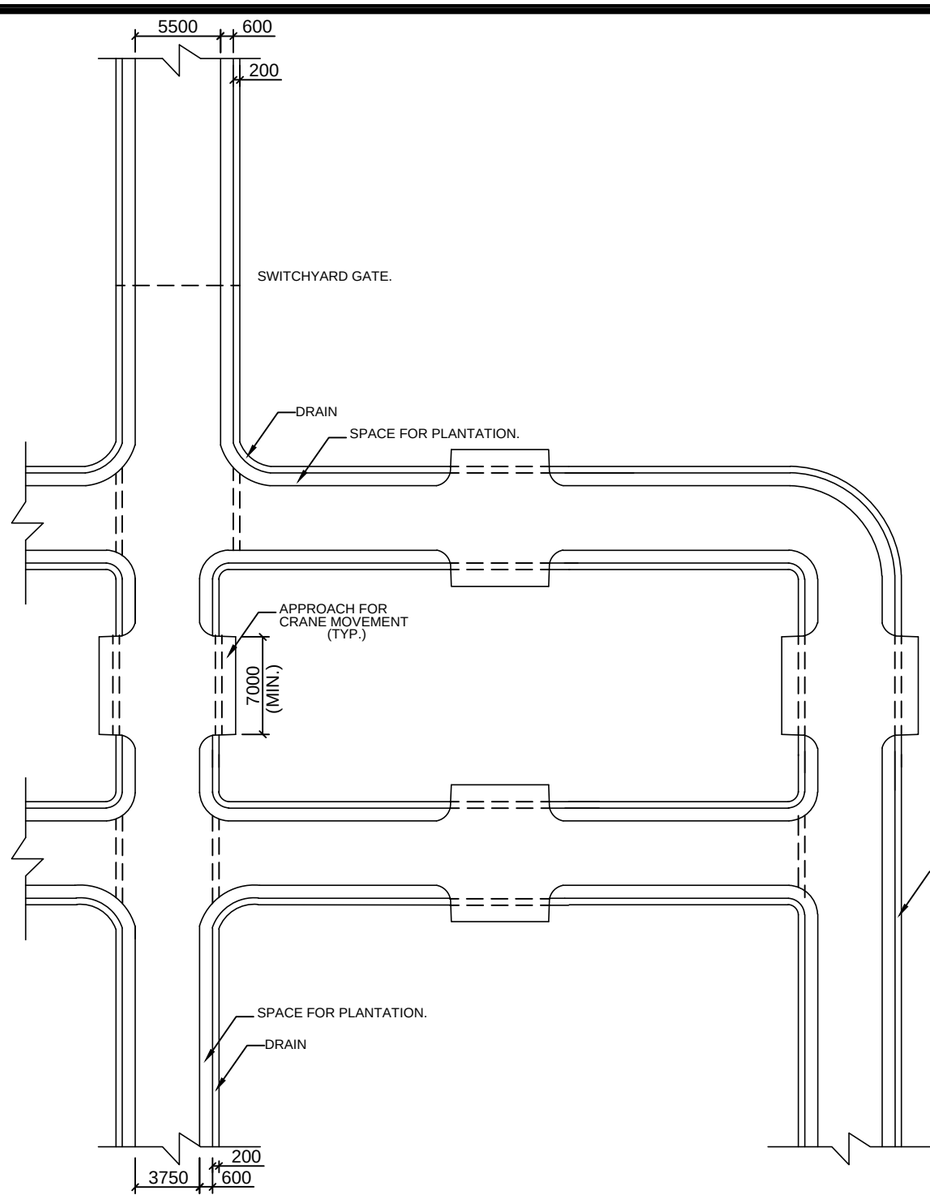


2

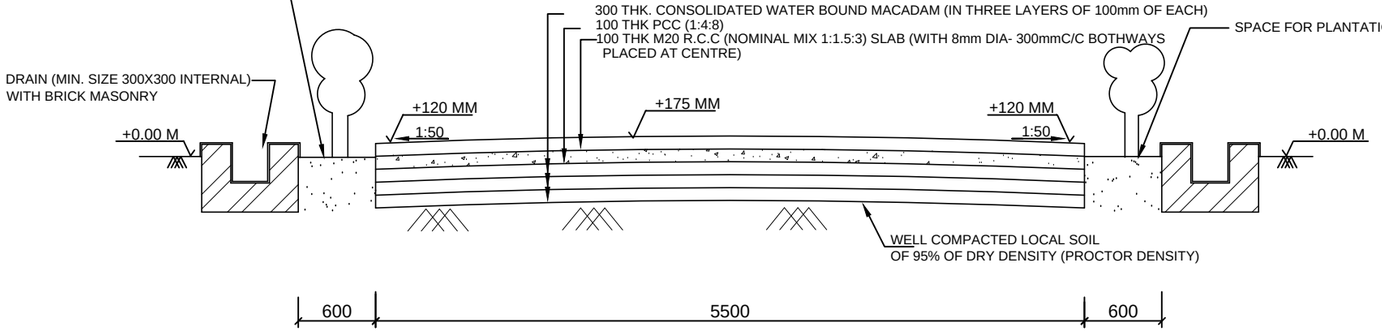
TYP. CROSS SECTION OF 3.75 M WIDE ROAD
(VALID FOR SWITCHYARD INTERNAL ROADS)



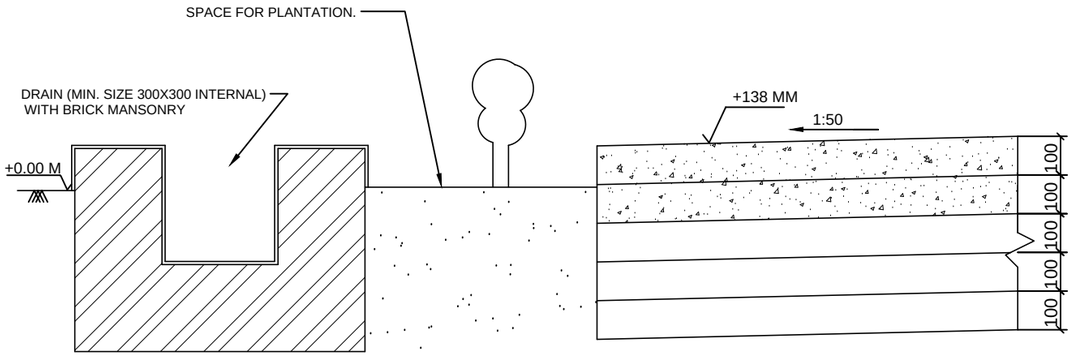
BEDDING FOR HUME PIPE



TYP. SWICHYARD ROAD AND DRAIN LAYOUTPLAN



TYP. CROSS SECTION OF 5.5 M WIDE ROAD
(VALID FOR APPROACH TO SWITCHYARD)



DETIAL - 2

NOTES:

1. ALL DIMESION ARE IN MM UNLESS NOTED OTHERWISE.
2. CAMBER OF 1:50 SHALL BE PROVIDED
3. EXPANSION JOINT (12 MM THICK) SHALL BE PROVIDED AT EVERY 8.0M.
   EXPANSION JOINT SHALL ALSO BE PROVIDED AT CENTRE .
4. POLYTHENE SHEET OF 125 MICRONS SHALL BE PLACED BETWEEN THE PCC AND RCC SLAB. (TOP SLAB)
5. 100MM DIA. RCC HUME PIPE (NP-3) SHALL BE PLACED ACROSS THE ROAD AT EVERY 100M INTERVAL.
   ALONG THE ROAD.
6. FINISHED TOP OF ROAD CREST SHALL BE 175 MM (MIN.) ABOVE F.G.L. (SWITCHYARD FORMATION LEVEL)

RELEASED FOR TENDER

REV.	DESCRIPTION	CIVIL.	REVD.	REVD.	ELEC.	APPD.	DATE.

REC TRANSMISSION PROJECTS COMPANY LTD.

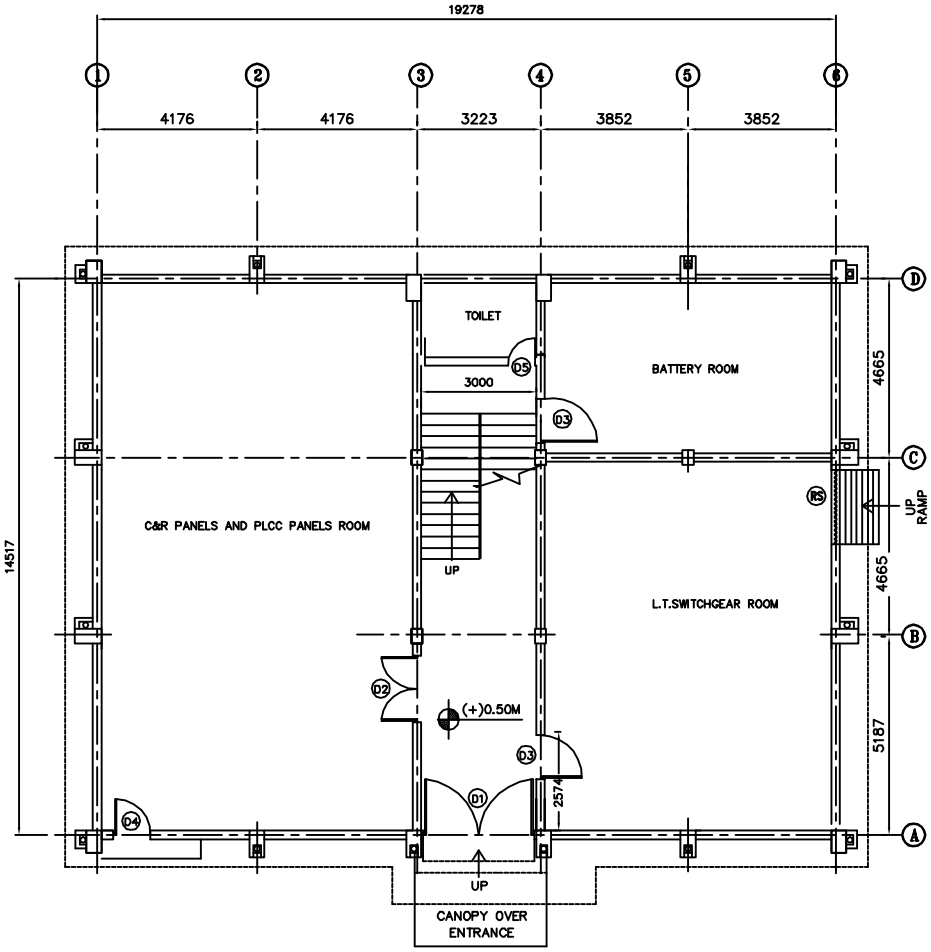
PROJECT : 765 / 400 / 220 Kv SUBSTATIONS

TITLE : DETAIL OF CONCRETE ROAD (RIGID PAVEMENT) IN SWITCHYARD AREA

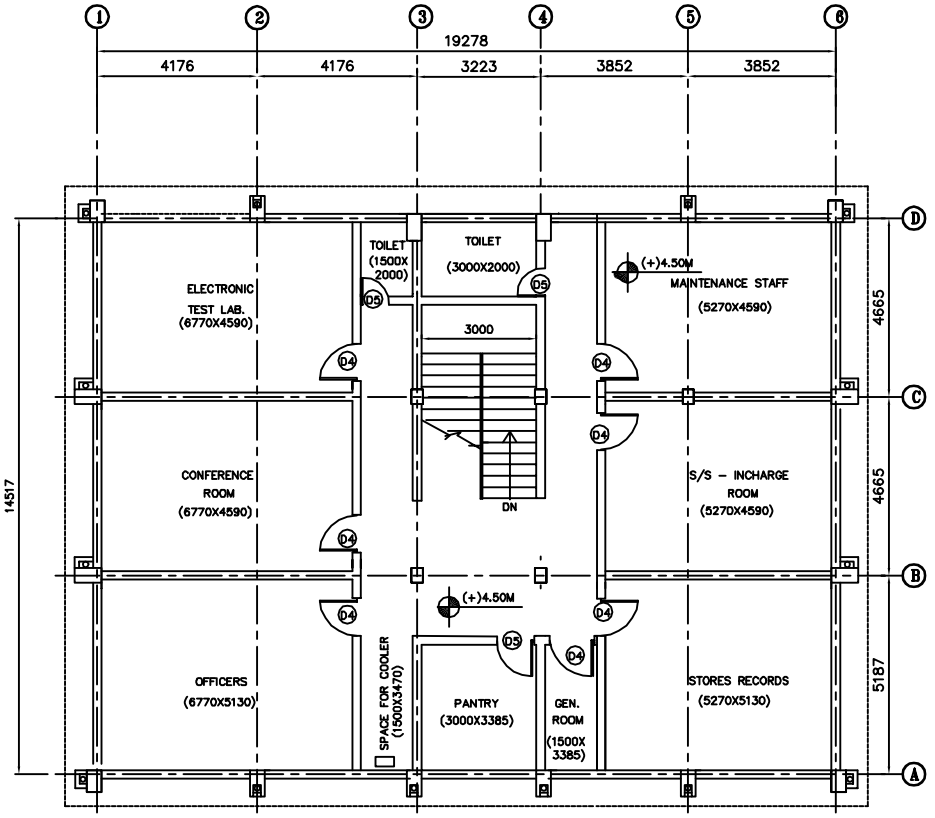
DRAWING NO. **C/ENGG/STD/ROAD/411**

SCALE

REV 0



GROUND FLOOR PLAN



FIRST FLOOR PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. FINISHED FLOOR LEVEL OF CONTROL ROOM IS EL.(+)500MM ABOVE FINISHED GROUND LEVEL.
3. TOP OF ROOF IS AT EL(+)8250MM ABOVE FINISHED GROUND LEVEL

FOR TENDER PURPOSE ONLY

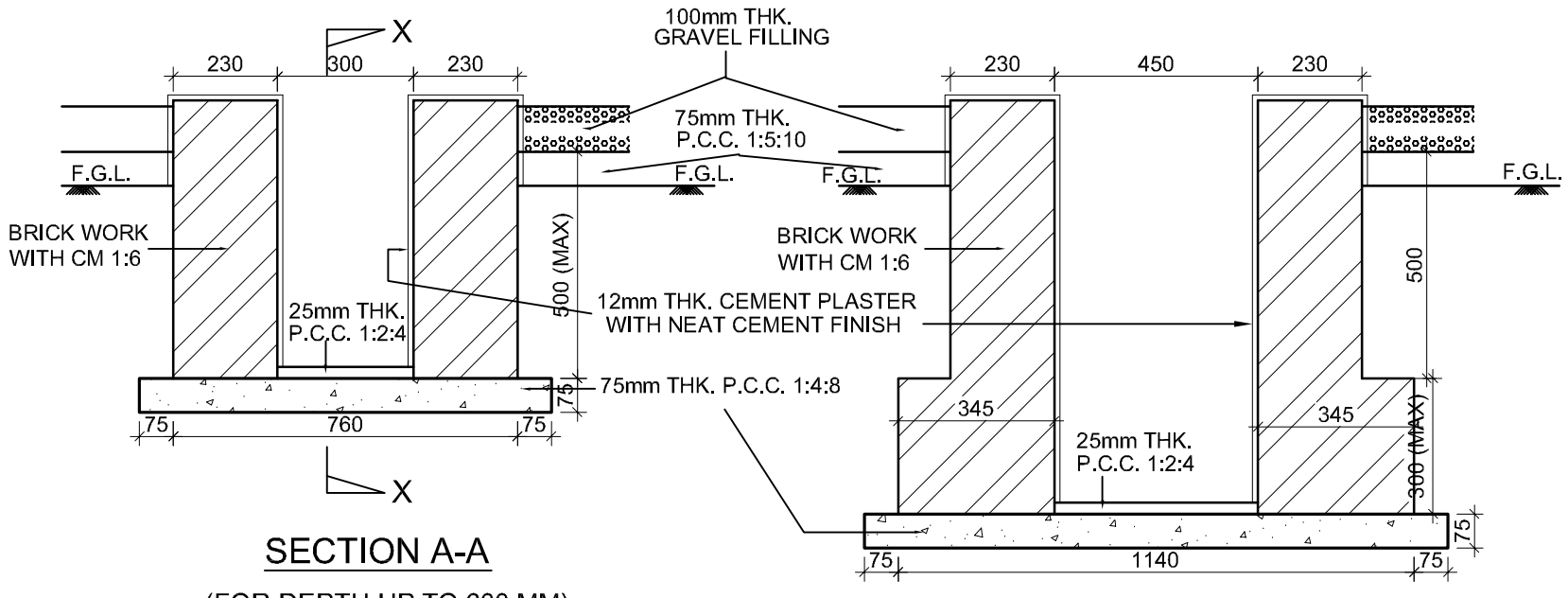
REC TRANSMISSION PROJECTS COMPANY LTD.

PROJECT:

220/33KV LASSIPORA GIS SUBSTATION

TITLE:

CONCEPTUAL LAYOUT PLAN OF CONTROL ROOM BUILDING

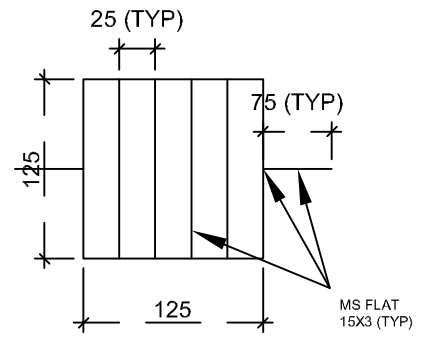


SECTION A-A

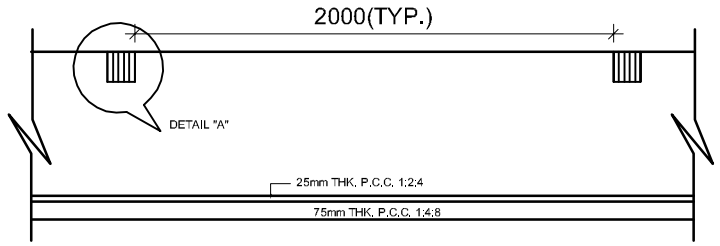
(FOR DEPTH UP TO 600 MM)

SECTION B-B

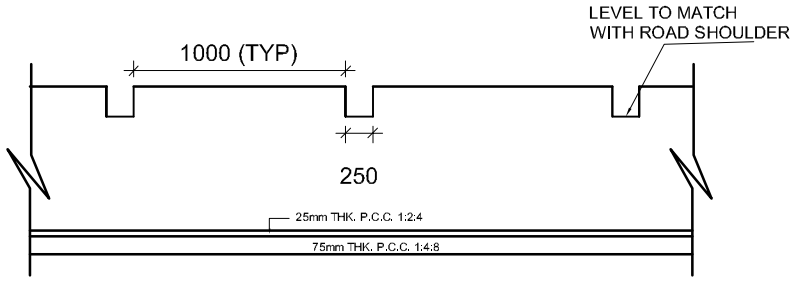
(FOR DEPTH FROM 600 TO 900 MM)



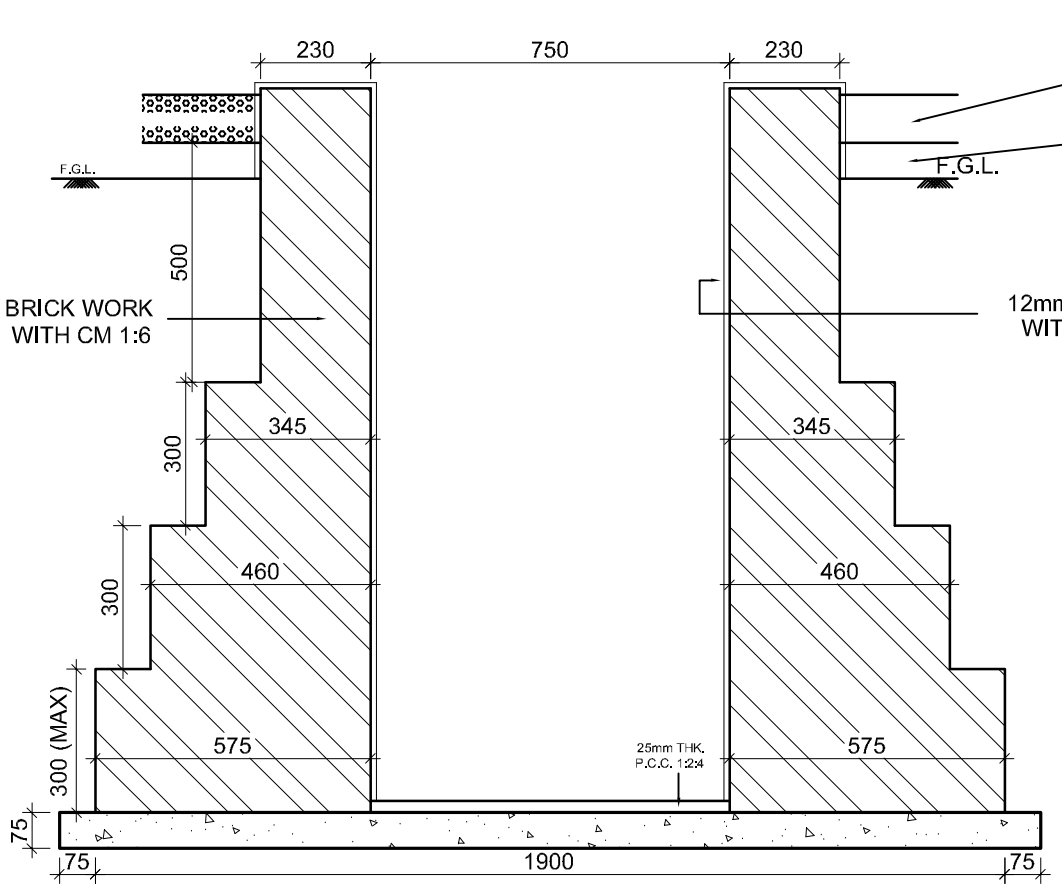
DETAIL "A"



SECTION X-X
(APPLICABLE FOR GRAVEL SIDE)

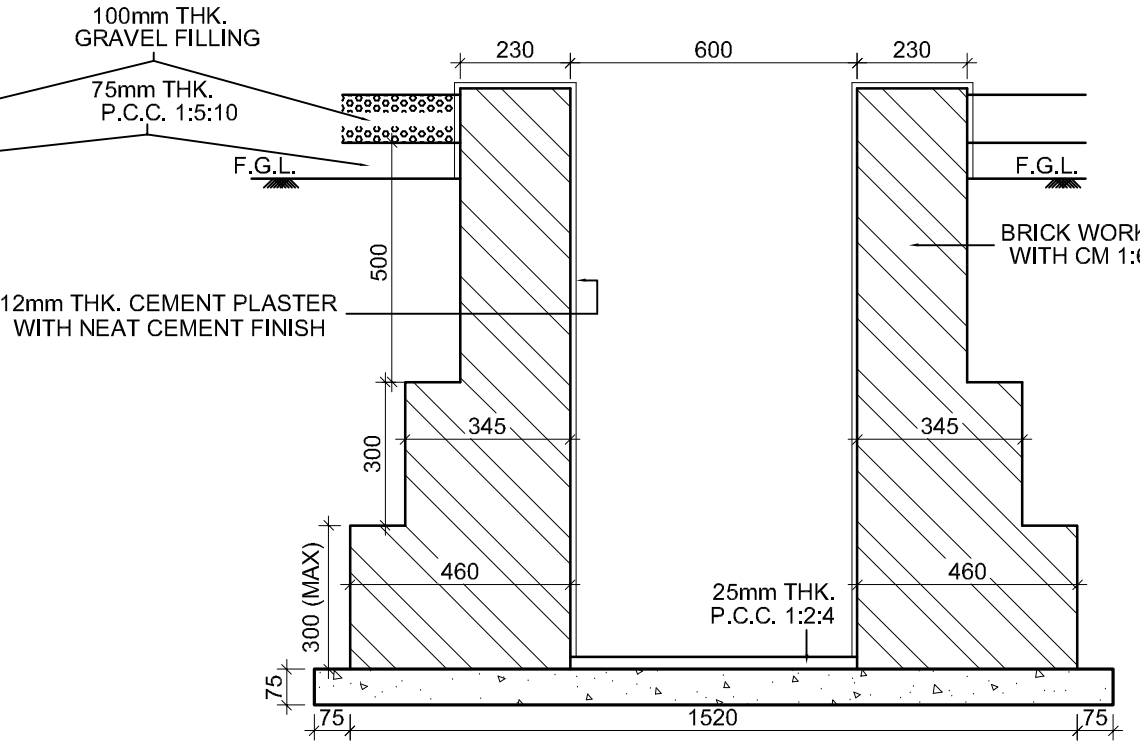


SECTION X-X
(APPLICABLE FOR ROAD SIDE)



SECTION D-D

(FOR DEPTH FROM 1200 TO 1500 MM)



SECTION C-C

(FOR DEPTH FROM 900 TO 1200 MM)

NOTES:-

1. ALL DIMENSIONS ARE IN MM. & ELEVATIONS ARE IN METRE UNLESS NOTED OTHERWISE.
2. ALL DRAINS SHALL BE GIVEN A MINIMUM SLOPE OF 1: 1000 IN THE LONGITUDINAL DIRECTION
3. MINIMUM DEPTH OF DRAIN SHALL BE 300MM BELOW FGL.
4. WHERE EVER TWO SECTIONS ARE MEETING A TRANSITION ZONE SHALL BE CONSTRUCTED HAVING LENGTH 1000mm.
5. 75X75mm WEEP HOLE SHALL BE PROVIDED AT SPACING OF 1500mm HORIZONTALY & 300mm VERTICALLY IN STAGGERED MANER.
6. DEPTH OFF DRAIN IS TAKEN AS HEIGHT FROM TOP OF DRAIN TO INVERT OF DRAIN
7. LAYOUT OF DRAIN WILL BE ISSUED DURING EXECUTION STAGE

RELEASED FOR TENDER

APPROVED BY ED (ENGG) ON 02.05.2005 VIDE NOTE
SHEET REF. NO. C/ENGG./CIV/Std-S/S DTD 30.03.2005

ACDE(ENGG-CIVIL)	CDE(ENGG-CIVIL)	DGM(ENGG-CIVIL)	AGM(ENGG-TL/CIVIL)	GM(ENGG-S/S)	GM(ENGG-TL/CIVIL)	ED(ENGG)	DATE

PROJECT : STANDARD SUBSTATION DRAWING

TITLE : DETAILS OF DRAIN

DRAWING NO. TND/RECTPPL/J&K/DRG/C14

REV. 0

FROM ACDB

1R,3.5Cx70 Sq.mm AL.(PVC)

25KVA
LTG TRAFO
415/415V
DYn1,

3.5Cx70sqmm Al. PVC

415V EMERGENCY LIGHTING DISTRIBUTION BOARD

R Y B (0–500V) VSS V

63A

415V, 3PH. 4WIRE, 63A,
20kA FOR 1SEC, AL.BUS

SECTION–II

E E G2 E

E E E E

63A

32A 32A 32A

32A 32A 32A

3.5Cx70 Sq.mm PVC, AL. CABLE

3.5Cx35 Sq.mm PVC, AL. CABLE

3.5Cx35 Sq.mm PVC, AL. CABLE

3.5Cx35 Sq.mm PVC, AL. CABLE

OUTDOOR LIGHTING PANEL–1

FF PUMP HOUSE EMERGENCY LIGHTING

SPARE

INDOOR LIGHTING PANEL–1

INDOOR LIGHTING PANEL–2

SPARE

LEGEND:–

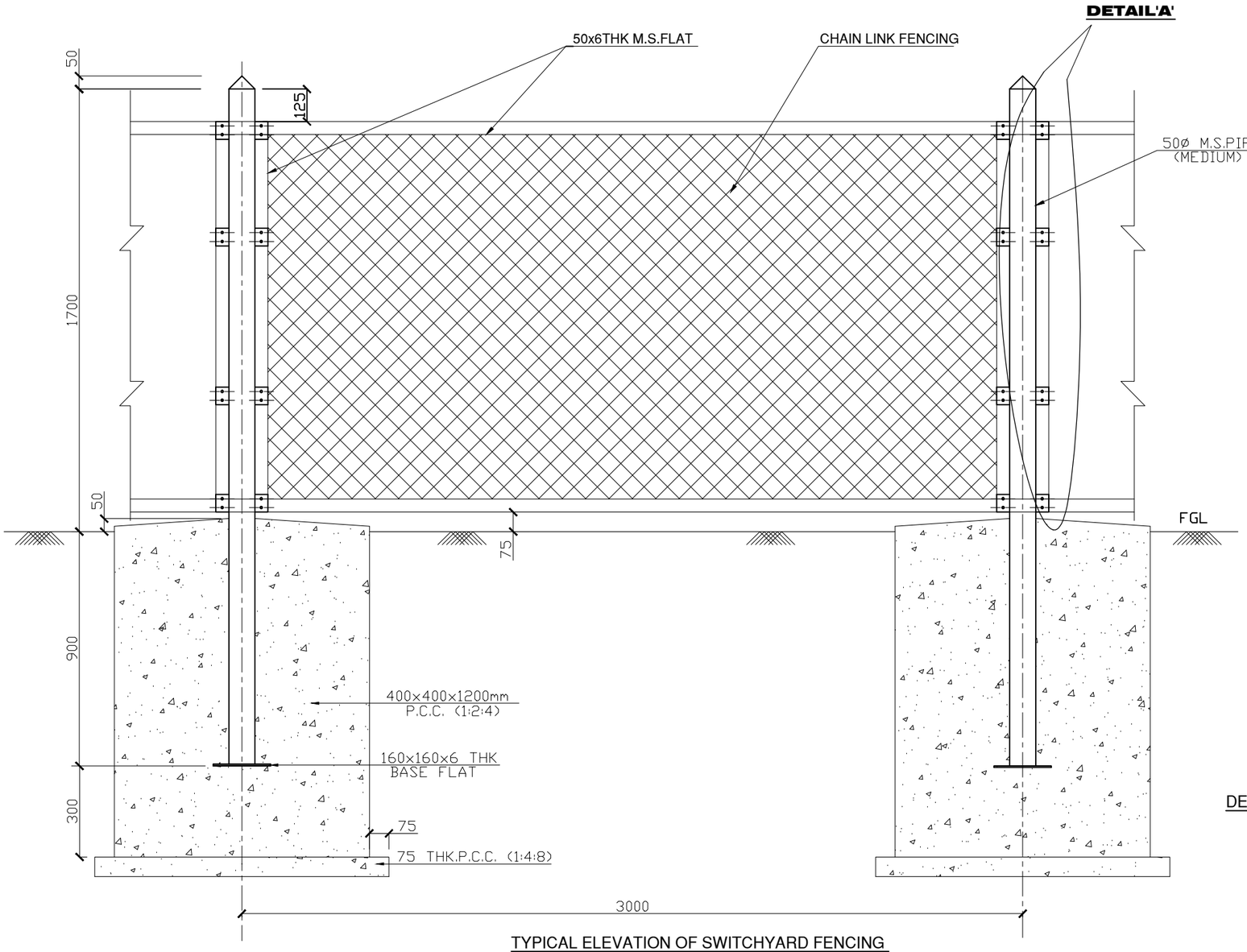
SYMBOL	DESCRIPTION
	LTG TRANSFORMER
	4POLE MCCB
	FUSE
	INDICATING LAMP
VSS	VOLTAGE SELECTOR SWITCH
V	VOLTMETER

RELEASED FOR TENDER

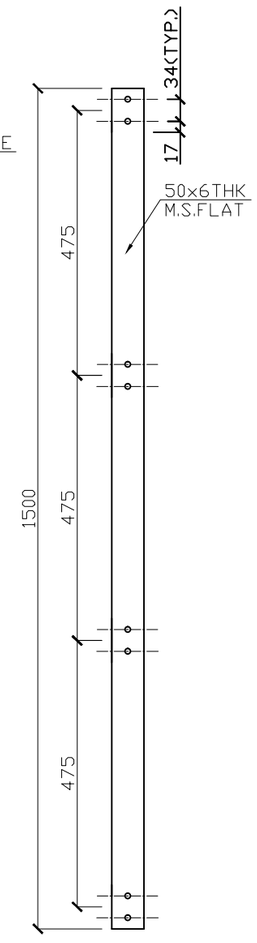
REC TRANSMISSION PROJECTS COMPANY LTD.

PROJECT :	220/33kV GIS LASSIPORA SS
TITLE :	SLD FOR EMERGENCY LIGHTING DISTRIBUTION BOARD
SHEET 1 OF 1	

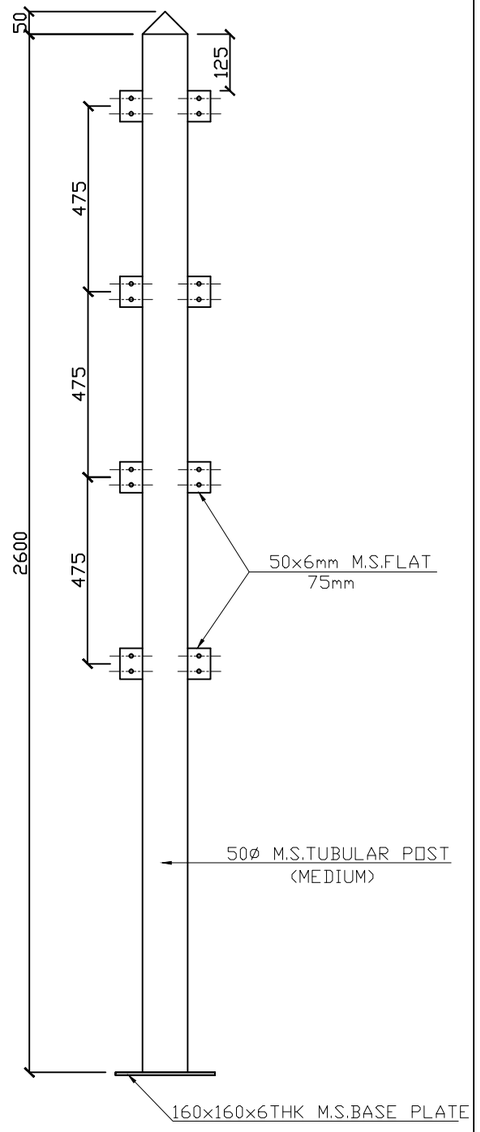
297 X 210 – A4



TYPICAL ELEVATION OF SWITCHYARD FENCING



DETAIL VERTICAL M.S. FLAT
'A'



DETAIL OF TUBULAR POST

NOTES:

1. ±0.00 SHALL DENOTE SWITCHYARD FINISHED FORMATION LEVEL
2. CHAIN LINK FENCING SHALL HAVE 3.15 mm DIAMETER WIRE AS PER IS 2721 WITH 75x75 mm MESH SIZE AND PAINTED
3. TUBULAR POST SHALL BE PLACED @ 3.0m CENTRE TO CENTRE AND SHALL REST IN WELL COMPACTED EARTH
4. CORNER TUBULAR POST SHALL BE PROVIDED CLEATS IN FOUR SIDES SUITING TO REQUIREMENT
5. TUBES/PIPES OF POST SHALL BE GALVANIZED
6. CONCRETE GRADE FOR P.C.C. SHALL CONFORM IS 456: LATEST
7. EXPOSED SURFACE OF CONCRETE PAD (P.C.C.) SHALL BE PLASTERED WITH 12mm THICK CEMENT PLASTER (1:6)

RELEASED FOR TENDER

REC TRANSMISSION PROJECTS COMPANY LTD.

PROJECT : STANDARD DRAWING FOR FENCING

TITLE : STANDARED DETAILS FOR SWITCH YARD CHAIN LINK FENCING

ACDE(ENGG-CIVIL)	CDE(ENGG-CIVIL)	DGM(ENGG-CIVIL)	AGM(ENGG-TL/CIVIL)	GM(ENGG-S/S)	GM(ENGG-TL/CIVIL)	ED(ENGG)	DATE	SCALE	DRAWING NO.	REV
								NTS	C:ENGG/CVL/SYD/FENCE/001	R-0

FROM
415V AC MAIN SWITCH BOARD

1R,3.5Cx70 Sq.mm AL.(PVC)

25KVA
LTG TRAFO-1
415/415V

1R,3.5Cx70 Sq.mm AL.(PVC)

FROM
415V AC MAIN SWITCH BOARD

1R,3.5Cx70 Sq.mm AL.(PVC)

25KVA
LTG TRAFO-2
415/415V

1R,3.5Cx70 Sq.mm AL.(PVC)

R Y B 1 VSS (V) (0-500V)

100A

100A

R Y B VSS 1 (V) (0-500V)

415V, 3PH. 4WIRE, 100A,
20kA FOR 1SEC, AL.BUS

SECTION-1

SECTION-2

100A

E E G2 E E E E E E E E E E E E G2 E

63A 63A 63A 63A 63A 100A 32A 63A 63A 32A 63A 32A 63A 32A

3.5Cx70 Sq.MM PVC AL.CABLE

3.5Cx70 Sq.MM PVC AL.CABLE

3.5Cx70 Sq.MM PVC AL.CABLE

3.5Cx70 Sq.MM PVC AL.CABLE

3.5Cx35 Sq.MM AL.PVC CABLE

3.5Cx70 Sq.MM AL.PVC CABLE

3.5Cx35 Sq.MM AL.PVC CABLE

3.5Cx70 Sq.MM AL.PVC CABLE

3.5Cx35 Sq.MM AL.PVC CABLE

SPARE

STREET LIGHTING PANEL-1

SWITCHYARD LIGHTING PANEL-1

SWITCHYARD LIGHTING PANEL-2

SWITCHYARD LIGHTING PANEL-3

INDOOR LIGHTING PANEL-1

63A OUTDOOR RECEPTACLE

SPARE

INDOOR LIGHTING PANEL-2

63A OUTDOOR RECEPTACLE

FF PUMPHOUSE NORMAL LIGHTING

SPARE

SPARE

LEGEND:-

SYMBOL	DESCRIPTION
	LTG TRANSFORMER
	4POLE MCCB
	FUSE
	INDICATING LAMP
VSS	VOLTAGE SELECTOR SWITCH
V	VOLTMETER

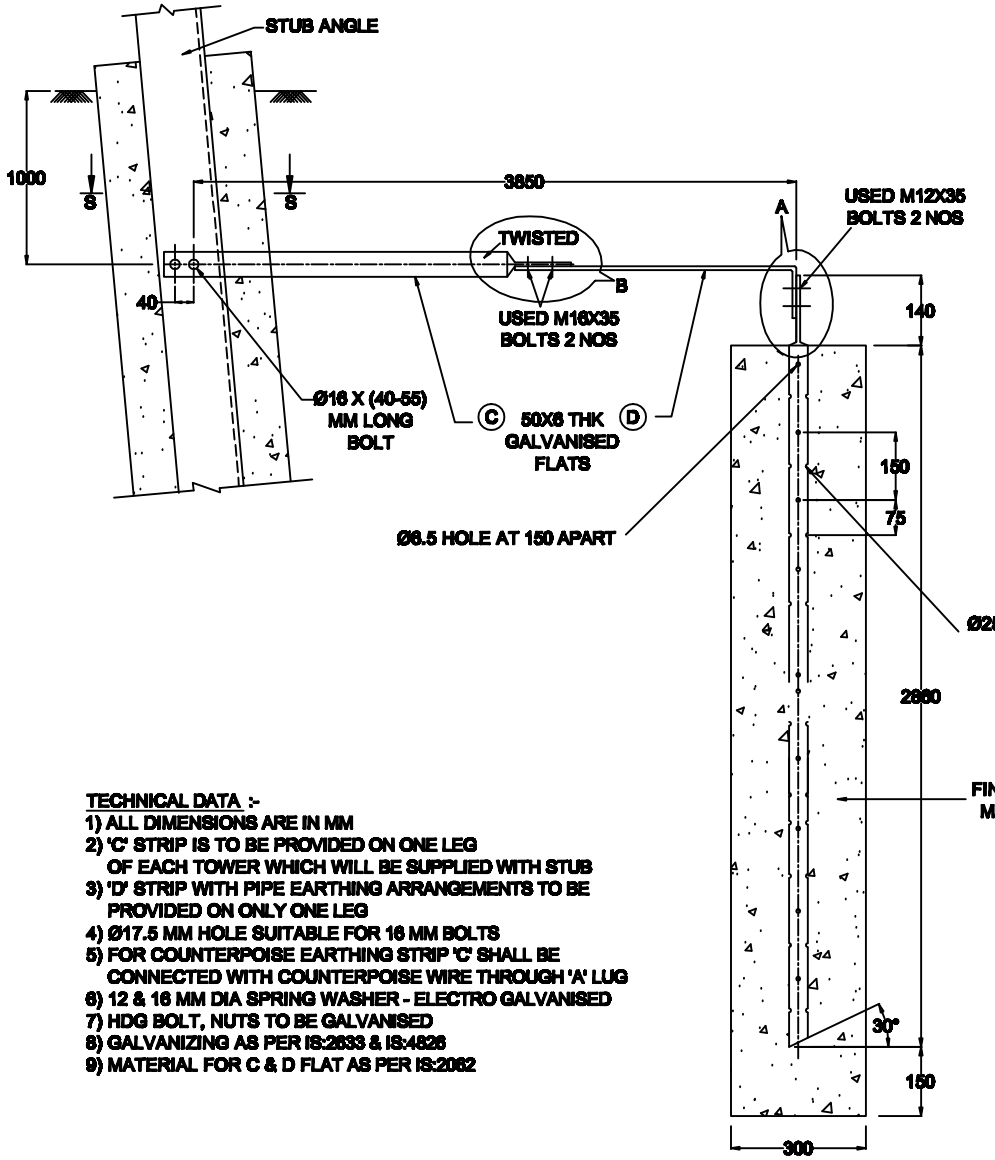
RELEASED FOR TENDER

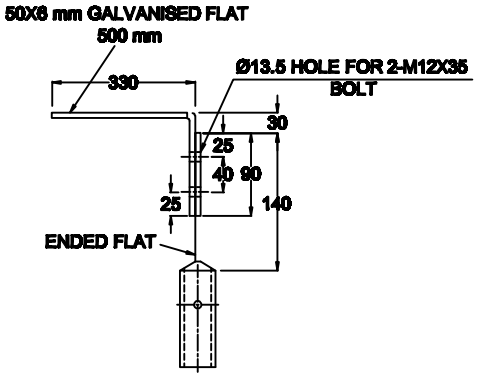
REC TRANSMISSION PROJECTS COMPANY LTD.

PROJECT :	220/33kV GIS LASSIPORA SS
TITLE :	SLD FOR MAIN LIGHTING DISTRIBUTION BOARD
SHEET 1 OF 1	

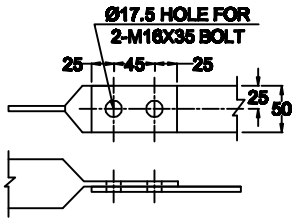
420 X 297 – A3

ISO : 9001





DETAIL AT - 'A'



DETAIL AT- 'B'

TECHNICAL DATA :-
1) ALL DIMENSIONS ARE IN MM
2) 'C' STRIP IS TO BE PROVIDED ON ONE LEG OF EACH TOWER WHICH WILL BE SUPPLIED WITH STUB
3) 'D' STRIP WITH PIPE EARTHING ARRANGEMENTS TO BE PROVIDED ON ONLY ONE LEG
4) Ø17.5 MM HOLE SUITABLE FOR 16 MM BOLTS
5) FOR COUNTERPOISE EARTHING STRIP 'C' SHALL BE CONNECTED WITH COUNTERPOISE WIRE THROUGH 'A' LUG
6) 12 & 16 MM DIA SPRING WASHER - ELECTRO GALVANISED
7) HDG BOLT, NUTS TO BE GALVANISED
8) GALVANIZING AS PER IS:2633 & IS:4826
9) MATERIAL FOR C & D FLAT AS PER IS:2062

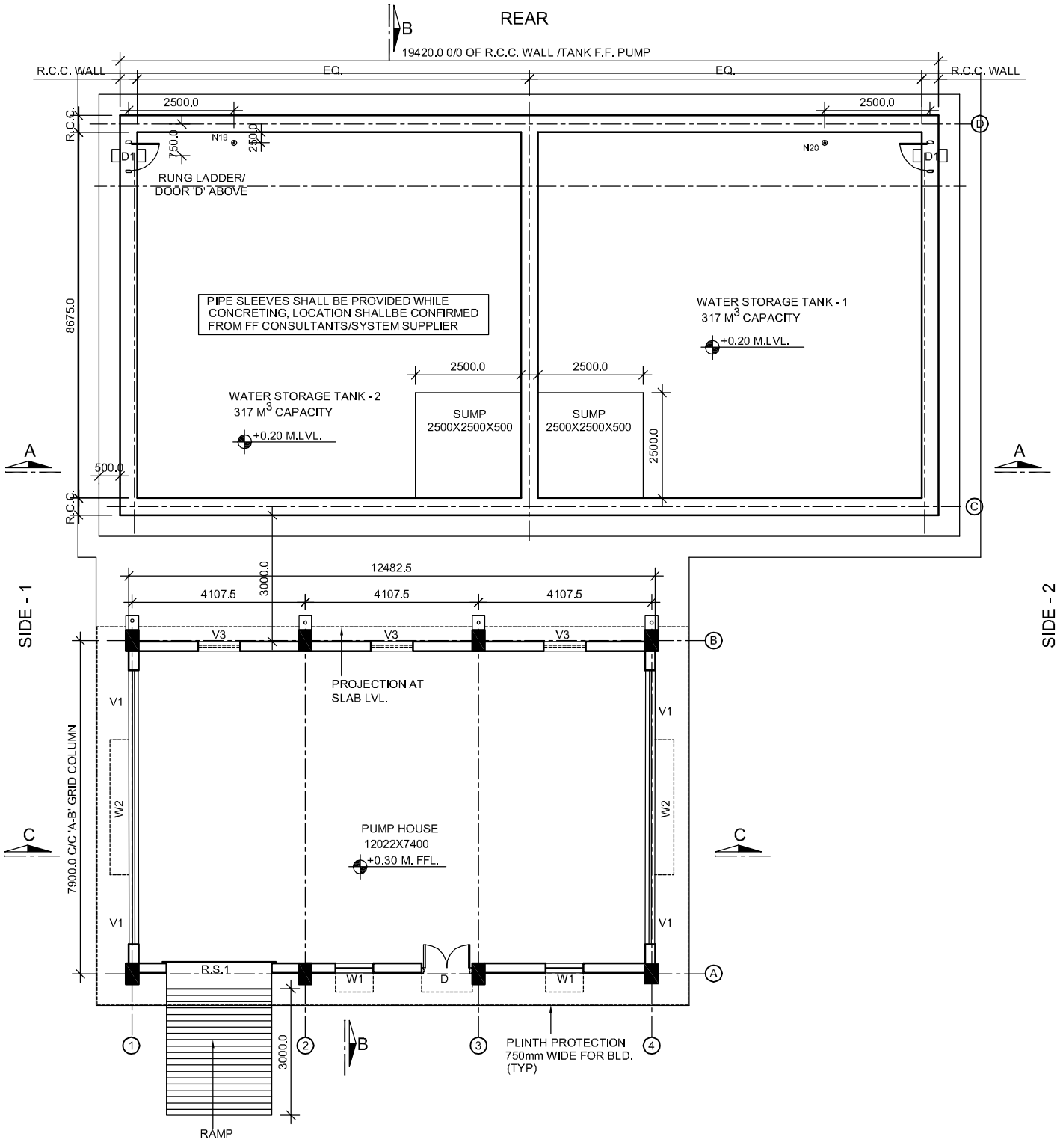
LIST OF BOLTS & NUTS / TOWER		
SL NO.	SIZE	QTY.
1	16X35 LG	2
2	12X35 LG	2
3	16 MM DIA SPRING WASHER	2
4	12 MM DIA SPRING WASHER	2

SHEET NO. : 1/1

FOR TENDER PURPOSE ONLY

REC TRANSMISSION PROJECTS COMPANY LTD.

TITLE PIPE EARTHING ARRANGEMENT



FRONT

GROUND FLOOR PLAN FOR FFPH

RELEASED FOR TENDER & CONSTRUCTION.

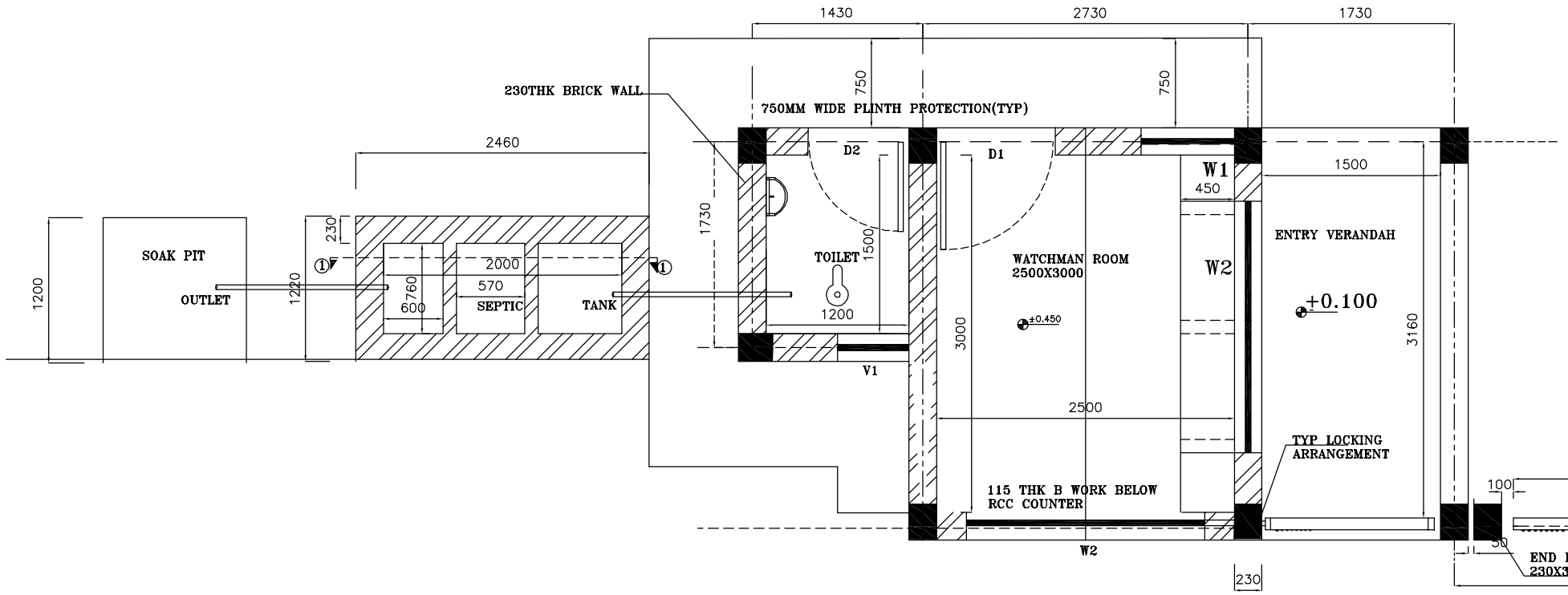
REC TRANSMISSION PROJECTS COMPANY LTD.

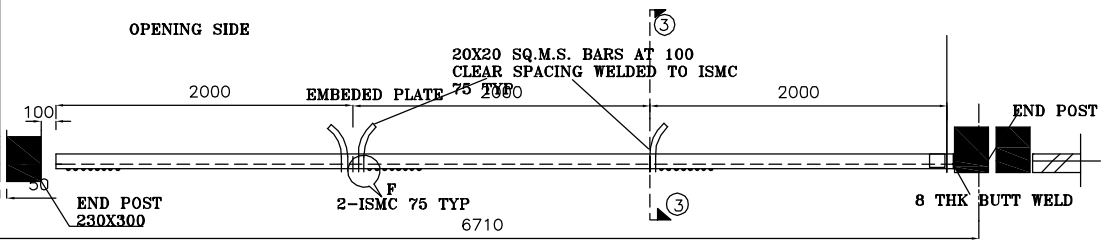
FIRE FIGHTING PUMP HOUSE

TITLE : **GROUND FLOOR PLAN FOR FIRE WATER PUMP HOUSE & WATER TANK**

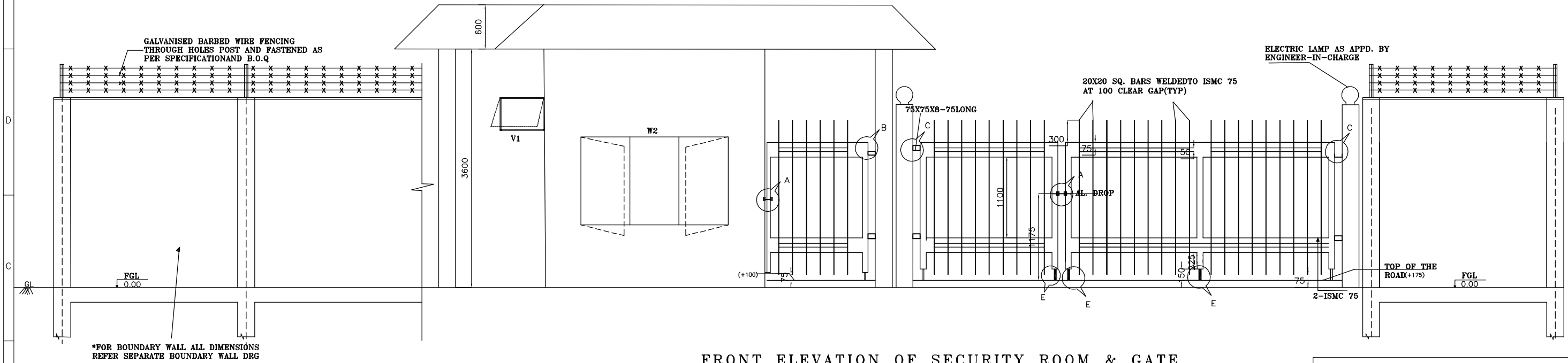
NOTE:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. PROVIDE BRICK WORK IN ENGLISH BOND IN 1:6CEMENT MORTAR (1CEMENT:6 COARSE SAND)
3. a) BRICKWORK TO BE DONE WITH BRICK OF FIRST CLASS DESIGNATION-75.
   b) PLASTERING WORK SHALL BE IN CEMENT MORTAR1:6(1CEMENT:6FINE SAND) THICKNESS OF PLASTER SHALL BE AS PER B.O.Q.
4. ALL EXPOSED PLASTER SURFACES TO BE PAINTED WITH MINIMUM OF TWO COATS OF COLOUR WASH OVER A BASE COAT OF WHITE WASH WITH LIME.
5. ALL STRUCTURAL STEEL SHALL CONFORM TO IS:2062 AND SHALL BE PAINTED WITH TWO OR MORE COATS OF SYNTHETIC ENAMEL PAINTS OF APPROVED BRAND AND MANUFACTURE OVER A PRIMING COAT OF APPROVED STEEL PRIMER.
6. CONCRETE FOR R.C.C. WORK SHALL BE OF GRADE 1:1.5:3(1CEMENT:1.5 COARSE SAND :3 GRADED STONE AGGREGATE 20MM NOMINAL SIZE).
7. REINFORCEMENT BARS SHALL BE TMT BARS CONFORMING TO IS:1786 LATEST REVISION.
8. STRUCTURE STEEL USED FOR GRADING SHALL CONFORM TO IS:2062 LATEST EDITION.
9. LAP/ANCHORAGE SHALL BE 50X DIA OF BAR.
10. CLEAR COVER TO MAIN REINFORCEMENT SHALL BE AS FOLLOWS
    a) FOOTING -50MM
    b) SLAB - 20MM
    c) COLUMN-40MM
    d) BEAMS -25MM

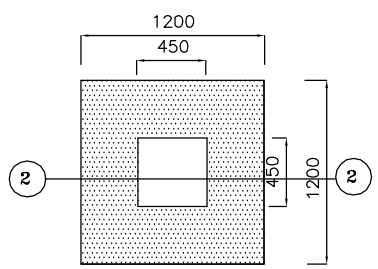




PLAN OF SECURITY ROOM AND GATE



FRONT ELEVATION OF SECURITY ROOM & GATE



SOAK PIT PLAN

DOOR WINDOW SCHEDULE

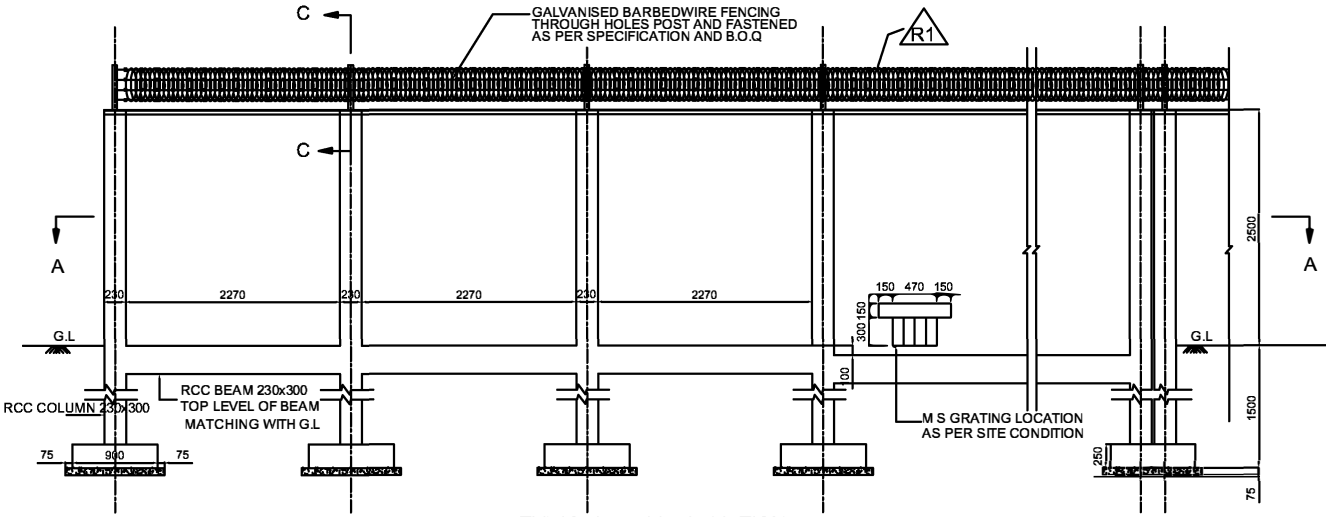
TYPE	SIZE	LEVEL	LINTEL LEVEL	TOTAL NOS
D1	900X2100	+0.450	+2.55	1
D2	750X2100	+0.450	+2.55	1
W1	900X1200	+1.350	+2.55	1
W2	2000X1200	+1.350	+2.55	2
V1	600X450	+2.100	+2.55	1

REV. No.	DESCRIPTION	CHECKED	APPROVED	DATE

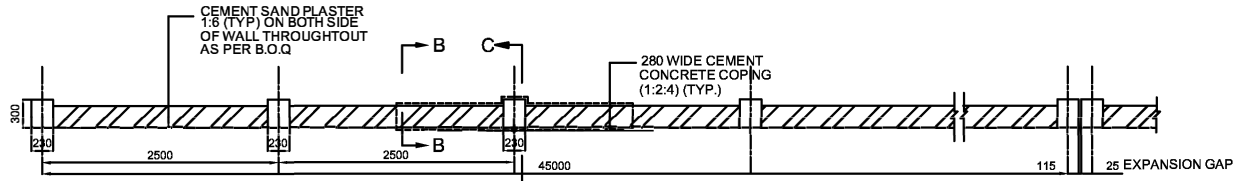
FOR TENDER PURPOSE ONLY

REC TRANSMISSION PROJECTS COMPANY LTD..

TITLE : SECURITY ROOM & GATE



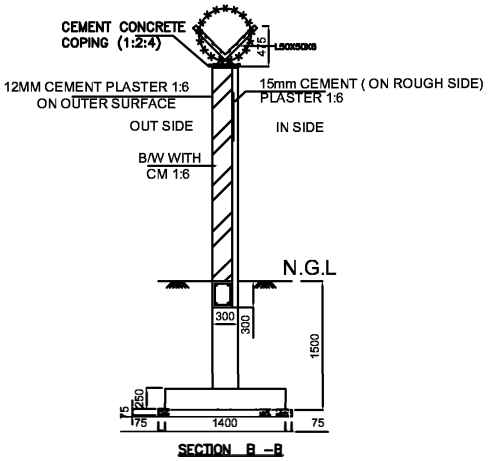
TYPICAL WALL ELEVATION



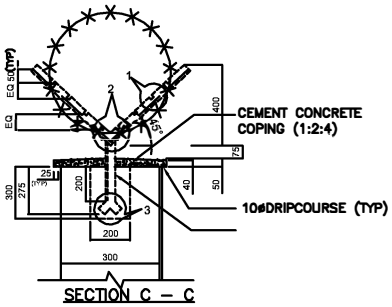
SECTION A-A

NOTES:

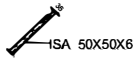
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. LOCATION OF BOUNDARY WALL SHALL BE AS PER GA./ DRG. LATEST APPROVED.
3. PROVIDE BRICK WORK IN ENGLISH BOND IN 1:6 CEMENT MORTAR (1CEMENT : 6 COARSE SAND).
4. CONC GROUTING FOR ANGLE POST AT TOP OF BOUNDARY WALL SHALL BE IN 1:2:4 (1CEMENT:2COURSE SAND:4 STONEAGGREGATE).
5. CONCERTINA COIL FENCING OF 610 MM DIA. SHALL BE AS PER LATEST DSR
6. a). BRICK TO BE DONE WITH BRICK OF FIRST CLASS DESIGNATION-75
   b). PLASTER WORK SHALL BE AS PER TECHNICAL SPECIFICATION
7. THE LAST 300mm EXCAVATION IN SOIL IS TO BE DONE JUST PRIOR TO THE PLACING OF FOUNDATION P.C.C.
8. P.C.C. OF 1:4:8 GRADE SHALL BE WITH 40mm NOMINAL SIZE AGGREGRATE.
9. EXPANSION JOINTS ARE TO BE PROVIDEDMIN BOUNDARY WALL AT
   a). MAXIMUM OF 45.0 M.
10. ALL EXPOSED PLASTER SURFACES ARE TO BE PAINTED WITH WATER PROOFING CEMENT PAINT
11. STRUCTURAL STEEL FOR ANGLE POSTS SHALL CONFORM TO IS:2062, ANGLE POST SHALL BE PAINTED WITH TWO OR MORE COATS OF ENAMEL PAINTS OF APPROVED BRAND AND MANUFACTURE OVER A PRIMING COAT OF APPROVED STEEL PRIMER.
12. THE RISE/FALL IN BOUNDARY WALL FOUNDATION SHALL BE PROVIDED WHEREVER THE DIFFERENCE IN GROUND LEVEL IS MORE THAN500mm.
13. NO FOUNDATION SHALL REST ON THE FILLED UP SOIL, IF ANY, THE FOUNDATION SHALL BE MINIMUM 500mm, BELOW VERGIN SOIL.
14. THE HEIGHT OF BOUNDARY WALL EXCLUDING FENCE ON TOP SHALL NOT BE LESS THAN 2500mm, ABOVE GROUND LEVEL OR FORMATION LEVEL WHICHEVER IS HIGHER.
15. NO. OF M.S. GRATING AND THEIR LOCATION TO BE INSTALLED IN BOUNDARY WALL ALONG WITH THE LEVELS SHALL BE DECIDED BY THE SITE AS/THE SITE CONDITION KEEPING IN VIEW THE MAX. POSSIBLE CATCHMENT AREA FOR EACH GRATING.
16. ALL M.S SECTION USED FOR GRATING SHALL BE PAINTED WITH TWO OR MORE COATS OF BLACK ANTICORROSIVE BITUMASTIC PAINT OF APPROVED BRANDAND MANUFACTURE OVER A PRIMING COAT OF APPROVED STEEL PRIMER.
17. CONC. FOR R.C.C WORK SHALL BE GRADE AS PER BPS.
18. REINF. BARS SHALL BE H.Y.S.D. BARS OR TMT BARS CONFORMING TO IS:1786 LATEST REVISION.
19. STRUCTURE STEEL USED FOR GRATING SHALL CONFORM TO IS:2062 LATEST EDITION.
20. LAP/ANCHORAGE SHALL BE 50 X DIA OF BAR
21. CLEAR COVER TO MAIN REINFORCEMENT SHALL BE AS FOLLOWS
    a) FOOTING - 50MM (b) SLAB - 20MM (c) COLOUMN - 40MM,
    d) BEAMS - 25MM
22. TOP OF PLINTH BEAM SHALL BE REDUCED BY 100mm WHEREVER MS GRATING IS TO BE PROVIDED
23. INCASE BLACK COTTON SOIL IS ENCOUNTERED SUITABLE TREATMENT IN FOUNDATION SHALL BE PROVIDED.



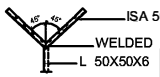
SECTION B –B



SECTION C – C



DETAIL – 1

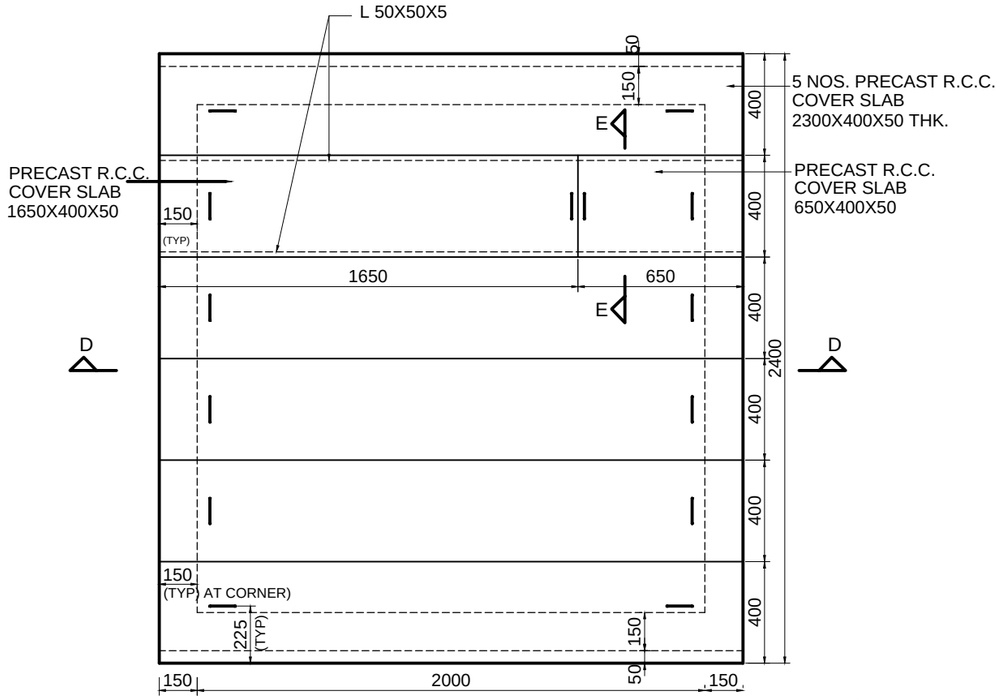


DETAIL – 2

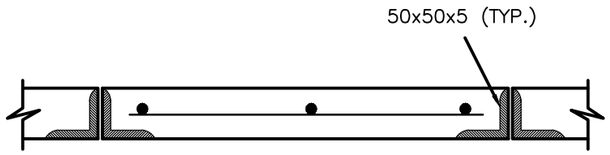
REV.	DESCRIPTION	CIVIL	REVD.	REVD.	APPD. DATE.

REC TRANSMISSION PROJECTS COMPANY LTD.

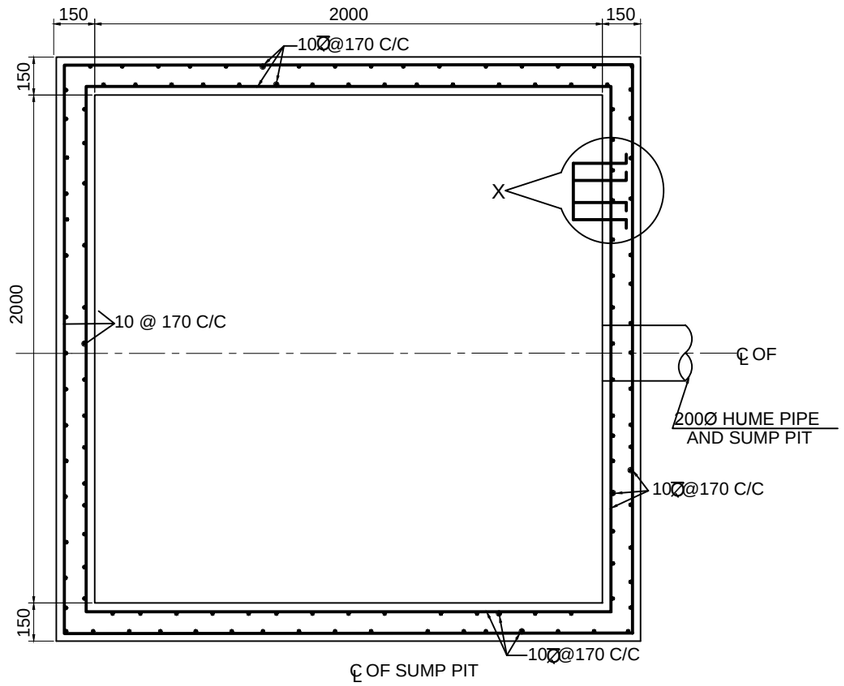
PROJECT :	STANDARD BOUNDARY WALL FOR NERPSIP
TITLE :	DETAILS OF BOUNDARY WALL
DRAWING NO.	(SH.1 OF 1)
SCALE	NTS
REV.	



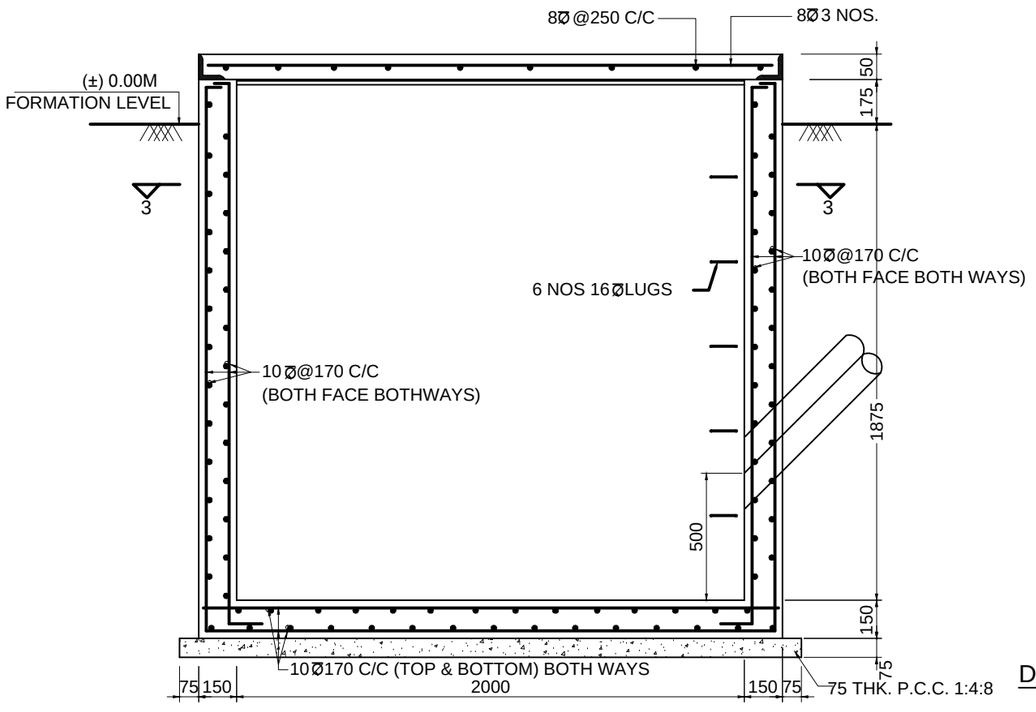
TOP PLAN OF SUMP PIT



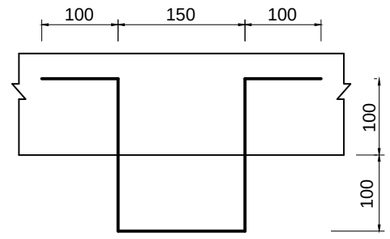
SECTION E-E



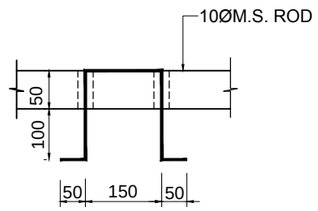
SECTION 3-3



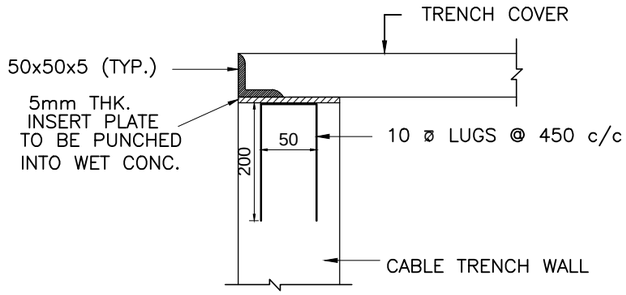
SECTION D-D



DETAIL 'X'



DETAIL OF LIFTING HOOK



TYPICAL DETAIL OF SLAB SUPPORT

NOTE:

1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE SPECIFIED.
2. R.C.C. MIX.SHOULD BE 1:1.5:3 (1 CEMENT: 1.5 COARSE SAND:3 STONE AGGREGATE 20mm NOMINAL SIZE.)
3. LEAN CONC. SHALL BE IN THE RATIO.1:4:8. (1 CEMENT:4 COURSE SAND: 8STONE AGGREGATE 40MM NORMINAL SIZE)
4. FOR ALL OTHER NOTES REF. DRG. No. C/ENGG/STD/CT-1(SHEET-2)

RELEASED FOR TENDER

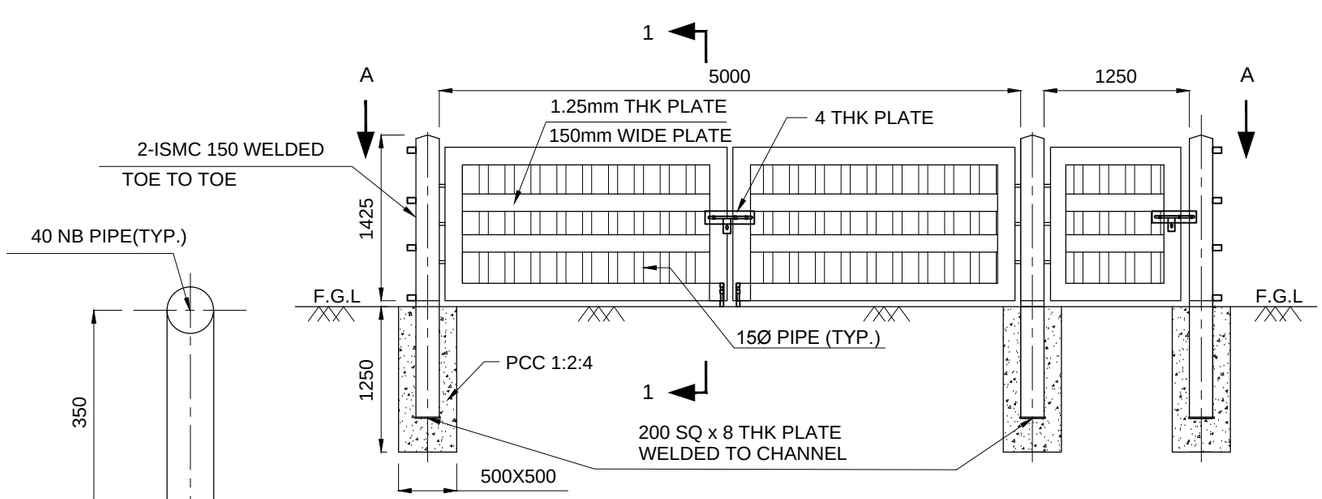
REC TRANSMISSION PROJECTS COMPANY LTD.

PROJECT : **STANDARD DRAWING FOR CABLE TRENCH**

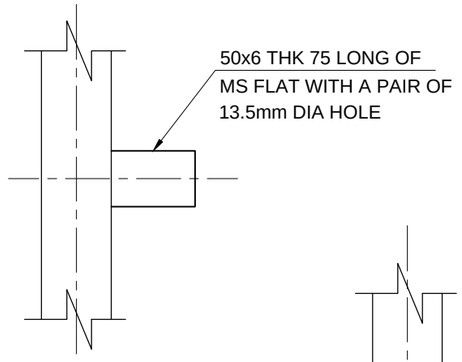
TITLE : **G.A. & R.C.C. DETAILS OF SUMP PIT**

REV.	DESCRIPTION	CLEARED BY				
		CIVIL	REVD	ELECT	APPD	DATE
0	RELEASED FOR TENDER & CONSTRUCTION.					

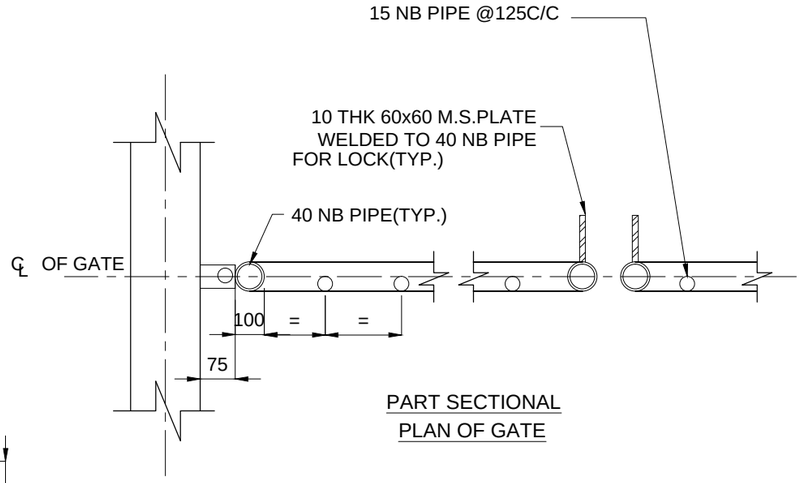
SCALE **NTS** | DRAWING NO. **C/ENGG/STD/CT-3** | REV **R-0**



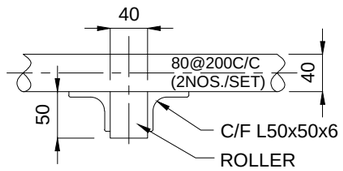
SWITCHYARD FENCING GATE DETAIL



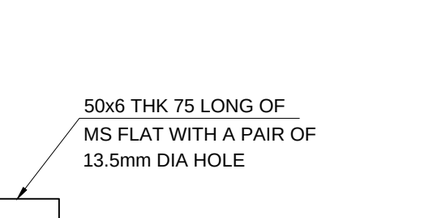
DETAIL -B



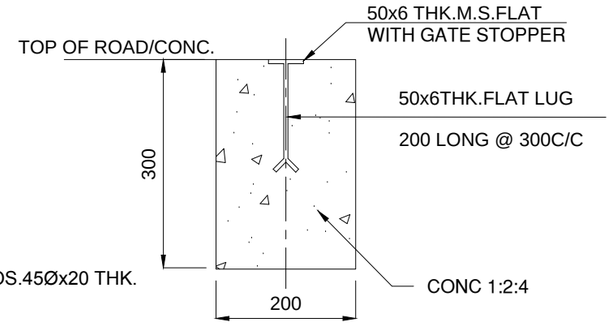
PART SECTIONAL
PLAN OF GATE



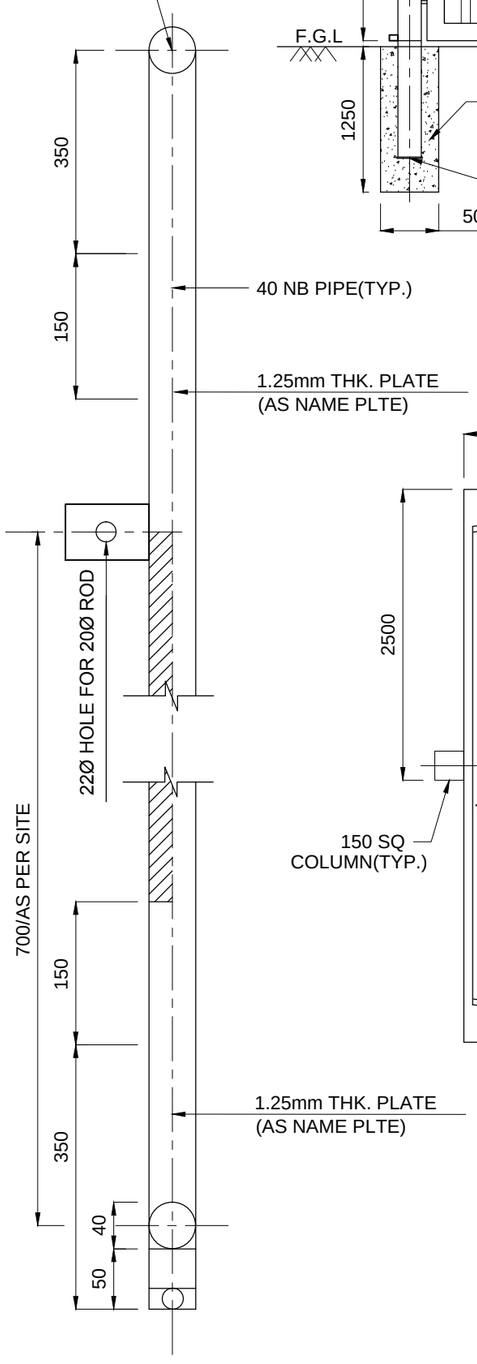
TYP.DETAIL OF
GATE ROLLER



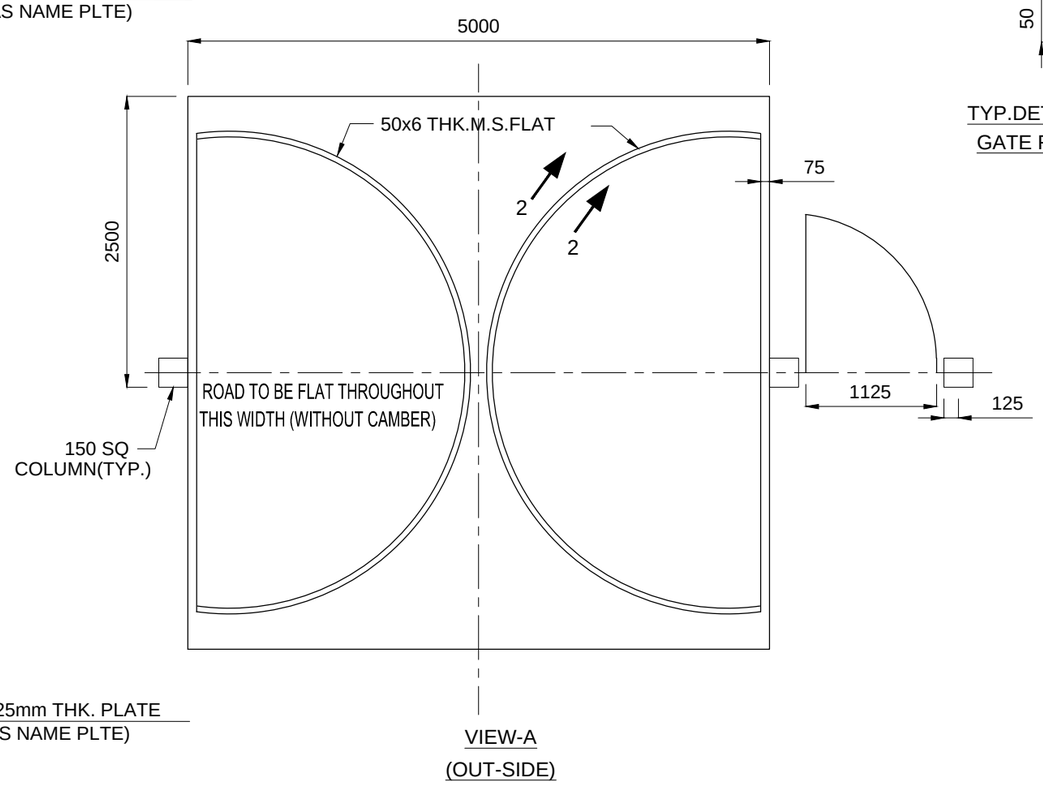
DETAIL -A
(ROLLER BEARING)



SECTION 2:2



SECTION 1-1



VIEW-A
(OUT-SIDE)

NOTES:

1. ALL DIMENSIONS ARE IN MM & ELEVATION ARE IN METER UNLESS NOTED OTHERWISE
2. ALL LEAN CONC. SHALL BE PCC (1:4:8)UNLESS NITED OTHERWISE.
3. UNLESS NOTED OTHERWISE LAP/ANCHOR LENGTH SHALL BE 50 TIMES THE DIA OF BARS
4. ALL STRUCTURAL STEEL CONFORM TO IS:2062 &SHALL PAINTED WITH A COAT OF APPROVED STEEL PRIMER &TWO COATS OF SYNTHETIC ENAMEL. PAINT UNLESS NOTED OTHERWISE.
5. DROP BOLTS SHOULD BO PROVIDED ON THE FAR SIDE ONLY.
6. ALL WELDS ARE 6MM THK. FILLET WELDS UNLESS NOTED OTHERWISE.
7. GATE & M.S.HOOKS TO BE PAINTED WITH ONE COAL APPROVED STEEL PRIMER BEFORE ERECTION &TWO COAT OF SYNTHETIC PAINTS AFTER ERECTION.
8. STRUCTURAL PIPES SHALL BE MEDIUM TYPE CONFORMING TO IS 1161/806

RELEASED FOR TENDER

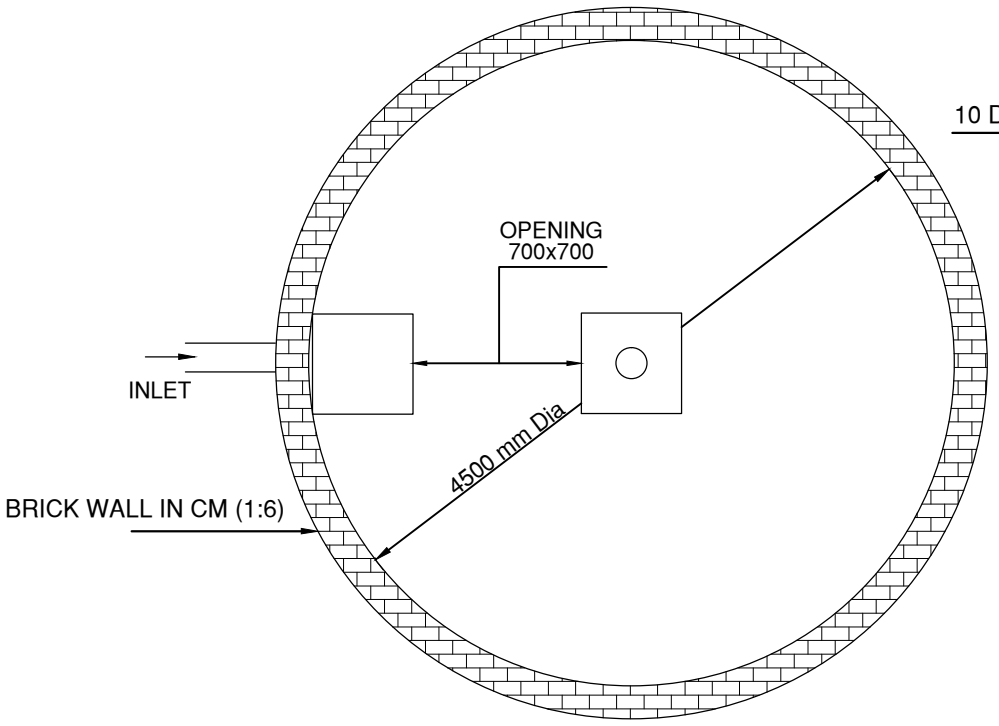
ACDE(ENGG-CIVIL)	CDE(ENGG-CIVIL)	DGM(ENGG-CIVIL)	AGM(ENGG-TL/CIVIL)	GM(ENGG-S/S)	GM(ENGG-TL/CIVIL)	ED(ENGG)	DATE

REC TRANSMISSION PROJECTS COMPNY LTD.

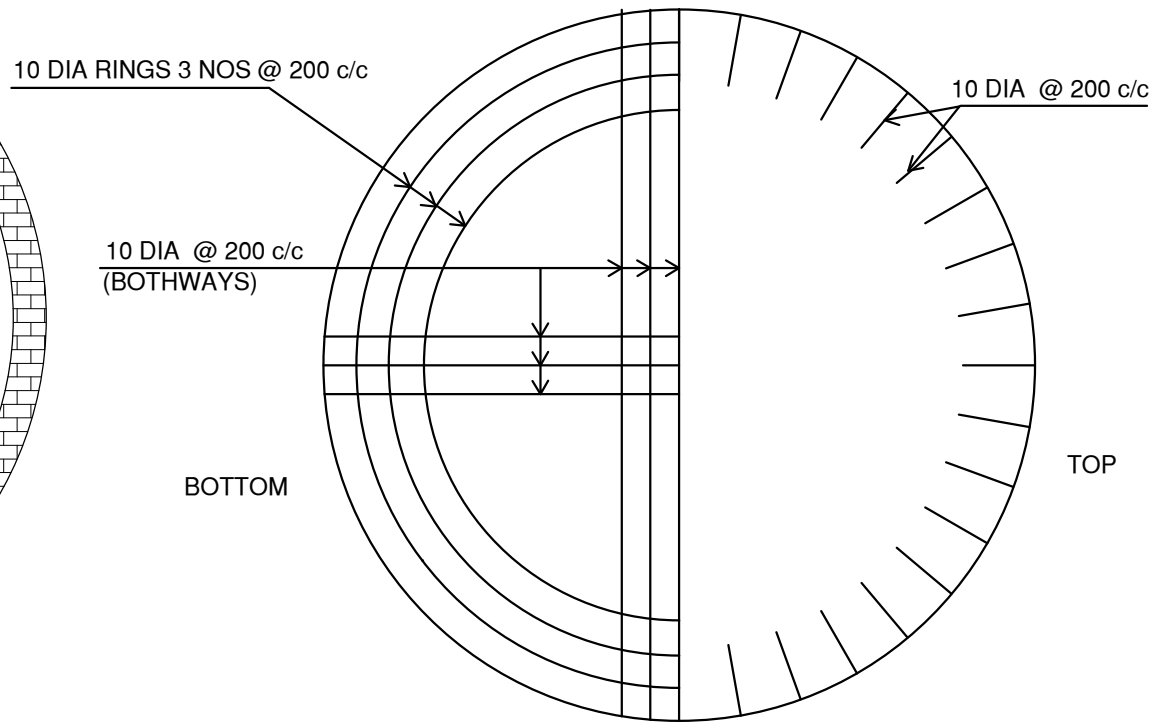
PROJECT : STANDARD DRAWING FOR SWITCHYARD GATE

TITLE : DETAILS OF SWITCHYARD GATE

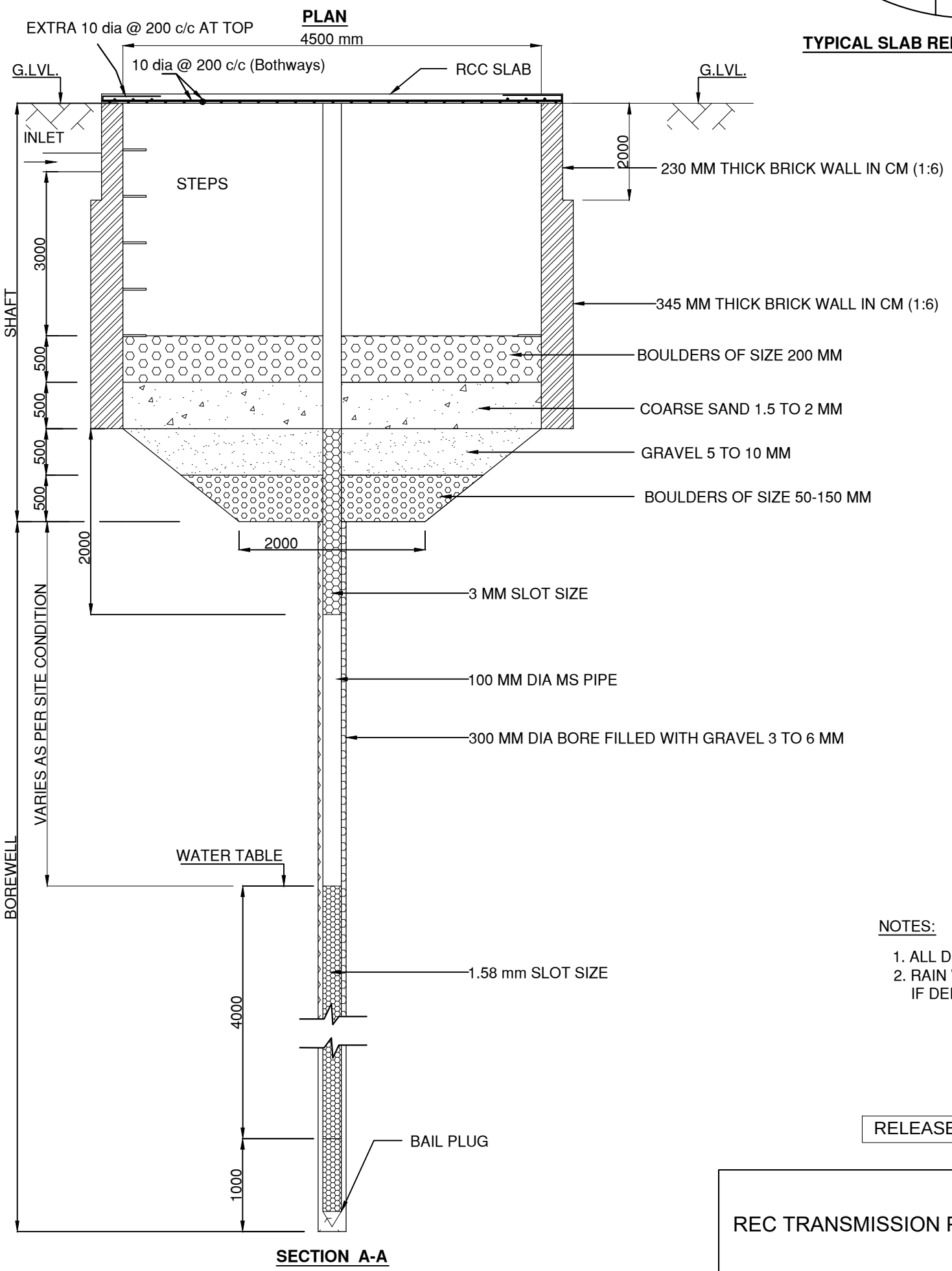
SCALE	DRAWING NO.	REV
NTS	C:ENGG/CVL/SYD/GATE/002	R-0



PLAN



TYPICAL SLAB REINFORCEMENT DETAILS



SECTION A-A

NOTES:

1. ALL DIMENSIONS ARE IN MM
2. RAIN WATER HARVESTING SHALL NOT BE DONE IF DEPTH OF WATER TABLE IS LESS THAN 8.0 M

RELEASED FOR TENDER

REC TRANSMISSION PROJECTS COMPANY LTD.

PROJECT : STANDARD DRAWING FOR RAIN WATER HARVESTING

TITLE : DETAILS OF RECHARGE STRUCTURE FOR RAIN WATER HARVESTING

ACDE(ENGG-CIVIL)	CDE(ENGG-CIVIL)	DGM(ENGG-CIVIL)	AGM(ENGG-TL/CIVIL)	GM(ENGG-S/S)	GM(ENGG-TL/CIVIL)	ED(ENGG)	DATE	SCALE NTS	DRAWING NO. C/ENGG/STD/RWH-01	REV R-0

REC TRANSMISSION PROJECTS COMPANY LIMITED

On Behalf of POWER DEVELOPMENT DEPARTMENT J&K GOVERNMENT

As Project Implementation Agency

(Invites bid through e-Tendering mode only)

FOR
TURNKEY CONTRACT PACKAGE OF

"Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

Tender Specification No- RECTPCL/PIA/JKPDD/SS -02 dt: 18.11.17

VOL-III

September 2017

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

General guidelines for filling up the Attachments	
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"	
TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02	
1	**Fill up only green shaded cells in the relevent attachments.**
2	**Attachments 3(JV),3(QR), 4, 4(A), 5, 5(A) 6, 9, 10, 11, 12, 13, 14, 15, 16, 17 , 18 & 19 and Bid Form for 1st Envelope are included here.**
3	**Attachment 1 Bid Security : To be submitted as per proforma provided in the Bidding Document.**
4	**Attachment 2 Power of Attorney : No specific format is provided by RECTPCL. Bidder may use their own format.**
5	**Attachment 8 Manufacturer's Authorisation Form : To be furnished as per proforma provided in the bidding document, on the letter head of the each Manufactures proposed to supply main items. This attachment is not included here.**
6	**Attachment 14 Integrity Pact : To be submitted as per ITB Clause No. 9.3(n) and as per remarks in the Attach 14-IP.**
7	**Attachment 18 Safety Pact : To be submitted as per ITB Clause No. 9.3(r).**
Click for Detailed General Instructions	Click to skip Instructions & Proceed

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

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"	
TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02	
Enter following details of the bidder	
Specify type of Bidder [Select from drop down menu]	JV (Joint Venture)
Total Nos. of Partners in the JV [excluding the Lead Partner]	2 or More
Name of Lead Partner	
Address of the Lead Partner	
Name of other Partner - 1	....
Address of other Partner-1	....
	....
	....
Name of other Partner - 2	....
Address of other Partner-2	....
	....
	....
Printed Name	
Designation	
Date :	
Place :	

Click here for next

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Attachment-3(JV) SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"		
(Joint Venture Agreement and Power of Attorney for Joint Venture*)		
Bidder's Name and Address (Sole Bidder) :		**REC Transmission Projects Company Limited** **(A wholly owned subsidiary of REC, a 'Navratna CPSE'** **Under the Ministry of Power, Govt of India)** **ECE House, 3rd Floor, Annexe – II,** **28 A, K G MARG, NEW DELHI – 110 001** **Website: www.rectpcl.in**
Name :		
Address :		
Dear Sir,		
The Joint Venture Agreement (as per the proforma attached at no. 15 in Section-IX, Sample Forms and Procedures, Conditions of Contract, Vol.-I of the Bidding Documents) and Power of Attorney for Joint Venture (as per the proforma attached at no. 14 in Section-IX, Sample Forms and Procedures, Conditions of Contract, Vol.-I of the Bidding Documents) are enclosed herewith.		
Date :		**Printed Name :**
Place :		**Designation :**

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Attachment-3(QR) SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"		
(Qualifying Requirement Data)		
Bidder's Name and Address (Sole Bidder) :		To:
Name :		REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Address :		
Dear Sir,		
For our Qualifying Requirements Data, please refer Schedule-QR of this VOLUME		
Date :	Printed Name :	
Place :	Designation :	

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Attachment-4 SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"		
(Form of Certificate of Origin and Eligibility)		
Bidder's Name and Address (Sole Bidder) :		**To:**
Name :		REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Address :		
Dear Sir,		
We hereby certify that equipment and materials to be supplied are produced in [Name of Countries], eligible source country. We hereby certify that our company is incorporated and registered in [Name of Countries], eligible source country.		
	Equipment and material produced in (Name of Countries)	Company incorporated & registered in (Name of Countries)
	(Name of Countries)	(Name of Countries)
Date :		**Printed Name :**
Place :		**Designation :**

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02+A1:E16E5A1:E15A1:E18A1:E17				Attachment-4(A) SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"				
(List of Special Maintenance Tools & Tackles)				
Bidder's Name and Address (Sole				**To:**
Name :				REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE'Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Address :				
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 which are to be taken back after the completion of the work by us are not included in our lumpsum bid price. We further confirm that the list of special maintenance tools & tackles includes all the items specifically identified in your bidding documents as brought out below:				
S. No.	For Equipment	Item Description	Unit	Quantity
1				
2				
3				
4				
5				
Notwithstanding what is stated above, we further confirm that any additional special maintanence tool and tackels required for the equipment under this package shall be furnished by us at no extra cost to the employer.				
Date :			**Printed Name :**	
Place :			**Designation :**	

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Attachment-4(B) SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"		
(List of Special Maintenance Tools & Tackles)		
Bidder's Name and Address (Sole Bidder) :		**To:**
Name :		REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Address :		
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 which are to be taken back after the completion of the work by us are not included in our lumpsum bid price. We further confirm that the list of special maintenance tools & tackles includes all the items specifically identified in your bidding documents as brought out below:		
(a)		
(b)		
(c)		
(d)		
(e)		
(f)		
Date :	**Printed Name :**	
Place :	**Designation :**	

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02			Attachment-5 SS	
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"				
(Brought out & Sub-contracted Items)				
Bidder's Name and Address (Sole Bidder) :			**To:**	
Name :			REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II,	
Address :				
Dear Sir,				
1.We hereby furnish the details of the items/ sub-assemblies (supply items), we propose to buy for the purpose of furnishing and installation of the subject Package :				

Sl. No.	Item Description	Quantity proposed to be bought/sub-	Details of the proposed sub-	
			Name	Address
1				
2				
3				
4				
5				

We hereby delare that we would not subcontract the erection portion of the contract without prior approval of the Employer.

We hereby furnish the details of the items/ sub-assemblies post to supply from our own work (i.e. as direct transations) in addition to the supplies the same from other venders(i.e. as bought-out transations) as detailed in the table given above .

Sl. No.	Item Description	Quantity proposed to be supplied	Details of the plant from where supplies are proposed	
			Name of plant	Address
1				
2				
3				
Date :		**Printed Name :**		
Place :		**Designation :**		

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02	ATTACHMENT-5A

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

(Items, Components, Raw Material, Services proposed to be sourced from Micro and Small Enterprises)

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

Dear Sir,

1. We hereby furnish the details of the items, components, raw material, services which we propose to buy/avail from Micro and Small Enterprises (MSEs) for the purpose of completion of works under the subject package :

Sl. No.	Item Description	Quantity proposed to be brought/sub-contracted	Name of Micro and Small Enterprises (MSEs)	
			Name & Address	Category (Micro or Small)
1				
2				
3				
4				
5				

2. The above is a list of items we propose to procure from MSEs. However, based on the situations during the execution of the contract, the above list may undergo changes. We hereby confirm that the details regarding actual procurement from MSEs carried out by us, as per the format provided at Section IX, Forms and Procedures, Volume-I of bidding documents, shall be submitted along with the bills for payment against supplies made/works done during execution of contract.

Date :		**Printed Name :**	
Place :		**Designation :**	

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02			Attachment-6 SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"			
(Alternative, Deviations and Exceptions to the Provisions)			
Bidder's Name and Address (Sole Bidder) :			**To:**
Name :			REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Address :			
Dear Sir,			

The bidder shall itemize any deviation from the Specifications included in his bid. Each item shall be listed (separate sheets may be used and enclosed with this Attachment) with the following information:

Sl. No.	Reference clause in the Specifications	Deviation	Cost of withdrawal of the deviation

The above deviations and variations are exhaustive. We confirm that we shall withdraw the deviations proposed by us at the cost of withdrawal indicated in this attachment, failing which our bid may be rejected and Bid Security forfeited.

Except for the above deviations and variations, the entire work shall be performed as per your specifications and documents.
Further, we agree that any deviations, conditionality or reservation introduced in this Attachment-6 and/or in the Bid form, Price schedules & Technical Data Sheets and covering letter, or in any other part of the bid will be reviewed to conduct a determination of the substantial responsiveness of the bid.

Date :		**Printed Name :**	
Place :		**Designation :**	

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Attachment-7 SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"		
(Details of Alternative Bid)		
Bidder's Name and Address (Sole Bidder) :	**To:**	
Name :	REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II,	
Address :		
No Alternative Bid is allowed		
Date :	**Printed Name :**	
Place :	**Designation :**	

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Attachment-9
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"		
(Work Completion Schedule)		
Bidder's Name and Address (Sole Bidder) :		**To:**
Name :		REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Address :		
Dear Sir,		
We hereby declare that the following Work Completion Schedule shall be followed by us in furnishing and installation of the subject Package i.e., Construction of 2X50 MVA, 220/33 kV Nagrota (New) substation including LILO of 220kV Kishenpur-Barn on D/C Tower at Nagrota Substation under PMDP Sceme-15"		

Sl. No.	Description of Work	Period in months from the effective date of contract
1	Detailed Engineering and drawing submission	
	a) commencement	
	b) completion	
2	Procurement of equipment/ components &	
	a) commencement	
	b) completion	
3	Type Tests	
	a) commencement	
	b) completion	
4	Manufacturing	
	a) commencement	
	b) completion	
Sl. No.	**Description of Work**	**Period in months from the effective date of contract**
5	Shipments & Delivery	
	a) commencement	
	b) completion	
6	Establishment of site office	
7	Installation at Site	
	a) commencement	
	b) completion	
8	Testing & Pre-commissioning	
	a) commencement	
	b) completion	
9	Trial Operation	
	a) commencement	
	b) completion	
Date :		**Printed Name :**
Place :		**Designation :**
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.	

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

Click here for next attachment

(Guarantee Declaration)

Bidder's Name and Address (Sole Bidder) :			
Name :			To, REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Address :			
Dear Sir, We conform that the equipments offered shall have minimum (or a muximum, as the case may be) performance specified in Technical Specification. We further guarantee the performance/efficiency of the equipments in response to the Technical Specifications.			

Equipment	**Guaranteed losses at rated output (KW) per Unit (applicable for each item/unit of the facilities)**		
	Copper loss at 75 degree C at rated current	Iron loss at rated voltage and frequency	Cooler loss (Power consumptions by all fan and pumps, except standby one) at rated voltage & frequency
50 MVA, (220/√3)/ (33/√3) kV 3-Phase Transformer			

Applicable in case of 50 MVA, 220/33kV, 3-phase Power Transformers

We note that in the above guaranteed losses are not meeting the criteria specified in the technical Specifications i.e " Copper loss (Load Loss)> iron Loss (No Load Loss)> Cooler loss(Auxiliary Loss)", our bid will be considered non-responsive in line with ITB Clause 24.1 (b).

Date: Printed Name:
Place: Designation:

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02			Attachment-11 SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"			
Bidder's Name and Address (Sole Bidder) :		**To:**	
Name :		REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II,	
Address :			
Dear Sir,			

Information Regarding Ex-employee of RECTPCL

(NOT APPLICABLE FOR THIS TENDER)

We declare that we are aware of and have gone through the "Code of Business Conduct and Ethics for Senior Management Personnel"1 and "Code of Business Conduct and Ethics for Board Members"1 of RECTPCL (hereinafter referred to as the "Code of Conduct"). We further understand that as per the "Code of Conduct", Senior Management Personnel including Board Members, who have retired/resigned from RECTPCL, shall not accept any appointment or post, as detailed in the referred "Code of Conduct", within 1 year from the date of cessation of service/directorship unless approved by the Competent Authority.
Accordingly,We hereby furnish the details of ex-employees of RECTPCL who had retired/ resigned at the level of General Manager and above from RECTPCL and subsequently have been employed by us:

Sl. No.	Name of the person with designation in RECTPCL	Date of Retirement/ resignation from RECTPCL	Date of joining and designation in our organisation
1			
2			
3			
4			

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02				Attachment-12 SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"				
(Price Adjustment Data)				
Bidder's Name and Address (Sole Bidder) :			**To:REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in**	
Name :				
Address :				
Dear Sir,				

We hereby furnish the relevant details pertaining to the price adjustment provisions for equipment as specified in your specifications and documents for the Tender Package "Construction of 2X50 MVA, 220/33 kV Nagrota (New) substation including LILO of 220kV Kishenpur-Barn on D/C Tower at Nagrota Substation under PMDP Sceme-15"

Sl. No.	Name of Materials	Value of co- efficient	Name of the published index	Value of index as 30 days prior to date set for opening of bids
1	*2*	*3*	*4*	*5*
In accordance with clause -2 Appedix-2,form of contract agreement, section-VI;Forms. Volume-I				
	TOWER PORTION			
A	For Fabricated Tower Parts (including bolts & nuts)			
a	Steel Blooms, co-efficient a =		IEEMA	
b.	Electrolytic High Grade Zinc, co-efficient b =		IEEMA	
c.	Labour, Co-efficient l=		Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in)	
Coefficient 'a' shall be between 0.51 to 0.57 and coefficient 'b' shall be between 0.08 to 0.10 and coefficient 'l' shall be between 0.20 to 0.24 and sum of Coefficients 'a', 'b' and 'l' shall be 0.85				
B.	**LINE MATERIALS**			
1.A	**Conductor**			
1	EC grade aluminium ingots, co-eifciant a =	0.65	CACMAI	
2		OPTION-A		
	High Carbon Steel Rods , co efficient b =	0.13		
	High Grade Electrolytic Zinc , co-efficient c =	0.02		
3	Labour, Co-efficient l=		Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in)	
2	**Hardware Fittings**			
i)	Raw Material			
A	EC Grade Aluminium Ingots, coefficient a =		IEEMA	
B	Electrolytic High Grade Zinc, coefficient b =		IEEMA	

Click here for next attachment

Sl. No.	Name of Materials	Value of co- efficient	Name of the published index	Value of index as 30 days prior to date set for opening of bids
C	Ferrous Metals, coefficient c=		Wholesale Price Index Number for 'Ferrous Metals' (Group Item) (monthly) (Base: 2004-05=100) as published by Office of Economic Advisor, Ministry of Commerce & Industry (www.eaindustry.nic.in)	
ii)	Labour, coefficient l =		Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in)	
Coefficient 'a' shall be between 0.35 to 0.45 and coefficient 'b' shall be between 0.04 to 0.06 and coefficient 'c' shall be between 0.18 to 0.22 and coefficient 'l' shall be between 0.13 to 0.17 and sum of Coefficients 'a', 'b', 'c' and 'l' shall be 0.80				
3	**Conductor Accessories**			
3(a)	**Mid Span Compression Joint for Conductor**			
i)	Raw Material			
A	EC Grade Aluminium Ingots, coefficient a =		IEEMA	
Sl. No.	**Name of Materials**	**Value of co- efficient**	**Name of the published index**	**Value of index**
ii)	Labour, coefficient l =		Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in	
Coefficient 'a' shall be between 0.63 to 0.67 and coefficient 'l' shall be between 0.13 to 0.17 and sum of Coefficients 'a' and 'l' shall be 0.80				
3(b)	**Repair Sleeve for Conductor**			
i)	Raw Material			
A	EC Grade Aluminium Ingots, coefficient a =		IEEMA	
ii)	Labour, coefficient l =		Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in)	
Coefficient 'a' shall be between 0.63 to 0.67 and coefficient 'l' shall be between 0.13 to 0.17 and sum of Coefficients 'a' and 'l' shall be 0.80				
3(c)	**Vibration Damper for Conductor**			
i)	Raw Material			
A	EC Grade Aluminium Ingots, coefficient a =		IEEMA	
ii)	Labour, coefficient l =		Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in)	
Coefficient 'a' shall be between 0.63 to 0.67 and coefficient 'l' shall be between 0.13 to 0.17 and sum of Coefficients 'a' and 'l' shall be 0.80				
3(d)	**Flexible Copper Bond**	**Firm**		
C.	**For Erection Price Component**			

Sl. No.	Name of Materials	Value of co- efficient	Name of the published index	Value of index as 30 days prior to date set for opening of bids
1	**Installation Price Component {including civil works but excluding 'supply & placement of reinforcement steel', 'concreting', survey, soil investigation and aviation signal for river crossing towers(if any)}**			
A	High Speed Diesel, coefficient a =		Wholesale Price Index Number for 'High Speed Diesel' (Individual commodity) (monthly) (Base: 2004-05=100) as published by Office of Economic Advisor, Ministry of Commerce & Industry (www.eaindustry.nic.in)	
L	Labour, coefficient l =		Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100)	
Coefficient 'a' shall be between 0.20 to 0.24 and coefficient 'l' shall be between 0.56 to 0.60 and sum of Coefficients 'a' and 'l' shall be 0.80				
2	**Supply & Placement of Reinforcement Steel**			
A	High Speed Diesel, coefficient a =		Wholesale Price Index Number for 'High Speed Diesel' (Individual commodity) (monthly) (Base: 2004-05=100) as published by Office of Economic Advisor, Ministry of Commerce & Industry (www.eaindustry.nic.in)	
L	Labour, coefficient l =		Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in)	
B	Ferrous Metals, coefficient b =		Wholesale Price Index Number for 'Ferrous Metals' (Group Item) (monthly) (Base: 2004-05=100) as published by Office of Economic Advisor, Ministry of Commerce & Industry (www.eaindustry.nic.in).	
Coefficient 'a' shall be between 0.09 to 0.11 and coefficient 'b' shall be between 0.63 to 0.67 and coefficient 'l' shall be between 0.04 to 0.06 and sum of Coefficients 'a', 'b' and 'l' shall be 0.80				
3	**For Concreting**			
A	High Speed Diesel, coefficient a =		Wholesale Price Index Number for High Speed Diesel' (Individual commodity) (monthly) (Base: 2004-05=100) as published by Office of Economic Advisor, Ministry of Commerce & Industry (www.eaindustry.nic.in)	
L	Labour, coefficient l =		Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in	

Sl. No.	Name of Materials	Value of co- efficient	Name of the published index	Value of index as 30 days prior to date set for opening of bids
B	Cement & Lime, coefficient b =		Wholesale Price Index Number for 'Cement & Lime' (Group Item) (monthly) (Base: 2004- 05=100) as published by Office of Economic Advisor, Ministry of Commerce & Industry (www.eaindustry.nic.in).	
C	Structural Clay Products, coefficient c =		Wholesale Price Index Number for 'Structural Clay Products' (Group Item) (monthly) (Base: 2004- 05=100) as published by Office of Economic Advisor, Ministry of Commerce & Industry	
Sl. No.	**Name of Materials**	**Value of co- efficient**	**Name of the published index**	**Value of index**
SUBSTATION PORTION				
Sl. No.	**Name of Materials/Labour**	**Value of co- efficient**	**Name of the published index**	**Value of index as 30 days prior to date set for**
1	*2*		*4*	*5*
In accordance with Clause 2, Appendix-2, Form of Contract Agreement, Section-VI; Forms. Volume-I				
A) For Equipment Price Component:				
I.	**Circuit Breaker**			
a)	**Raw Material**			
i)	a=		IEEMA	
ii)	b=		IEEMA	
iii)	c=		IEEMA	
iv)	d=		IEEMA	
b)	Labour I=		Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in	
The sum of the value of coefficients for raw materials: a+b+c+d=0.55 to 0.65 and sum of all the coefficients including labour shall be a+b+c+d+l=0.85.				
II	**Current Transformer**			
a)	**Raw Material**			
i)	a=		IEEMA	
ii)	b=		IEEMA	
iii)	c=		IEEMA	
iv)	d=		IEEMA	
b)	Labour I=		Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in	
The sum of the value of coefficients for raw materials: a+b+c+d=0.55 to 0.65 and sum of all the coefficients including labour shall be a+b+c+d+l=0.85.				
III	**Capacitive VoltageTransformer**			
a)	**Raw Material**			
i)	a=		IEEMA	
ii)	b=		IEEMA	
iii)	c=		IEEMA	
iv)	d=		IEEMA	
b)	Labour I=		Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in	
The sum of the value of coefficients for raw materials: a+b+c+d=0.55 to 0.65 and sum of all the coefficients including labour shall be a+b+c+d+l=0.85.				
Sl. No.	**Name of Materials**	**Value of co- efficient**	**Name of the published index**	**Value of index**
IV	**Isolators**			
a)	**Raw Material**			
i)	a=		IEEMA	
ii)	b=		IEEMA	
iii)	c=		IEEMA	
iv)	d=		IEEMA	
b)	Labour I=		Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in	

Sl. No.	Name of Materials	Value of co- efficient	Name of the published index	Value of index as 30 days prior to date set for opening of bids
The sum of the value of coefficients for raw materials: a+b+c+d=0.55 to 0.65 and sum of all the coefficients including labour shall be a+b+c+d+l=0.85.				
V	**Surge Arrester**			
a)	**Raw Material**			
i)	a=		IEEMA	
ii)	b=		IEEMA	
iii)	c=		IEEMA	
iv)	d=		IEEMA	
b)	Labour I=		Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in	
The sum of the value of coefficients for raw materials: a+b+c+d=0.55 to 0.65 and sum of all the coefficients including labour shall be a+b+c+d+l=0.85.				
VI	**PVC/XLPE Insulated Power and Control Cable**			
a)	**a=PVC Compound**			
b)	Published Price of Metal		IEEMA	
	i) Aluminium per MT		IEEMA	
	ii) Copper per MT		IEEMA	
c)	Weight in MT of Metal per kM(Size wise)			
	i)			
	ii)			
	iii)			
	iv)			
	v)			
VII	**Substation Structures**			
i)	**Lattice Steel Structures & Pipe Structures (including bolts & nuts, washers & foundation bolts)**			
a)	Raw Materials			
i)	a=Structural steel	0.58	JPC Market Price (Retail) for average Price of Steel Angles of size 50 x 50 x 6 mm of all cities in Rs./MT as published by Joint Plant Committee(JPC).	
ii)	b=Electrolytic Zinc	0.16	IEEMA	
b)	Labour	0.11	Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in)	
B (I) For Ex-works Price Component of Power Transformer/ Reactor without Insulating oil:				
a)	**Raw Material**			
i)	Copper a=		Price of Copper wire bars, in Rupees per MT, as	
ii)	Electrical Lamination Steel b=		Price of CRGO Electrical Steel Sheets: C&F Price converted into Indian Rupees per MT for Transformer of rating above 10MVA or voltage	
iii)	Construction Steel c=		Wholesale Price Index Number for 'Ferrous Metals' (Group Item) (monthly) (Base: 2004-05=100) as published by Office of Economic Advisor, Ministry of Commerce & Industry (www.eaindustry.nic.in).	
iv)	Insulating Material d=		Price of Insulating Materials , as published by	
b)	**Labour I=**		Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in	
Sl. No.	**Name of Materials**	**Value of co- efficient**	**Name of the published index**	**Value of index**
The sum of the value of coefficients for raw materials: a+b+c+d=0.65 to 0.73 and value of coefficient for labour shall be between 0.12 and 0.20, so that sum of all the coefficients including labour shall be a+b+c+d+l=0.85				

Sl. No.	Name of Materials	Value of co- efficient	Name of the published index	Value of index as 30 days prior to date set for opening of bids
B (II) For Ex-works Price Component of Insulating oil for Power Transformer/ Reactor:				
a)	Insulating Oil e=		Transformer Oil base stock (TOBS): C&F price of Group- II 70 grade oil converted into Indian Rupees, as published by IEEMA.	
C). For Ex-works Price Component of L. T. Transformer:				
a)	**Raw Material**			
i)	Copper a=		Price of Copper wire bars, in	
ii)	Electrical Lamination Steel b=		Price of CRGO Electrical Steel Sheets: C&F Price converted into Indian Rupees per MT for Transformer of rating up	
iii)	Construction Steel c=		Wholesale Price Index Number for 'Ferrous Metals' (Group Item) (monthly) (Base: 2004-05=100) as published by Office of Economic Advisor, Ministry of Commerce & Industry (www.eaindustry.nic.in).	
iv)	Insulating Material d=		Price of Insulating Materials , as published by IEEMA.	
v)	Insulating Oil e=		Transformer Oil Base Stock	
b)	**Labour I=**		Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in	
The sum of the value of coefficients for raw materials: a+b+c+d+e =0.65 to 0.73 and value of coefficient for labour shall be between 0.12 and 0.20, so that sum of all the coefficients including labour shall be a+b+c+d+e+l=0.85				
C.	**For Installation Price Component**			
I	**Installation price component (including Civil works but excluding 'supply & placement of reinforcement steel' and 'concreting')**			
i)	Labour I=	0.8	Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in)	
II	**Supply & Placement of Reinforcement Steel**			
i)	High Speed Diesel	0.1	Wholesale Price Index Number for 'High Speed Diesel' (Individual commodity) (monthly) (Base: 2004-05=100) as published by Office of Economic Advisor, Ministry of Commerce & Industry (www.eaindustry.nic.in).	
ii)	Labour I=	0.05	Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100) (www.labourbureau.nic.in	

Sl. No.	Name of Materials	Value of co- efficient	Name of the published index	Value of index as 30 days prior to date set for opening of bids
iii)	Ferrous Metal	0.65	Number for 'Ferrous Metals' (Group Item) (monthly) (Base: 2004-05=100) as published by Office of Economic Advisor, Ministry of Commerce & Industry (www.eaindustry.nic.in).	
iii)	**For Concereting**			
i)	High Speed Diesel	0.2	Wholesale Price Index Number for 'High Speed Diesel' (Individual commodity) (monthly) (Base: 2004-05=100) as published by Office of Economic Advisor, Ministry of	
ii)	Labour I=	0.1	Indian Labour Bureau, Shimla, Govt. of India (monthly) (Base: 2001 = 100)	
iii)	Cement & Lime	0.3	Wholesale Price Index Number for 'Cement & Lime' (Group Item) (monthly) (Base: 2004-05=100) as published by Office of Economic Advisor, Ministry of	
iii)	Structural Clay Products	0.2	Wholesale Price Index Number for 'Structural Clay Products' (Group Item) (monthly) (Base: 2004- 05=100) as published by Office of Economic Advisor,	

Coefficient 'a' shall be between 0.18 to 0.22 and coefficient 'b' shall be between 0.25 to 0.35 and coefficient 'c' shall be between 0.18 to 0.22 and coefficient 'l' shall be between 0.09 to 0.11 and sum of Coefficients 'a', 'b', 'c' and 'l' shall be 0.80

The Bidders are required to estimate and indicate the values of different coefficients for each of the items in the price variation formulae within the specified range such that their summation is as specified in the Bidding Documents. Where no value or '-' or 'shall be furnished later' is specified against the coefficient, the same will be deemed to be zero and the fixed component would be suitably adjusted. If the values of all coefficients in price variation formulae indicated by the Bidder are within the specified range but their sum exceeds the summation specified in the Bidding Documents, the values of the coefficients shall be pro rata adjusted such that the summation remains as per the provisions of the Bidding Documents. If the values of all coefficients indicated by the Bidder are within the specified range but their summation is less than the value specified in the Bidding Documents, the values of the coefficients as indicated by the Bidder shall be considered as such and the fixed component in the price variation formulae would be suitably adjusted. Further, if any of values of the coefficients indicated by the Bidder is out of the range specified in the Bidding Documents, the lower of the values, as indicated by the Bidder vis-à-vis lower value of the range for that coefficient specified in the Bidding Documents, shall be considered and the fixed component would be suitably adjusted.

Date :		**Printed Name :**		
Place :		**Designation :**		

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Attachment-13 SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"		
(Declaration regarding Social Accountability)		
Bidder's Name and Address (Sole Bidder) :		**To:**
Name :		REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II,
Address :		
Dear Sir,		
We conform that we stand committed to comply to all requirements of Social Accountability Standards i.e., SA8000 (latest Standard available at *www.sa-intl.org*) and maintain the necessary records.		
Date :		**Printed Name :**
Place :		**Designation :**

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Attachment-14 SS	
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"			
Integrity Pact			
Bidder's Name and Address (Sole Bidder) :		**To:**	
Name :		REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in1	
Address :			
Dear Sir,			
Bidders are requested to refer Section-IX of VOL-I for the format of INTEGRITY PACT			
Date :		**Printed Name :**	
Place :		**Designation :**	

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Attachment-15 SS

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

Click here for next attachment

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

Bidder's Name and Address (Sole Bidder) :		**To.**
Name :		REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Address :		
Dear Sir,		
I	We have read the provisions in the Bidding Documents regarding furnishing the option for advance payment. Accordingly, as per ITB Clause 9.3 as provided in Section BDS, Section III, Vol.-I of the Bidding Documents, we hereby confirm to opt the following:	
	Interest Bearing Initial Advance **NOT APPLICABLE**	
	Supply Portion:	
	Services Portion:	
II	We are furnishing the following details of Statutory Registration Numbers and details of Bank for electronic payment.	
1.	Name of the Supplier/ Contractor in whose favour payment is to be made	
2.	Address with PIN Code and State	
	Registered Office:	
	Branch Office:	
	Correspondence Address:	
3.	Status – Company/others	
	[Declaration of Micro/ Small/ Medium Enterprise under Micro/ Small & Medium Enterprises Development Act 2006, if applicable]	
4.	Permanent Account (PAN) No.	
5.	**GSTIN Numbers**	
I.	GSTIN in the Sates/UT from where the supply of goods take place	
	Name of the States/UT	GSTIN number
(i)		
(ii)		
(iii)		
II.	GSTIN in the States/UT where the supply for services take place (states where sites under the subject package is situated)	
	Name of the States/UT	GSTIN number
6.	PF Registration No. of the Company	
7.	PF Regional Office covered (with Address)	
8.	Name of Contact Person	
	Designation	
9.	Contact Details	
	Landline(s):	
	Mobile(s):	
	Email ID :	
10.	Bank Details for Electronic Payment	
	Name of the Bank:	
	Address of Branch:	
	Account No.:	
	Type of Account:	
	Type of Account: Saving Account Current Account	Current Account
11.	9 digit MICR code printed at bottom in middle, next to cheque no.	
12.	IFSC (for RTGS)/NEFT Code (*to be obtained from the Bank*) Sample Cancelled Cheque to be enclosed	

We hereby declare that the above information are true and correct and we agree that the payment on account of this Contract, in the event of award, be made in the above account maintained in the above mentioned Bank.

Date :	**Printed Name :**	
Place :	**Designation :**	

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02	Attachment-16 SS

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

Click here for next

(Additional Information)

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

In support of the additional information required as per ITB Sub-Clause 9.3 (p) of the Bidding Documents, we furnish herewith our data/details/documents etc., alongwith other information, as follows (the stipulations have been reproduced in italics for ready reference):

1.0	The Bidder shall furnish				
	A certificate from their Banker(s) (as per prescribed formats in Form 16, Section-IX: Sample Forms and Procedures) indicating various fund based/non fund based limits sanctioned to the Bidder and the extent of utilization as on date. Such certificate should have been issued not earlier than three months prior to the date of bid opening. Wherever necessary the Employer may make queries with the Bidders' Bankers. [Reference ITB clause 9.3(p)(i)]				
1.1	In accordance with 1.0, certificate(s) from banker as per requisite format, indicating various fund based/non fund based limits sanctioned to the bidder or each member of the joint venture and the extent of utilization as on date is/are enclosed, as per the following details:				
	Name of the Bidder (Sole Bidder)				
	Name of the Banker by whom certificate issued				
	Date of certificate (should not be earlier than **3 months** prior to date of bid opening)				
	Whether fund based/non fund based limits are indicated in the certificate				
	Whether extent of utilization is indicated in the certificate				
1.2	The Bidder should accordingly also provide the following information/documents				
(i)	Details of Banker:				
	Name of Banker				
	Address of Banker				
	Telephone No.				
	Contact Name and				
	Fax No.				
	E-mail ID				
(ii)	As per para 1.0, Authorization Letter(s) from the bidder (in case of JV bidder, from all the partners) addressed to the Banker(s), authorizing POWERGRID to seek queries about the bidder with the Banker(s) and advising the Banker(s) to reply the same promptly, is/are enclosed as per following details:				
	Sl.	Letter Ref.	Date	Addressed to (name of the Bank)	
(iii)	*As per para ITB clause 9.3 q, Bidder shall furnish the details of their Provident Fund Code Number*				
	Sl. No.	Name of Bidders/JV Partners	Provident Fund Code	Details	
2.0	**Litigation History**				
	The bidder should provide detailed information on any litigation or arbitration arising out of contracts completed or under execution by it over the last five years. A consistent history of awards involving litigation against the Bidder or any partner of JV may result in rejection of Bid. [Reference ITB clause 9.3(p)(ii)]				

2.1	Details of litigation history resulting from Contracts completed or under execution by the bidder over the last five years				
	Year	Name of client, cause of litigation/arbitration and matter in dispute	Details of Contract and date	Award for or against the bidder	Disputed amount
	1				
	2				
	3				
	4				
	5				

3.0	**OTHER INFORMATION**
3.1	Current Contract Commitments of works
	Bidders (individual firms or each partners of JV) should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Details of Contract	Value of outstanding work (Rs.)	Estimated completion date

3.2	Financial Data:										
										Figures Rs in	

Details	Actual (Previous five years)					Projection for next five years				
	2016 - 2017	2015 - 2016	2014-2015	2013 - 2014	2012 - 2013	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022
Total Assets										
Current Assets										
Total Liability										
Current Liability										
Profit before taxes										
Profit after taxes										

4	**Details of provident fund for no. of the bidder (ref. ITB9.3(q))**		
Date :		**Printed Name :**	
Place :		**Designation :**	

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02				Attachment-17 SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"				
(Declaration for tax exemptions, reductions, allowances or benefits)				
Bidder's Name and Address (Sole Bidder) :			**To:**	
Name :			REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II,	
Address :				
Dear Sir,				
1	We confirm that we are solely responsible for obtaining following tax exemptions, reductions, allowances or benefits in respect of supplies under the subject package, in case of award. We further confirm that we have considered the same in our bid thereby passing on the benefit to POWERGRID while quoting our prices. In case of our failure to receive such benefits, partly or fully, for any reason whatsoever, the Employer will not compensate us.			
2	We are furnishing the following information required by the Employer for issue of requisite certificate if and as permitted in terms of the applicable Govt. of India policies/procedures (in case of award):			
Applicable Act, Notification No. and Clause Ref. No.	Sl. No.	Description of item on which applicable	Country of origin	Remarks, if any
(The requirements listed above are as per current Notification of Govt. of India indicated above. These may be modified, if necessary, in terms of the Notifications.)				
Date :		**Printed Name :**		
Place :		**Designation :**		

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Attachment-18 SS	
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"			
(Safety Pact)			
Bidder's Name and Address (Sole Bidder) :		**To:**	
Name :		REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II,	
Address :			
Dear Sir,			
Bidders are requested to refer Section-IX of VOL-I for the format of SAFETY PACT			
Date :		**Printed Name :**	
Place :		**Designation :**	

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02	Attachment-19 SS
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"	
(Declaration)	
Bidder's Name and Address (Sole Bidder) :	**To:**
Name :	REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Address :	
Dear Sir,	
We confirm that Bid Form and Price Schedules in the Second Envelope have been filled up by us as per the provisions of the Instruction to Bidders. Further, we have noted that the same shall be evaluated as per the provisions of the Bidding Documents.	
Further, we hereby confirm that except as mentioned in the Attachment – 6 (Alternative, Deviations and Exceptions to the Provisions) hereof forming part of our First Envelope :	
(i) there are no discrepancies/inconsistencies and deviations/omissions/ reservations to the Bidding Documents, in the Second Envelope bid; (ii) the description of items and the unit thereof in the price schedules in the Second Envelope bid are in conformity with those indicated in the price schedule of the Bidding Documents without any deviation to the specified scope of work. We also confirm that in case any discrepancies/ inconsistencies and deviations/ omissions/ reservations, as referred to in para (i) and (ii) above, is observed in the Second Envelope, the same shall be deemed as withdrawn/rectified without any financial implication, whatsoever to RECTPCL. However, in case of any arithmetical errors, the same shall be governed as per the provision of ITB Sub-Clause 27.2	
Date :	**Printed Name :**
Place :	**Designation :**

Click here for next attachment

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02	**Attachment-20 SS**
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of	
(confirmation regarding compliance to submission of value Addition certificate)	
Bidder's Name and Address (Sole Bidder) :	To:REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE'Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Name :	
Address :	
Dear Sir,	
It is hereby confirmed that we are complying the provision of ITB sub clause 28(I), BDS, Section III, Volume I of Bidding document regarding submission of value Addition Certificate to the concerned Ministry/Department on half yearly basis(sept.30 to march31)	

Date :		**Printed Name :**	
Place :		**Designation :**	

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02	Bid Form 1st Envelope

BID FORM (First Envelope)

Bid Proposal Ref. No.

Date :

To,
Additional Chief Executive Officer,
REC Transmission Projects Company Limited
(A wholly owned subsidiary of REC, a 'Navratna CPSE'
Under the Ministry of Power, Govt of India)
ECE House, 3rd Floor, Annexe – II,
28 A, K G MARG, NEW DELHI – 110 001

Name of Contract : **Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"**

Dear Ladies and/or Gentlemen,

1.0 Having examined the Bidding Documents, including Amendment Nos. ...[Enter the Amendment]... dated ...[Enter the Date in dd-mm-yyyy]... the receipt of which is hereby acknowledged, we the undersigned, offer to design, manufacture, test, deliver, install and commission (including carrying out Trial operation, Performance & Guarantee Test as per the provision of Technical Specification) the Facilities under the above-named package in full conformity with the said Bidding Documents. In accordance with ITB Clause 9.1 of the Bidding Documents, as per which the bid shall be submitted by the bidder under "Single Stage - Two Envelope" procedure of bidding. Accordingly, we hereby submit our Bid, in two envelopes i.e. First Envelope – Techno – Commercial Part & Second Envelope - Price Part (to be opened subsequently).
The above amounts are in accordance with the price schedules attached herewith and are made part of this bid

2.0 Attachments to the Bid Form (First Envelope)

In line with the requirement of the Bidding Documents, we enclose herewith the following Attachments:

(a) Attachment 1	Bid Security,in a separate envelope,in the form of Bank Guarantee for a sum INR 50,00,000(Fifty Lacs Only). Bid security shall remain valid for a period of thirty (30) days beyond the original bid validity period i.e., for a period of TEN (10) months after the last date of bid submission, and beyond any extension subsequently requested under ITB Sub-Clause 14.2.
(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 14.
(c) Attachment 3	The documentary evidence that we are eligible to bid in accordance with ITB Clause 2. Further, in terms of ITB Clause 9.3 (c) & (e), the qualification data has been furnished as per your format enclosed with the bidding documents Attachment- 3(QR). Further, the required joint venture Agreement signed by us and our partners has also been furnished as per your format Attachment 3 (JV). Further the required deed of Joint Undertaking signed by us and Tower Manufacturer has also been furnished as per your format.
(d) Attachment 4	The documentary evidence establishing in accordance with ITB Clause 3, Vol.-I of the Bidding Documents that the facilities offered by us are eligible facilities and conform to the Bidding Documents has been furnished as Attachment 4. A list of Special Tools & Tackles to be used by us for erection, testing & Commissioning and to be handed over to Employer, the cost of which is included is our Bid Price, is also enclosed as per your format as Attachment 4A. A list of Special Tools & Tackles to be brought by the contractor for erection, testing & Commissioning and to be taken back after completion of work, whose cost in not included in our bid price, is enclosed as per your format as Attachment 4B.
(e) Attachment 5	The details of all major items of services or supply which we propose subletting in case of award, giving details of the name and nationality of the proposed subcontractor/sub-vendor for each item.
(g) Attachment 6	The variation and deviations from the requirements of the Conditions of Contract, Technical Specification and Drawings (excluding critical provisions as mentioned at clause 6.0 below) in your format enclosed with the Bidding Documents, including, inter alia, the cost of withdrawal of the variations and deviations indicated therein.
(h) Attachment 7	The details of Alternative Bids made by us indicating the complete Technical Specifications and the deviation to contractual and commercial conditions. (Not Applicable)
(i) Attachment 8	Manufacturer's Authorisation Forms.
(j) Attachment 9	Work Completion Schedule.
(k) Attachment 10	Guarantee Declaration.
(l) Attachment 11	**Not Applicable**

(m) Attachment 12	Filled up information regarding Price Adjustment Data as per the format enclosed in the bidding documents.
(n) Attachment 13	Declaration regarding Social Accountability.
(o) Attachment 14	Integrity Pact, in a separate envelope, duly signed on each page by the person signing the bid.
(p) Attachment 15	**Not Applicable**
(q) Attachment 16	Additional Information.
(r) Attachment 17	Declaration for tax exemptions, reductions, allowances or benefits
(s) Attachment 18	Safety Pact, in a separate envelope, duly signed on each page by the person signing the bid.
(t) Attachment 19	Declaration
(u) Attachment 20	confirmation regarding compliance to submission of value Addition certificate
(v) Attachment 21	Affidavit (Declaration of Key Managerial Person jointly with Power of Attorney holder)

2.2	We are a Micro and Small Enterprise (MSE) registered with a designated Authority of GoI under the Public Procurement Policy for MSEs order 2012. (applicable for MSE only)
3.0	We are aware that, in line with Clause No. 27.1 (ITB), our Second Envelope (Price Part) is liable to be rejected in case the same contains any deviation/omission from the contractual and commercial conditions and technical Specifications other than those identified in this First Envelope.
3.1	We are aware that the Price Schedules do not generally give a full description of the Work to be performed under each item and we shall be deemed to have read the Technical Specifications and other sections of the Bidding Documents and Drawings to ascertain the full scope of Work included in each item while filling-in the rates and prices in Second Envelope.
3.2	We declare that as specified in Clause 11.5, Section –II:ITB, Vol.-I of the Bidding Documents, prices quoted by us in the Price Schedules in Second Envelope shall be subject to Price Adjustment during the execution of Contract in accordance with Appendix-2 (Price Adjustment) to the Contract Agreement.
4.0	We confirm that except as otherwise specifically provided our Bid Prices in Second Envelope include all GST and charges as may be assessed on us, our Sub-Contractor/Sub-Vendor or their employees by all municipal, state or national government authorities in connection with the Facilities, in and outside of India.
4.1	100% of applicable GST which are payable by the Employer under the Contract, shall be reimbursed by the Employer 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, GST in respect of supplies by us to you, imposed on the Plant & Equipment including Mandatory Spare Parts to be incorporated into the Facilities including Type Test charges for Type test to be conducted specified in Schedule No. 1, Installation Services specified in Schedule No. 3 and Charges for Training to be imparted specified in Schedule No. 4 of the Price Schedule in Second Envelope, by the Indian Laws.
4.3	We confirm that we have also registered/we shall also get registered in the GST Network with a GSTIN, in all the states where the project is located and the states from which we shall make our supply of goods
5.0	**Construction of the Contract**
5.1	We declare that we have studied Clause ITB 31.4.1 relating to mode of contracting for Domestic Bidders and we are making this proposal with a stipulation that you shall award us two separate Contracts viz 'First Contract' for ex-works supply of all equipment and materials including mandatory spares and 'Second Contract' for providing all the services i.e. inland transportation for delivery at site, insurance, unloading, storage, handling at site, installation, testing and commissioning including Trial operation in respect of all the equipment supplied under the 'First Contract' and other services specified in the Contract Documents. We declare that the award of two contracts, will not, in any way, dilute our responsibility for successful operation of plant/equipment and fulfillment of all obligations as per Bidding Documents and that both the Contracts will have a cross-fall breach clause i.e. a breach in one Contract will automatically be classified as a breach of the other contract which will confer on you the right to terminate the other contract at our risk and cost.
6.0	We have read the provisions of following clauses and confirm that the specified stipulations of these clauses are acceptable to us:

(a)	ITB 13	Bid Security	
(b)	GCC 5(i)(b)	Governing Law	
(c)	GCC 7 (i)	Contractor's Responsibility	
(d)	GCC 9.0	Performance Security	
(e)	GCC 27	Liquidity Damage	
(f)	GCC 31(i)(a)	Defect Liability	
(g)	GCC 33	Payment Terms	
(h)	GCC 26	Limitations of Liability	
(i)	GCC 47	Settlement of Disputes	
(j)	GCC 48	Arbitration	
(k)	SCC 14	Taxes & Duties	
(l)	Appendix 2 to Form of Contract Agreement	Price Adjustment	

Further we understand that deviation taken in any of the above clauses by us may make our bid non-responsive as per provision of bidding documents and be rejected by you.

7.0	We undertake, if our bid is accepted, to commence the work immediately upon your Notification of Award to us, and to achieve the delivery of goods and related services within the time stated in the Bidding Documents.				
8.0	If our bid is accepted, we undertake to provide a Performance Security in the form and amounts, and within the times specified in the Bidding Documents.				
9.0	We agree to abide by this bid for a period of six (06) months from the date fixed for opening of bids as stipulated in the Bidding Documents, and it shall remain binding upon us and may be accepted by you at any time before the expiration of that period.				
10.0	Until a formal Contract is prepared and executed between us, this bid, together with your written acceptance thereof in the form of your Notification of Award shall constitute a binding contract between us.				
11.0	We understand that you are not bound to accept the lowest or any bid you may receive.				
12.0	Commissions or gratuities, if any, paid or to be paid by us to agents relating to this Bid, and to contract execution, if we are awarded the contract, are listed below:-				
	Name and	Amount and Currency	Purpose of Commission or		
	(If none, state				
13.0	# (For Joint Venture only) We, the partners of Joint Venture submitting this bid, do agree and confirm that in case of Award of Contract on the Joint Venture, we shall be jointly and severally liable and responsible for the execution of the Contract in accordance with Contract terms and conditions.				
14.0	We, hereby, declare that only the persons or firms interested in this proposal as principals are named here and that no other persons or firms other than those mentioned herein have any interest in this proposal or in the Contract to be entered into, if the award is made on us, that this proposal is made without any connection with any other person, firm or party likewise submitting a proposal is in all respects for and in good faith, without collusion or fraud.				
	Thanking you, we				
		Yours faithfully,			
		For and on behalf of			
Date		**Printed Name :**			
Place		**Designation :**			

Please provide additional information of the Bidder	
Business Address :	
Country of	
State/Province to be	
Name of Principal	
Address of Principal Officer :	

Note: Bidders may note that no prescribed proforma has been enclosed for Attachment 2(SS01B) Power of Attorney. Bidders may use their own proforma for furnishing the required information with the bid.

Tender Package of "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

(Qualifying Requirement Data)

Bidders Name & Address:

To
REC Transmission Projects Company Limited
(A wholly owned subsidiary of REC, a 'Navratna CPSE')
Under the Ministry of Power, Govt of India)
ECE House, 3rd Floor, Annexe – II,

Dear Ladies and/or Gentlemen,

In support of the Qualification Requirements (QR) for bidders, stipulated in Section - III, Volume-I & additional information required as per ITB clause 9.3(c) of the Bidding Documents, we furnish herewith our QR data/details/documents etc., alongwith other information, as follows (The QR stipulations have been reproduced in italics for ready reference, however, in case of any discrepancy the QR as given in Section-III, Vol-I shall prevail).
* We have submitted bid as individual firm.

* We have submitted bid as joint venture of following firms:

(i) .....

(ii) .....

(iii) .....
(* ***Strike-off whichever is not applicable***)
[For details regarding Qualification Requirements of a Joint Venture, please refer para 4.0 below.]

We are furnishing the following details/document in support of Qualifying requirement for the subject package.

A. Attached copies of original documents defining:

a) The constitution or legal status;
b) The principal place of business;
c) The place of incorporation (for bidders who are corporations); or the place of registration and the nationality of the Owners (for applicants who are partnerships or individually-owned firms).

B. Attached original & copies of the following documents.

a) Written power of attorney of the signatory of the Bid to commit the bidder.

b)** Joint Venture Agreement

*[** To be submitted only in case of Joint Ventures. Strike off in case of individual firms.]*

1.0 **General Information**

[The information in this form is to be completed for individual firms and each Partner of a Joint Venture]

Where the Bidder proposes to use named subcontractor(s) for critical components of the works or for work contents in excess of 10 percent of the bid price, the following information should also be furnished for the subcontractor(s)].

Sl. No.	Particulars	For Individual Firm	In case of Joint Venture		
			For Lead Partner	For Other Partner - 1	For Other Partner - 2
1.	Name of the Firm				
2.	Head Office/ Registered Office Address				
3.	Telephone				
4.	Fax				
5.	Contact Person				
5(a)	Email				
6.	Place of Incorporation/ Registration				
7.	Year of Incorporation/ Registration				
8.	Nationality of				
	Owner (i)				
	Owner (ii)				
	Owner (iii)				

(Necessary documents to establish legal status of the bidder (all the partners in case of Joint Venture) should be enclosed with the bid.

2.0 **Technical experience**

2.1 ***(Reference: Para 1.0 of QR mentioned in Section-III of Vol-I)***

2.1.1 The Bidder must have Designed, Manufactured, Type Tested (As per IEC or equivalent standard), Supplied, Erected, Tested & commissioned of atleast two (2) number of GIS

substations having cumulatively atleast 12 (Twelve) circuit breaker bays* of 220kV or above in **India only**. The two (2) nos. GIS substations above should have been in satisfactory operation# for atleast two (2) years as on the originally scheduled date of bid opening i.e. **xx.xx.2017**. Further, at least one (1) number of above GIS substation must have been commissioned within last seven (7) years as on the date of bid opening.

(#) Satisfactory operation – means certificate issued by the employer certifying the operation without any adverse remark.

2.1.2 Alternatively, in case the bidder is an Indian arm (subsidiary or affiliate) of a foreign Company and if such foreign company desires that the contract be entered into with its Indian arm, then the following is necessarily to be met by the Indian arm,

a. The bidder must have manufactured at least one (1) 220kV or above voltage level GIS Circuit Breaker bay** based on the technological support of the Collaborator(s) and the bidder should have supplied and it should have been in satisfactory operation# for at least 01 (One) year as on the originally scheduled date of bid opening provided that the Collaborator(s) of the bidder meets the qualification requirements as stated in para 1.1 above.
b. The bidder shall enter into a valid Technical Collaboration agreement with the aforesaid foreign firm for technology transfer / license to design, manufacture, test and supply of 220 kV or above voltage class GIS equipment in India.
c. Such bidder 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.
d. The bidder 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.
e. The Collaborator /Parent Company /Principal should undertake backup support for 5 years for successful operation of the offered GIS.
f. 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 value of Supply portion as quoted by the bidder of such GIS equipment(s). This performance guarantee shall be to guarantee their obligations toward the owner as referred hereinbefore or else wherein the NIT conditions. This performance guarantee shall be in addition to the Contract Performance Guarantee to be submitted by the bidder.

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

(#) Satisfactory operation – means certificate issued by the employer certifying the operation without any adverse remark.

Note:
*(*) For the purpose of qualification requirement, one no. of circuit breaker bay shall be considered as a bay used for controlling a line or a transformer or a reactor or a bus section or a bus coupler and comprising of at least one circuit breaker, one disconnector and three nos. of single phase CTs / Bushing CTs.*

2.2 On a separate page, using the following format, Bidder is requested to furnish the details of the previous experience, on the basis of which the Bidder wishes to qualify, as detailed at para 2.0 above. The information is to be summarised using following formats, as applicable, for each previous experience of the Bidder.
(Documentary evidence, such as copies of utility certificates etc., in support of its experience shall be attached with the filled-up format for each experience/Contract)

Format A **Format for the Bidder (Single Firm / Partner in case of Joint Venture) [In case of Joint Venture bidder, the QR data of each of the partner (in support of meeting the requirement of para 1.0 of QR mentioned in Section-III of Vol-I, Conditions of Contract, Volume-I of the bidding documents] is also is to furnished, as applicable, using this format**

Name of the Bidder (Single Firm/Lead partner/Partners of a JV)		
A1.	Name of Contract (executed during the last 7 years as on the date of bid opening):	
A2.	Contract Reference No. & Date of Award	
A3.	Name and Address of the Employer/Utility by whom the Contract was awarded e-mail ID Telephone No. Fax No.	 _____ _____ _____
A4(i)	Name of sub-station or switchyard executed under the Contract	_____
(ii)	Voltage level of sub-station or switchyard	_____
(iii)	No. of Circuit Breaker Bays in the GIS	_____
(iv)	(a) No. of CB in the bay (b) No. of single phase CTs or Bushing CTs in the bay (c) No. of disconnectors in the bay	
A5(i)	Date of successful execution of the Contract	_____
(ii)	No. of years the above referred substation is in successful operation as on the date of bid opening	_____ years

A6.	Scope of work executed under the above contract	
A7.	Capacity in which the Contract was undertaken (Check One)	○ Prime Contractor ○Sub Contractor ○Partner of JV (Tick whichever is applicable)
A8.	Details/documentary evidence submitted in support of stated experience/Contract	

3.0 **Financial Position**

3.1 ***(Reference: Para 2.0 of QR mentioned in Section-III, Vol-I)***

a) Net Worth for last 3 financial years should be positive

b) Minimum Average Annual Turnover* (MAAT) of the bidder for best three years i.e. 36 months out of last five financial years **as annualised should be** Rs. **54.38** Crore **or equivalent for the Package.**

*** Note- Annual total income as incorporated in the profit & loss account except non-recurring income e.g. sale of fixed assets**

c) Bidder shall have Liquid Assets (LA) and/or evidence of access to or availability of credit facilities of not less than Rs**. 09.06 Crore** or equivalent for the subject Package.

In case bidder is a holding company, the Financial Position criteria referred to in clause 2.0 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, the Financial Position criteria referred to in clause 2.0 above shall be that of subsidiary company only (i.e. excluding its holding company).

[Further, for joint venture bidders, the requirement to be met is stipulated under para 3.0 of QR mentioned in Section-III of Vol-I]

3.2 In support of its 'Financial Position', in line with the above, the Bidder (Individual firm or all the JV partners in case of JV bidder) must provide the relevant information, alongwith documentary evidence, in the following formats A & B:

Name of the Bidder [Single Firm / Lead Partner of a JV / Partner of a JV		
A. Annual Turnover details:		
Sl. No.	**Financial year**	**Annual turnover in Rs. Million**
1.0		
2.0		
3.0		

4.0		
5.0		
Average annual turnover for best three years is:		
B. Liquid Assets		
Details of evidence of having Liquid assets (LA) Or Details of evidence of access to or availability of credit facilities		_____ _____

4.0 **Joint Venture (JV) Firms**

4.1 **(Reference: Para 3.0 of QR mentioned in Section-III, Vol-I)**

In case a bid is submitted by a Joint Venture (JV) of two or more firms as partners, the JV shall meet collectively the complete requirements mentioned **at clause no. 1.0** and 2.0 (b) & (c) above. Further, the partners of Joint Venture shall meet the following requirements:

a) All the partners of the JV shall meet individually the Financial Position criteria given at 2.0 (a) above.

b) The lead partner shall meet not less than 40% of the Financial Position minimum criteria given at para 2.0 (b) & (c)

c) Each of the other partner(s) individually shall meet not less than 25% of the minimum Financial Position criteria given at para 2.0 (b) & (c)

4.2

The figure of average annual turnover and liquid assets/credit facilities for each of the partners of the JV shall be added together to determine the JV's compliance with the minimum qualifying criteria set out in para 2.0 (b) & (c)above

However, for a JV to be qualified, the partner(s) of JV must also meet the following minimum criteria :

i) One of the partner(s) of JV shall meet the Technical Experience criteria as per para 1.0

4.3 In accordance with the above, in case of JV bidders, it should be ensured that necessary details including those pertaining to each JV partner are furnished and the documents are submitted alongwith the bid. Further, the JV bidders should also ensure that other requirements are complied with. The lists of documents furnished are to be indicated below:

i) ……..
ii) ……..

iii) ……..
iv) ……..
v) ……..

5.0 ***The Bidder shall also furnish following documents/details with its bid. {Reference ITB clause 9.3 (c)}***

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

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

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

5.2 The Bidder should accordingly also provide the following information /documents (**In case of JV bidders, information should be provided separately for all the Partners of JV in the given format**):

Audited balance sheet and income statements for the last five years as per the following:

Years preceding to the bid opening	**Audited Balance Sheet and Income Statements enclosed**	
1st Year	○ Yes	○ No
2nd Year	○ Yes	○ No
3rd Year	○ Yes	○ No
4th Year	○ Yes	○ No
5th Year	○ Yes	○ No

Date:..... (Signature) …….....

Place:..... (Printed Name) .....….

(Designation) .....….

Tender Package of "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

(Manufacturer's Authorization Form)

(On Manufacturer's Letterhead, see Clause 9.3(c) of the ITB)

To: [Insert: name of Employer]

Dear Ladies and/or Gentlemen,

WE *[insert: **name of Manufacturer]*** who are established and reputable manufacturers of *[insert: **name and/or description of the plant & equipment]*** having production facilities at *[insert: **address of factory]*** do hereby authorize *[insert: **name & address of Bidder]*** (hereinafter, the "Bidder") to submit a bid, and subsequently negotiate and sign the Contract with you against IFB *[insert**: title and reference number of Invitation for Bids]*** including the above plant & equipment or other goods produced by us.

We hereby extend our full guarantee and warranty for the above specified plant & equipment materials or other goods offered supporting the supply, installation and achieving of Operational Acceptance of the plant by the Bidder against these Bidding Documents, and duly authorize said Bidder to act on our behalf in fulfilling these guarantee and warranty obligations. We also hereby declare that we and ……, *[insert: **name of the Bidder]*** have entered into a formal relationship in which, during the duration of the Contract (including warranty / defects liability) we, the Manufacturer or Producer, will make our technical and engineering staff fully available to the technical and engineering staff of the successful Bidder to assist that Bidder, on a reasonable and best effort basis, in the performance of all its obligations to the Purchaser under the Contract.

For and on behalf of the Manufacturer

Signed: _____
Date: _____

In the capacity of *[insert: **title of position or other appropriate designation]*** and this should be signed by a person having the power of attorney to legal bind the manufacturer.

Date:.....

Place:..... (Signature).....
(Printed Name).....
(Designation).....
(Common Seal).....

Note 1. The letter of Undertaking should be on the letterhead of the Manufacturer and should be signed by a person competent and having Power of Attorney to legally bind the Manufacturer. It shall be included by the bidder in its bid.

2. Above undertaking shall be registered or notarized so as to be legally enforceable.

LEGENDS

Service Unit Description		
S.No	**Legend**	**Description**
1	B50	BAG PER 50 KG OF CEMENT
2	CM	Centimeter
3	EA	each
4	JHR	Years
5	KG	Kilogram
6	KL	Kilolitre
7	KM	Kilometer
8	L	Liter
9	LOT	LOT
10	LS	LUMP SUM
11	M	Meter
12	M2	Square meter
13	M3	Cubic meter
14	MND	MAN DAYS
15	MNW	MAN WEEKS
16	MT	Metric Ton
17	PAA	Pair
18	QTL	QUINTAL
19	RM	RUN. MTR.
20	SET	SET
21	STD	Hours
22	TAG	Days
23	DAY	Days
24	YR	Years

Material Unit Description		
S.No	**Legend**	**Description**
1	EA	each
2	FT	Foot
3	FT2	Square foot
4	G	Gram
5	H	Hour
6	KG	Kilogram
7	KL	Kilolitre
8	KM	Kilometer
9	L	Liter
10	LOT	LOT
11	LS	LUMP SUM
12	M	Meter
13	M2	Square meter
14	ML	Milliliter
15	MON	Months
16	MT	Metric Ton
17	PAA	Pair
18	RM	RUN. MTR.
19	ROL	Role
20	SET	SET
21	PAK	Pack
22	CS	Case
23	TAG	Days

Second Envelope (Price Schedule)

General guidelines for filling up the Price Schedules, Sch-1 to Sch-7

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02

1	**Fill up only green shaded cells in Sch-1, Sch-2, Sch-3, Sch-4, Sch-5, Sch-7, Guarantee Declariation and Bid Form 2nd Envelope.**
2	**All the cells in Sch-6 are auto filled, therefore no cell is required to be filled up there.**
3	**Instructions / error messages, if any, will be displayed automatically after selecting the cell.**

Click for Detailed General Instructions | Click to skip Instructions & Proceed

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

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

Click to Proceed

I While filling up the worksheets following may please be observed :

(i) Fill up only green shaded cells.

(ii) Certain data type entries have been restricted, such as Numeric values or limits of numeric values.

(iii) Select only the options provided in pull down menus.

(iv) Do not link any cell of this work book with any other work book.

(v) Do not use copy & paste or cut & paste options for filling up the data.

(vi) Do not reformat any of the cell of the work book.

II This Workbook consists of following worksheets :

Cover :

Opening page of the workbook.

Names of Bidder :

- Select Sole Bidder or JV (Joint Venture) from the pull down menu. Do not leave this cell blank.
- Select nos. of the JV Partners other than the Lead Partner from drop down
- In case of JV partners more than 2, enter details of 3rd & more partners along with details of 2nd partner.
- Fill up names and address of the Sole Bidder and /or Joint Venture.
- Fill up date in dd-mm-yyyy format from drop down menu.
- Click for Sch-1 given at the right top of the worksheet to go to Sch-1.

Sch-1 (Ex-works Prices) :

- Fill up unit rates for all the items in numeric values greater than 0 (zero). If unit rate is left blank, the corresponding item shall be deemed to be included in the total price.
- Total amount shall get calculated automatically.
- Type Test charges shall appear automatically in Sch-1, after filling up Sch- 7 appropriately.

Sch-2 (Freight & Insurance Charges) :

- Fill up unit rates for all the items in numeric values greater than 0 (zero). If unit rate is left blank, the corresponding item shall be deemed to be included in the total price.
- Total amount shall get calculated automatically.

Sch-3 (Erection Charges) :

- Fill up unit rates for all the items in numeric values greater than 0 (zero). If unit rate is left blank, the corresponding item shall be deemed to be included in the total price.
- Total amount shall get calculated automatically.

Sch-4 (Training Charges) :

- Not applicable, hence no cell is required to be filled up.

Sch-5 (Summary of GST applicable on Supply of Goods and

- Amount of GST shall be calculated autometically

Sch -6 :

- Summary of all the Schedules without considering discount (mentioned in the work sheet discount) shall be displayed automatically.
- No cell is required to be filled in by the bidder in this worksheet.

Sch-7 (Type Test Charges) :

- Fill up the rates & location where type tests are proposed.
- Total of this Sch-7 shall automatically appear in Sch-1.

Bid from 2nd Envelope :

- Fill up ref. no. as bidder's ref no. of this letter.
- This letter shall consider the net price as per Sch-6 (After Discount).
- Fill up names & Designation of the representatives of other JV partner(s) if the bidder is JV (Joint Venture) .
- Fill up additional information as required.

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"	
TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02	
Enter following details of the bidder	
Specify type of Bidder [Select from drop down menu]	JV_JointVenture
Total Nos. of Partners in the JV [excluding the Lead Partner]	2 or More
Name of the Sole Bidder	
Address of the Sole Bidder	
Name of the other Partner-1	
Address of the other Partner-1	
Name of other Partner -2 (more, if any)	
Address of other Partner -2 (more, if any)	
Printed Name	
Designation	
email -id of Bid signatory	
Mobile No. of Bid signatory	
Fax No. of Bid signatory	
Date	
Place	

Click for Sch. 1

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02										Schedule - 1
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"										Click to S Click to Sch. 2
(SCHEDULE OF RATES AND PRICES)										
Bidder's Name and Address :						To: REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in				
Name :										
Address :										
PLANT AND EQUIPMENT (INCLUDING MANDATORY SPARES PARTS) TO BE SUPPLIED:										
All Prices are in Indian Rupees.										
Sl. No.	HSN Code	Whether HSN in column'2' is confirm. If not indicate applicable HSN*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Item Description	Unit	Qty.	Unit Ex-works price(excluding GST)	Total Ex-works price(excluding GST)	GST Tax as Confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=9x8	11
		220/33kV New GIS Grid Substation at Lassipora								
A.1					POWER TRANSFORMER					
A.1.1					POWER TRANSFORMER					
a)	85042330		18%		160MVA (3x53.33 + 1x53.33 Spare), 220/33 KV, Single Phase transformers (Excluding insulating oil)	Nos.	4		0.00	0.00
b)	85049010		18%		Insulating oil for 3x53.33MVA + 1x53.33MVA Spare, 245/36 KV, 1-phase transformer (LOT* - Oil for One Transformer)	LOT*	4		0.00	0.00
c)	84248990		18%		Nitrogen Injection Fire Fighting System	Nos.	4		0.00	0.00
d)	72169990		18%		Neutral formation for 220kV & 33kV side	Set	1		0.00	0.00
e)	85049010		18%		On line Insulaing oil drying system	Set	1		0.00	0.00
f)					On line Dissolved Gas & Moisture Analyser	Set	1		0.00	0.00
A.1.2					Testing & Maintenance Equipments					
a)	73090090		18%		Oil Storage Tank (10KL)	No.	1		0.00	0.00
b)					Transformer Oil Filtration plant (6KLPH)	No	1		0.00	0.00
c)					BDV TEST KIT	No.	1		0.00	0.00
d)					OIL SAMPLING BOTTLE	No.	3		0.00	0.00
A.2					AUXILIARY TRANSFORMER					
a)	85042100		18%		250 kVA, 33/0.433kV	Nos	2		0.00	0.00
A.3	85042100		18%		250KVA, 3 Phase, Automatic voltage Stablizer	Nos	1		0.00	0.00
B					245KV Equipment					
B.1					245KV GIS Equipment					
a)	85372000		28%		245kV, SF6 GIS Bus Bars Module [Module description as per Section Project, Technical specification]	Set	2		0.00	0.00
b)	85372000		28%		245kV, SF6 GIS Transformer bay Module [Module description as per Section Project, Technical specification]	Set	1		0.00	0.00
c)	85372000		28%		245kV Auxiliary Bus Module to Connect Spare Unit of Transformer (module Description as per Section Project)	set	1		0.00	0.00
d)	85372000		28%		245kV, SF6 GIS Line bay Module [Module description as per Section Project, Technical specification]	Set	4		0.00	0.00
e)	85372000		28%		245kV, SF6 GIS Bus Coupler bay Module [Module description as per Section Project, Technical specification]	Set	1		0.00	0.00
f)	85372000		28%		245kV, 1600A, 40kA SF6/Air Bushing for Connecting GIS to AIS (For Transformer and line feeders) alongwith support structure (Single Phase)	Nos.	15		0.00	0.00
g)	85372000		28%		245kV, 1600A, 1-phase/ 3 Phase SF6 GIS Bus duct alongwith support structure from GIS building to C/L of SF6 to Air Bushing (* = Considered for Single Phase Duct)	Mtr*	200		0.00	0.00

Sl. No.	HSN Code	Whether HSN in column'2' is confirm. If not indicate applicable HSN*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Item Description	Unit	Qty.	Unit Ex-works price(excluding GST)	Total Ex-works price(excluding GST)	GST Tax as Confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=9x8	11
B.2					**245KV Outdoor Equipment**					
i)	85354010.0		**18%**		216KV Surge Arrester (1-phase)	Nos.	16		0.00	0.00
ii)	73045930.0		**18%**		245kV BPI	Nos.	18		0.00	0.00
C					**36KV Equipment**					
C.1					**36KV, 2500Amps, 25KA for 3 Sec GIS Equipment**					
a)	85372000		**28%**		36kV, SF6 GIS Bus Bar Enclosure Module including Bus sectionalizer, Bus PT's, Bus riser etc [Module description as per Section Project, Technical specification]	Set	1		0.00	0.00
b)	85372000		**28%**		36kV, SF6 GIS Line bay Module [Module description as per Section Project, Technical specification]	Set	6		0.00	0.00
c)	85372000		**28%**		36kV, SF6 GIS Transformer bay Module [Module description as per Section Project, Technical specification]	Set	2		0.00	0.00
d)	85372000		**28%**		36kV, SF6 GIS Auxiliary transformer bay Module [Module description as per Section Project, Technical specification]	Set	2		0.00	0.00
C.2					**36kV Outdoor equipment**					
i)	85353090		**18%**		33 kV Isolators with earth switch	No.	7		0.00	0.00
ii)	85354010		**18%**		30 kV Surge Arrestors (1-phase)	Nos.	21		0.00	0.00
iii)	73045930		**18%**		33 kV BPI	Nos.	18		0.00	0.00
D.					**Testing & Maintenance Equipment for GIS**					

Sl. No.	HSN Code	Whether HSN in column'2' is confirm. If not indicate applicable HSN*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Item Description	Unit	Qty.	Unit Ex-works price(excluding GST)	Total Ex-works price(excluding GST)	GST Tax as Confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=9x8	11
a)					SF6 Gas filling & evacuating plant					
	85372000		28%		For 245kV & 36kV GIS	Set	1		0.00	0.00
b)					Partial Discharge Monitoring System for GIS as per Technical Specification					
i)	85372000		28%		For 245kV GIS	Set	1		0.00	0.00
ii)	85372000		28%		For 36kV GIS	Set	1		0.00	0.00
c)					Dew Point meter					
	85372000		28%		For 245kV & 36kV GIS	Set	1		0.00	0.00
d)					SF6 Gas Leak Detector					
	85372000		28%		For 245kV & 36kV GIS	Set	1		0.00	0.00
e)	85372000		28%		EOT crane for 245kV GIS Hall	Set	1		0.00	0.00
f)	85372000		28%		SF6 Gas Analyser	Set	1		0.00	0.00
E.					**RELAY PANELS (WITH AUTOMATION)**					
E.1					**245kV Simplex Panels**					
a)					Circuit Breaker Relay Panel					
i)	85371000		28%		With Auto Reclose	Set	5		0.00	0.00
ii)	85371000		28%		With out Auto Reclose	Set	1		0.00	0.00
b)	85371000		28%		Line Protection Panel	Set	4		0.00	0.00
c)	85371000		28%		Transformer Protection Panel (For both HV & LV side)	Set	1		0.00	0.00
d)	85371000		28%		Bus Bar Protection Panel	Set	1		0.00	0.00
E.2					**Teleprotection Equipments**					
a)					Digital protection coupler including cabling etc.	Set	2		0.00	0.00
b)					Digital protection coupler including cabling etc. for other end	Set	2		0.00	0.00
c)					Shifting and re-erection of existing panel of MirBazar/Wagoora as per Technical specification	LS	1		0.00	0.00
F.					**COMMON EQUIPMENTS**					
a)	90172090		18%		Relay Test tool kit	Set	1		0.00	0.00
b)	90172090		18%		Time synchronisation equipment	No.	1		0.00	0.00
G.					**SUBSTATION AUTOMATION**					
G.1					Complete Substation Automation System (SAS) for substation including hardware and software for the substation & remote control stations alongwith associated equipments for the following bays as per Technical Specification					
a)					Main bays to be automated					
i)	90328990		18%		245 kV system	Bay Nos	6		0.00	0.00

Sl. No.	HSN Code	Whether HSN in column'2' is confirm. If not indicate applicable HSN*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Item Description	Unit	Qty.	Unit Ex-works price(excluding GST)	Total Ex-works price(excluding GST)	GST Tax as Confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=9x8	11
ii)	90328990		**18%**		36 kV system	Bay Nos	11		0.00	0.00
iii)	90328990		**18%**		BCU for controlling & monitoring of Auxilary System	Set	1		0.00	0.00
H.					**LT Switchgear (As per Technical specification)**					
a)	85371000		28%		415V Main switchboard	Set	1		0.00	0.00
b)	85371000		28%		415V ACDB	Set	1		0.00	0.00
c)	85371000		28%		415V MLDB	Set	1		0.00	0.00
d)	85371000		28%		415V Emergency LDB	Set	1		0.00	0.00
e)	85371000		28%		220V DCDB	Sets	2		0.00	0.00
f)	85371000		28%		48V DCDB	Set	2		0.00	0.00
I.					**Batteries**					
a)					220V					
	85072000		28%		600 AH	Nos	2		0.00	0.00
b)					48V					
	85072000		28%		300 AH	Nos	2		0.00	0.00
J.					**Float Cum Boost Battery Charger**					
a)					220V Float Cum Boost Battery Charger					
	85044030		28%		80A/80A	Nos	2		0.00	0.00
b)					48V Float Cum Boost Battery Charger					
	85044030		28%		40A/40A	Nos	2		0.00	0.00
K.					**Diesel Generator with control Panel**					
a)	85021200		18%		100 kVA	Set	1		0.00	0.00
L.					**Fire Protection System**					
a)					Portable /Trolley/Wheel mounted extinguishers					
i)	84241000		28%		9 litre water type	Nos	5		0.00	0.00
ii)	84241000		28%		50 litre foam type	Nos	3		0.00	0.00
iii)	84241000		28%		4.5 kg CO_2 type	Nos	15		0.00	0.00
iv)	84241000		28%		4.5 kg Dry Chemical Power (DCP) type	Nos	5		0.00	0.00
M.					**Cables along with clamps, glands, lugs and straight joints etc.**					
a)					**Power Cables - (36kV grade)**					
i)	85446090		28%		36kV Single Core H.T cable suitable for 1600Amps rating along with all accessories including termination kit as per specification (for Power transformer application). Number of runs and size of the cable per Phase to be decided by contractor	Metre	500		0.00	0.00
ii)	85446090		28%		36kV H.T cable of suitable size along with all accessories including termination kit as per specification (for Auxiliary transformer application)	Meter	100		0.00	0.00
iii)	85446090		28%		36kV Single core H.T cable suitable for 500Amps. Rating along with all accessories including termination kit as per specification (for Feeder Bay application)	Meter	600		0.00	0.00
b)					**Power cables - (1.1kV grade)**					
	85446090		28%		3.5Cx300 sqmm (XLPE) cable for filter Machine along with termination arrangement as per TS	Meter	150		0.00	0.00
N.					**Air conditioning System for Control room cum administrative building**					
a)	84151010		28%		High wall type split AC unit of 2 TR capacity	Nos	20		0.00	0.00
O.					**Fabrication, galvanising and supply of following Steel Structures including nuts, bolts, all types of washers, packplates, step bolts and gusset plates including foundation bolts.**					
a)					Lattice Structure (Towers, Beams, LM and Equipment/support structure) including Foundation Bolts	MT	40		0.00	0.00
b)					Fastners and step bolts.(Nuts,Bolts & Washers)	MT	1		0.00	0.00
P					**Telecommunication equipment**					
A					**SDH EQUIPMENTS(STM-4 MADM upto 5MSP Protected directions)**		1		0.00	0.00
1.0 (I)					**Lassipora**					

Sl. No.	HSN Code	Whether HSN in column'2' is confirm. If not indicate applicable HSN*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Item Description	Unit	Qty.	Unit Ex-works price(excluding GST)	Total Ex-works price(excluding GST)	GST Tax as Confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=9x8	11
					Base equipments(Common cards,Cross connect/control cards, power supply cards, power cabling, other hardware and accessories including sub rascks, patch cord, DDF etc fully equipped excluding (ii) & (iii) below	Nos.	1		0.00	0.00
					Mirbazaar					
					Base equipments(Common cards,Cross connect/control cards, power supply cards, power cabling, other hardware and accessories including sub rascks, patch cord, DDF etc fully equipped excluding (ii) & (ii) below	Nos.	1		0.00	0.00

Sl. No.	HSN Code	Whether HSN in column'2' is confirm. If not indicate applicable HSN*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Item Description	Unit	Qty.	Unit Ex-works price(excluding GST)	Total Ex-works price(excluding GST)	GST Tax as Confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=9x8	11
					Wagora					
					Base equipments(Common cards,Cross connect/control cards, power supply cards, power cabling, other hardware and accessories including sub rascks, patch cord, DDF etc fully equipped excluding (ii) & (ii) below	Nos.	1		0.00	0.00
(ii)					**Optical Interface Cards/SFP#**					
					lassipora					
a					S4.1 SFP	Nos.			0.00	0.00
b					L4.1 SFP	Nos.	4		0.00	0.00
					Mirbazaar					
a					S4.1 SFP	Nos.	0		0.00	0.00
b					L4.1 SFP	Nos.	4		0.00	0.00
					Wagora					
a					S4.1 SFP	Nos.	0		0.00	0.00
b					L4.1 SFP	Nos.	4		0.00	0.00
(iii)					**Tributary cards**					
					lassipora					
a					E1 Interface card(Min. 16 Interfaces per card)	Nos.	2		0.00	0.00
b					Ethernet interface 10/100 Base T with Layer-2 switching (Min 8 Interfaces per card)	Nos.	2		0.00	0.00
					Mirbazaar					
a					E1 Interface card(Min. 16 Interfaces per card)	Nos.	2		0.00	0.00
b					Ethernet interface 10/100 Base T with Layer-2 switching (Min 8 Interfaces per card)	Nos.	2		0.00	0.00
					Wagora					
a					E1 Interface card(Min. 16 Interfaces per card)	Nos.	2		0.00	0.00
b					Ethernet interface 10/100 Base T with Layer-2 switching (Min 8 Interfaces per card)	Nos.	2		0.00	0.00
B					**Equipment Cabinet one for each Lassipora, Mirbazaar,Wagora**	Nos.	3		0.00	0.00
2.0					**Network Manager System(NMS)**					
					Lassipora					
(I)					**Craft terminal**					
a					Hardware	Set	1		0.00	0.00
b					Software	Set	1		0.00	0.00
					Mirbazaar					
(I)					**Craft terminal**					
a					Hardware	Set	0		0.00	0.00
b					Software	Set	0		0.00	0.00
					Wagora					
(I)					**Craft terminal**					
a					Hardware	Set	0		0.00	0.00
b					Software	Set	0		0.00	0.00
3.0					**VOIP telephone instrument with one common switch(min. 8 port)**					
i)					**lassipora**	No.s	2		0.00	0.00
ii)					**Mirbazaar**	No.s	0		0.00	0.00
iii)					**Wagora**	No.s	0		0.00	0.00
4.0					**Approach Cable (24 fibres)$**					
					lassipora					
a					24 Fibre(DWSM)	Kms	1		0.00	0.00
b					Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable	Set	1		0.00	0.00
					Mirbazaar					
a					24 Fibre(DWSM)	kms	0		0.00	0.00
b					Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable	Set	0		0.00	0.00
					Wagora					
a					24 Fibre(DWSM)	kms	0		0.00	0.00

Sl. No.	HSN Code	Whether HSN in column'2' is confirm. If not indicate applicable HSN*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Item Description	Unit	Qty.	Unit Ex-works price(excluding GST)	Total Ex-works price(excluding GST)	GST Tax as Confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=9x8	11
b					Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable	Set	0		0.00	0.00
5.0					**FODP$**					
					lassipora					
a					**48 Fibre**:Indoor Type,Rack Mounted with FCPC Coupling & Pigtails(5mtrs)	No.s	1		0.00	0.00
					Mirbazaar					
a					**48 Fibre**:Indoor Type,Rack Mounted with FCPC Coupling & Pigtails(5mtrs)	No.s	1		0.00	0.00
					Wagiora					
a					**48 Fibre**:Indoor Type,Rack Mounted with FCPC Coupling & Pigtails(5mtrs)	No.s	1		0.00	0.00
					Part-B: VENDOR ASSESSED QUANTITIES					
A.					**Erection Hardware**					
					Hardware, conductor, Al tube, bus-bar materials, cable trays, clamps, spacers, connectors including equipment connectors, Junction box, earthwire, buried cable trenches/pipe equipment & lighting, 36kV Cable Termination kit alongwith all accessories etc. for 245kV &36 kV Switch yard:					
i)	85359090		18%		Transformer Bay SF6 -Air bushing to Transformer bushing connection arrangement 245 KV and 36kV side	Set	1		0.00	0.00
ii)	85359090		18%		220kV line	Set	4		0.00	0.00
iii)	85359090		18%		33kV line + LT Transformer Bays(6+2)	Set	8		0.00	0.00
A1	85359090		18%		Earthing material including main Earth mat, Equipment earthing, structures etc. inside and outside GIS Hall for complete scope of work as per technical specifications	LS	1		0.00	0.00
B.					**Fire detection & Alarm System for all buildings**					
i)	84241000		28%		245KV GIS hall	LS	1		0.00	0.00
ii)	84241000		28%		36KV GIS hall/Room	LS	1		0.00	0.00
iii)	84241000		28%		Panel room of 245kV	LS	1		0.00	0.00
iv)	84241000		28%		Control room cum administrative building	LS	1		0.00	0.00
C.					**Illumination System**					
a)					Control room cum administrative building illumination	LS	1		0.00	0.00
b)					Switchyard lighting	LS	1		0.00	0.00
c)					Street lighting	LS	1		0.00	0.00
d)					245KV GIS hall	LS	1		0.00	0.00
e)					36KV GIS hall/Room	LS	1		0.00	0.00
f)					Panel room of 245kV	LS	1		0.00	0.00
g)					Store	LS	1		0.00	0.00
h)					Security room	LS	1		0.00	0.00
i)					Parking Shed	LS	1		0.00	0.00
D.					**Air conditioning & ventilation System**					
D.1					**Air conditioning system**					
a)	84151010		28%		Panel room of 245kV GIS Hall	LS	1		0.00	0.00
D.2					**Ventilation system**					
a)					245KV GIS hall (AHU as per Annexure - IV of TS	LS	1		0.00	0.00
b)					36KV GIS hall (Exhaust fan)	LS	1		0.00	0.00
E.					**POWER & CONTROL CABLES**					
a)					Power Cables(PVC)- (1.1kV grade)	LS	1		0.00	0.00
b)					Power Cables (XLPE) (**excluding** 3.5Cx300 sqmm (XLPE) cable for filter Machine)- (1.1kV grade)	LS	1		0.00	0.00
c)					Control Cable (PVC)- (1.1kV grade)	LS	1		0.00	0.00
d)					Cable glands, lugs & straight through joints for Power & Control cables	LS	1		0.00	0.00
					Part-C: Mandatory Spares					
A.					**Mandatory Spare List for Transformer**					

Sl. No.	HSN Code	Whether HSN in column'2' is confirm. If not indicate applicable HSN*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Item Description	Unit	Qty.	Unit Ex-works price(excluding GST)	Total Ex-works price(excluding GST)	GST Tax as Confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=9x8	11
1.0					For 160MVA (3x 53.33MVA+1x53.33MVA) , 245/36 KV, 1-phase Autotransformer	LS	1		0.00	0.00
2.0					245kV GIS	LS	1		0.00	0.00
i					245 KV SF6 CIRCUIT BREAKER (GIS):	LS	1		0.00	0.00
ii	85353090		18%		245 KV ISOLATORS :	LS	1		0.00	0.00
iii)	85049010		18%		245 KV CURRENT TRANSFORMER	LS	1		0.00	0.00
iv	85049010		18%		245 kV VOLTAGE TRANSFORMER	LS	1		0.00	0.00
3	85381090		18%		SPARES FOR 36kV GIS	LS	1		0.00	0.00
i	85352911		18%		36 KV CIRCUIT BREAKER:	LS	1		0.00	0.00
ii	85353090		18%		36KV ISOLATORS :	LS	1		0.00	0.00
iii)	85049010		18%		36 KV CURRENT TRANSFORMER	LS	1		0.00	0.00
iv	85049010		18%		36 kV VOLTAGE TRANSFORMER	LS	1		0.00	0.00
4	85354010		18%		216kV SURGE ARRESTOR	LS	1		0.00	0.00
5	85353090		18%		36kV ISOLATOR	LS	1		0.00	0.00
6	85354010		18%		30kV SURGE ARRESTOR	LS	1		0.00	0.00
7	85021200		18%		DG SETS :	LS	1		0.00	0.00
8	85072000		28%		BATTERY	LS	1		0.00	0.00
9	85044030		28%		BATTERY CHARGER	LS	1		0.00	0.00
10	85371000		28%		RELAY & PROTECTION	LS	1		0.00	0.00
11					DIGITAL PROTECTION COUPLER	LS	1		0.00	0.00
12	90328990		18%		SAS	LS	1		0.00	0.00
13					LT SWITCHGEAR	LS	1		0.00	0.00
14					COMMON SPARES	LS	1		0.00	0.00
15					LT TRANSFORMER	LS	1		0.00	0.00
16					ILLUMINATION SYSTEM	LS	1		0.00	0.00
17	73269099		18%		ERECTION HARDWARE ITEMS	LS	1		0.00	0.00
18.0				28%	TELE COMMUNICATION	LS	1		0.00	0.00
TOTAL										
TOTAL EX-Works PRICE									0.00	
TYPE TEST CHARGES As Per Schedule- 7									0.00	
TOTAL EX-Works PRICE Including Type Test Charges									0.00	
GST Tax as Confirmed by Bidder										0.00

Sl. No.	HSN Code	Whether HSN in column'2' is confirm. If not indicate applicable HSN*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Item Description	Unit	Qty.	Unit Ex-works price(excluding GST)	Total Ex-works price(excluding GST)	GST Tax as Confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=9x8	11

Note :	Specify amount of GST on the transaction between contractor and employer.
	1) To facilitate the bidders, Employer has indicated an HSN/SAC code and rate of GST against each item in the Price Schedule except for some of lumpsum quantities/lot/Set as mentioned at ITB 11.3.2. It shall entirely be the responsibility of the bidder to check the HSN/SAC code and rate of GST given against each item. The bidder may either confirm the HSN/SAC and rate of GST or if the bidder opts to classify the item in question under a different HSN/SAC code or opts to indicate a different rate of GST, bidder may indicate the same in the columns provided. The bidder shall solely be responsible for HSN/SAC classification and the rate of GST for each item. Employer's liability for reimbursement/payment of GST shall be lower of the GST applicable at the rate as confirmed/deemed confirmed in the bid or actual GST paid/payable by the bidder for that item.
	2) For Supply of plants & equipment and Services from within India, HSN/SAC has not been indicated for some of lumpsum quantities/lot/Set as each of these consists of many items for which billing break up shall be furnished during contract execution. For the purpose of evaluation, the bidder has to indicate the rate of GST applicable on these items. As it is possible that the incidence of GST on each of these items may be different, provision has been made in the price schedules for quoting the bid price in different categories based on the incidence of GST. The bidder shall accordingly quote price in different tax categories. HSN /SAC for these items shall be furnished along with billing breakup prior to payment for these items. Employer's liability for reimbursement/payment of GST shall be lower of the GST applicable at the rate as confirmed/deemed confirmed in the bid or actual GST paid/payable by the bidder for that item.
	3) In case the bidder leaves the cell of confirmation of the HSN code and/or GST rate "blank", the HSN code and corresponding GST rate indicated by the Employer shall be deemed to be the one confirmed by the Bidder.
	4) HSN stands for Harmonized System of Nomenclature and SAC stands for Service Accounting Code, used for classification of Goods for GST purpose..
	Date :
	Place :

Printed Name :

Designation:

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02	Schedule - 2

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

Click to Sch. 3

(SCHEDULE OF RATES AND PRICES)

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

LOCAL TRANSPORTATION, INSURANCE AND OTHER INCIDENTAL SERVICES

All Prices are in Indian Rupees.

Sl. No.	Description	Unit	Quantity	Unit Freight, In-transit, Insurance, Loading & Unloading Charges	Total Freight, In-transit, Insurance, Loading & Unloading Charges
1	2	3	4	5	6 = 4 x 5
I	**220/33kV New GIS Grid Substation at Lassipora**				
A.1	**POWER TRANSFORMER**				
A.1.1	**POWER TRANSFORMER**				
a)	160MVA (3x53.33 + 1x53.33 Spare), 220/33 KV, Single Phase transformers (Excluding insulating oil)	Nos.	4		0.00
b)	Insulating oil for 3x53.33MVA + 1x53.33MVA Spare, 245/36 KV, 1-phase transformer (LOT* - Oil for One Transformer)	Nos.	4		0.00
c)	Nitrogen Injection Fire Fighting System	Nos.	4		0.00
d)	Neutral formation for 220kV & 33kV side	Nos.	4		0.00
e)	On line Insulaing oil drying system	Nos.	4		0.00
f)	On line Dissolved Gas & Moisture Analyser	Nos.	4		0.00
A.1.2	**Testing & Maintenance Equipments**				
a)	Oil Storage Tank (10KL)	No.	1		0.00
b)	Transformer Oil Filtration plant (6KLPH)	No	1		0.00
c)	BDV TEST KIT	No.	1		0.00
d)	OIL SAMPLING BOTTLE	No.	3		0.00
A.2	**AUXILIARY TRANSFORMER**				
a)	250 kVA, 33/0.433kV	Nos	2		0.00
A.3	250KVA, 3 Phase, Automatic voltage Stablizer	Nos	1		0.00
B	**245KV Equipment**				
B.1	**245KV GIS Equipment**				
a)	245kV, SF6 GIS Bus Bars Module [Module description as per Section Project, Technical specification]	Set	2		0.00
b)	245kV, SF6 GIS Transformer bay Module [Module description as per Section Project, Technical specification]	Set	1		0.00
c)	245kV Auxiliary Bus Module to Connect Spare Unit of Transformer (module Description as per Section Project)	set	1		0.00
d)	245kV, SF6 GIS Line bay Module [Module description as per Section Project, Technical specification]	Set	4		0.00
e)	245kV, SF6 GIS Bus Coupler bay Module [Module description as per Section Project, Technical specification]	Set	1		0.00
f)	245kV, 1600A, 40kA SF6/Air Bushing for Connecting GIS to AIS (For Transformer and line feeders) alongwith support structure (Single Phase)	Nos.	15		0.00

Sl. No.	Description	Unit	Quantity	Unit Freight, In-transit, Insurance, Loading & Unloading Charges	Total Freight, In-transit, Insurance, Loading & Unloading Charges
1	2	3	4	5	6 = 4 x 5
g)	245kV, 1600A, 1-phase/ 3 Phase SF6 GIS Bus duct alongwith support structure from GIS building to C/L of SF6 to Air Bushing (* = Considered for Single Phase Duct)	Mtr*	200		0.00
B.2	**245KV Outdoor Equipment**				
i)	216KV Surge Arrester (1-phase)	Nos.	16		0.00
ii)	245kV BPI	Nos.	18		0.00
C	**36KV Equipment**				
C.1	**36KV, 2500Amps, 25KA for 3 Sec GIS Equipment**				
a)	36kV, SF6 GIS Bus Bar Enclosure Module including Bus sectionalizer, Bus PT's, Bus riser etc [Module description as per Section Project, Technical specification]	Set	1		0.00
b)	36kV, SF6 GIS Line bay Module [Module description as per Section Project, Technical specification]	Set	6		0.00
c)	36kV, SF6 GIS Transformer bay Module [Module description as per Section Project, Technical specification]	Set	2		0.00
d)	36kV, SF6 GIS Auxiliary transformer bay Module [Module description as per Section Project, Technical specification]	Set	2		0.00
C.2	**36kV Outdoor equipment**				
i)	33 kV Isolators with earth switch	No.	7		0.00
ii)	30 kV Surge Arrestors (1-phase)	Nos.	21		0.00
iii)	33 kV BPI	Nos.	18		0.00
D.	**Testing & Maintenance Equipment for GIS**				
a)	SF6 Gas filling & evacuating plant				
	For 245kV & 36kV GIS	Set	1		0.00
b)	Partial Discharge Monitoring System for GIS as per Technical Specification				
i)	For 245kV GIS	Set	1		0.00
ii)	For 36kV GIS	Set	1		0.00
c)	Dew Point meter				
	For 245kV & 36kV GIS	Set	1		0.00
d)	SF6 Gas Leak Detector				
	For 245kV & 36kV GIS	Set	1		0.00
e)	EOT crane for 245kV GIS Hall	Set	1		0.00
f)	SF6 Gas Analyser	Set	1		0.00
E.	**RELAY PANELS (WITH AUTOMATION)**				
E.1	**245kV Simplex Panels**				
a)	Circuit Breaker Relay Panel				
i)	With Auto Reclose	Set	5		0.00
ii)	With out Auto Reclose	Set	1		0.00
b)	Line Protection Panel	Set	4		0.00
c)	Transformer Protection Panel (For both HV & LV side)	Set	1		0.00
d)	Bus Bar Protection Panel	Set	1		0.00
E.2	**Teleprotection Equipments**				
a)	Digital protection coupler including cabling etc.	Set	2		0.00
b)	Digital protection coupler including cabling etc. for other end	Set	2		0.00
c)	Shifting and re-erection of existing panel of MirBazar/Wagoora as per Technical specification	LS	1		0.00
F.	**COMMON EQUIPMENTS**				
a)	Relay Test tool kit	Set	1		0.00
b)	Time synchronisation equipment	No.	1		0.00
G.	**SUBSTATION AUTOMATION**				

Sl. No.	Description	Unit	Quantity	Unit Freight, In-transit, Insurance, Loading & Unloading Charges	Total Freight, In-transit, Insurance, Loading & Unloading Charges
1	2	3	4	5	6 = 4 x 5
G.1	Complete Substation Automation System (SAS) for substation including hardware and software for the substation & remote control stations alongwith associated equipments for the following bays as per Technical Specification				
a)	Main bays to be automated				
i)	245 kV system	Bay Nos	6		0.00
ii)	36 kV system	Bay Nos	11		0.00
iii)	BCU for controlling & monitoring of Auxilary System	Set	1		0.00
H.	**LT Switchgear (As per Technical specification)**				
a)	415V Main switchboard	Set	1		0.00
b)	415V ACDB	Set	1		0.00
c)	415V MLDB	Set	1		0.00
d)	415V Emergency LDB	Set	1		0.00
e)	220V DCDB	Sets	2		0.00
f)	48V DCDB	Set	2		0.00
I.	**Batteries**				
a)	220V				
	600 AH	Nos	2		0.00
b)	48V				
	300 AH	Nos	2		0.00
J.	**Float Cum Boost Battery Charger**				
a)	220V Float Cum Boost Battery Charger				
	80A/80A	Nos	2		0.00
b)	48V Float Cum Boost Battery Charger				
	40A/40A	Nos	2		0.00
K.	**Diesel Generator with control Panel**				
a)	100 kVA	Set	1		0.00
L.	**Fire Protection System**				
a)	Portable /Trolley/Wheel mounted extinguishers				
i)	9 litre water type	Nos	5		0.00
ii)	50 litre foam type	Nos	3		0.00
iii)	4.5 kg CO_2 type	Nos	15		0.00
iv)	4.5 kg Dry Chemical Power (DCP) type	Nos	5		0.00
M.	**Cables along with clamps, glands, lugs and straight joints etc.**				
a)	**Power Cables - (36kV grade)**				
i)	36kV Single Core H.T cable suitable for 1600Amps rating along with all accessories including termination kit as per specification (for Power transformer application). Number of runs and size of the cable per Phase to be decided by contractor	Metre	500		0.00
ii)	36kV H.T cable of suitable size along with all accessories including termination kit as per specification (for Auxiliary transformer application)	Meter	100		0.00
iii)	36kV Single core H.T cable suitable for 500Amps. Rating along with all accessories including termination kit as per specification (for Feeder Bay application)	Meter	600		0.00
b)	**Power cables - (1.1kV grade)**				
	3.5Cx300 sqmm (XLPE) cable for filter Machine along with termination arrangement as per TS	Meter	150		0.00
N.	**Air conditioning System for Control room cum administrative building**				
a)	High wall type split AC unit of 2 TR capacity	Nos	20		0.00

Sl. No.	Description	Unit	Quantity	Unit Freight, In-transit, Insurance, Loading & Unloading Charges	Total Freight, In-transit, Insurance, Loading & Unloading Charges
1	2	3	4	5	6 = 4 x 5
O.	**Fabrication, galvanising and supply of following Steel Structures including nuts, bolts, all types of washers, packplates, step bolts and gusset plates including foundation bolts.**				
a)	Lattice Structure (Towers, Beams, LM and Equipment/support structure) including Foundation Bolts	MT	40		0.00
b)	Fastners and step bolts.(Nuts,Bolts & Washers)	MT	1		0.00
P	**Telecommunication equipment**				
1.0	**SDH EQUIPMENTS(STM-4 MADM upto 5MSP Protected directions)**		1		0.00
(I)	**Lassipora**				
	Base equipments(Common cards,Cross connect/control cards, power supply cards, power cabling, other hardware and accessories including sub rascks, patch cord, DDF etc fully equipped excluding (ii) & (iii) below	Nos.	1		0.00
	Mirbazaar				
	Base equipments(Common cards,Cross connect/control cards, power supply	Nos.	1		0.00
	Wagora				
	Base equipments(Common cards,Cross connect/control cards, power supply cards, power cabling, other hardware and accessories including sub rascks, patch cord, DDF etc fully equipped excluding (ii) & (ii) below	Nos.	1		0.00
(ii)	**Optical Interface Cards/SFP#**				
	lassipora				
a	S4.1 SFP	Nos.			0.00
b	L4.1 SFP	Nos.	4		0.00
	Mirbazaar				
a	S4.1 SFP	Nos.	0		0.00
b	L4.1 SFP	Nos.	4		0.00
	Wagora				
a	S4.1 SFP	Nos.	0		0.00
b	L4.1 SFP	Nos.	4		0.00
(iii)	**Tributary cards**				
	lassipora				
a	E1 Interface card(Min. 16 Interfaces per card)	Nos.	2		0.00
b	Ethernet interface 10/100 Base T with Layer-2 switching (Min 8 Interfaces per card)	Nos.	2		0.00
	Mirbazaar				
a	E1 Interface card(Min. 16 Interfaces per card)	Nos.	2		0.00
b	Ethernet interface 10/100 Base T with Layer-2 switching (Min 8 Interfaces per card)	Nos.	2		0.00
	Wagora				
a	E1 Interface card(Min. 16 Interfaces per card)	Nos.	2		0.00
b	Ethernet interface 10/100 Base T with Layer-2 switching (Min 8 Interfaces per card)	Nos.	2		0.00
B	**Equipment Cabinet one for each Lassipora,Mirbazaar,Wagora**	Nos.	3		0.00
2.0	**Network Manager System(NMS)**				
	Lassipora				
(I)	**Craft terminal**				
a	Hardware	Set	1		0.00
b	Software	Set	1		0.00
	Mirbazaar				
(I)	**Craft terminal**				

Sl. No.	Description	Unit	Quantity	Unit Freight, In-transit, Insurance, Loading & Unloading Charges	Total Freight, In-transit, Insurance, Loading & Unloading Charges
1	2	3	4	5	6 = 4 x 5
a	Hardware	Set	0		0.00
b	Software	Set	0		0.00
	Wagora				
(I)	**Craft terminal**				
a	Hardware	Set	0		0.00
b	Software	Set	0		0.00
3.0	**VOIP telephone instrument with one common switch(min. 8 port)**				
i)	**lassipora**	No.s	2		0.00
ii)	**Mirbazaar**	No.s	0		0.00
iii)	**Wagora**	No.s	0		0.00
4.0	**Approach Cable (24 fibres)$**				
	lassipora				
a	24 Fibre(DWSM)	Kms	1		0.00
b	Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable	Set	1		0.00
	Mirbazaar				
a	24 Fibre(DWSM)	kms	0		0.00
b	Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable	Set	0		0.00
	Wagora				
a	24 Fibre(DWSM)	kms	0		0.00
b	Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable	Set	0		0.00
5.0	**FODP$**				
	lassipora				
a	**48 Fibre**:Indoor Type,Rack Mounted with FCPC Coupling & Pigtails(5mtrs)	No.s	1		0.00
	Mirbazaar				
a	**48 Fibre**:Indoor Type,Rack Mounted with FCPC Coupling & Pigtails(5mtrs)	No.s	1		0.00
	Wagiora				
a	**48 Fibre**:Indoor Type,Rack Mounted with FCPC Coupling & Pigtails(5mtrs)	No.s	1		0.00
	Part-B: VENDOR ASSESSED QUANTITIES				
A.	**Erection Hardware**				
	Hardware, conductor, Al tube, bus-bar materials, cable trays, clamps, spacers, connectors including equipment connectors, Junction box, earthwire, buried cable trenches/pipe equipment & lighting, 36kV Cable Termination kit alongwith all accessories etc. for 245kV &36 kV Switch yard:				
i)	Transformer Bay SF6 -Air bushing to Transformer bushing connection arrangement 245 KV and 36kV side	Set	1		0.00
ii)	220kV line	Set	4		0.00
iii)	33kV line + LT Transformer Bays(6+2=8)	Set	8		0.00
A1	Earthing material including main Earth mat, Equipment earthing, structures etc. inside and outside GIS Hall for complete scope of work as per technical specifications	LS	1		0.00
B.	**Fire detection & Alarm System for all buildings**				
i)	245KV GIS hall	LS	1		0.00
ii)	36KV GIS hall/Room	LS	1		0.00
iii)	Panel room of 245kV	LS	1		0.00
iv)	Control room cum administrative building	LS	1		0.00
C.	**Illumination System**				
a)	Control room cum administrative building illumination	LS	1		0.00
b)	Switchyard lighting	LS	1		0.00
c)	Street lighting	LS	1		0.00
d)	245KV GIS hall	LS	1		0.00
e)	36KV GIS hall/Room	LS	1		0.00
f)	Panel room of 245kV	LS	1		0.00

Sl. No.	Description	Unit	Quantity	Unit Freight, In-transit, Insurance, Loading & Unloading Charges	Total Freight, In-transit, Insurance, Loading & Unloading Charges
1	2	3	4	5	6 = 4 x 5
g)	Store	LS	1		0.00
h)	Security room	LS	1		0.00
i)	Parking Shed	LS	1		0.00
D.	**Air conditioning & ventilation System**				
D.1	**Air conditioning system**				
a)	Panel room of 245kV GIS Hall	LS	1		0.00
D.2	**Ventilation system**				
a)	245KV GIS hall (AHU as per Annexure - I	LS	1		0.00
b)	36KV GIS hall (Exhaust fan)	LS	1		0.00
E.	**POWER & CONTROL CABLES**				
a)	Power Cables(PVC)- (1.1kV grade)	LS	1		0.00
b)	Power Cables (XLPE) (**excluding** 3.5Cx300 sqmm (XLPE) cable for filter Machine)- (1.1kV grade)	LS	1		0.00
c)	Control Cable (PVC)- (1.1kV grade)	LS	1		0.00
d)	Cable glands, lugs & straight through joints for Power & Control cables	LS	1		0.00
	Part-C: Mandatory Spares				
A.	**Mandatory Spare List for Transformer**				
1.0	**For 160MVA (3x 53.33MVA+1x53.33MVA) , 245/36 KV, 1-phase Autotransformer**	LS	1		0.00
2.0	**245kV GIS**	LS	1		0.00
i	**245 KV SF6 CIRCUIT BREAKER (GIS):**	LS	1		0.00
ii	**245 KV ISOLATORS :**	LS	1		0.00
iii)	**245 KV CURRENT TRANSFORMER**	LS	1		0.00
iv	**245 kV VOLTAGE TRANSFORMER**	LS	1		0.00
3	**SPARES FOR 36kV GIS**	LS	1		0.00
i	**36 KV CIRCUIT BREAKER:**	LS	1		0.00
ii	**36KV ISOLATORS :**	LS	1		0.00
iii)	**36 KV CURRENT TRANSFORMER**	LS	1		0.00
iv	**36 kV VOLTAGE TRANSFORMER**	LS	1		0.00
4	**216kV SURGE ARRESTOR**	LS	1		0.00
5	**36kV ISOLATOR**	LS	1		0.00
6	**30kV SURGE ARRESTOR**	LS	1		0.00
7	**DG SETS :**	LS	1		0.00
8	**BATTERY**	LS	1		0.00
9	**BATTERY CHARGER**	LS	1		0.00
10	**RELAY & PROTECTION**	LS	1		0.00
11	**DIGITAL PROTECTION COUPLER**	LS	1		0.00
12	**SAS**	LS	1		0.00
13	**LT SWITCHGEAR**	LS	1		0.00
14	**COMMON SPARES**	LS	1		0.00
15	**LT TRANSFORMER**	LS	1		0.00
16	**ILLUMINATION SYSTEM**	LS	1		0.00
17	**ERECTION HARDWARE ITEMS**	LS	1		0.00
18.0	**TELE COMMUNICATION**	LS	1		0.00
TOTAL					0.00
Grand Total of Schedule-2				0.00	

Note : Bidders to note that the item description under various schedule are through unique material ID for respective items under SAP ERP system and therefore, identical item descriptions appears in schedule-1 (Ex-works) & Schedule-2(F&I). However, the prices to be quoted in price schedule-2(F&I) shall be towards local transpotation, Insurance and other Incidental Services only in line with Clause ITB 11.4(b)

Date :		Printed Name:	
Place :		Designation:	

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02											Schedule - 3

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

Click to Sch. 4

(SCHEDULE OF RATES AND PRICES)

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

INSTALLATION CHARGES

All Prices are in Indian Rupees.

Sl. No.	(SAC) Service Acounting Code	Whether SAC in column'2' is confirm. If not indicate applicable SAC*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Description	Unit	Quantity	Unit Erection Charges	Total Erection Charges	Total GST as confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=8x9	11
					220/33kV New GIS Grid Substation at Lassipora					
					Part-A : EMPLOYER ASSESSED QUANTITIES					
A.1					**POWER TRANSFORMER**					
A1.1					**POWER TRANSFORMER**					
a)	**998736**	1	18%	12%	160MVA (3x53.33 + 1x53.33 Spare), 220/33 KV, Single Phase transformers (Excluding insulating oil)	Nos.	4		0.00	0.00
b)	**998736**		18%		Insulating oil for 3x53.33MVA + 1x53.33MVA Spare, 245/36 KV, 1-phase transformer (LOT* - Oil for One Transformer)	LOT*	4		0.00	0.00
c)	**998736**		18%		Nitrogen Injection Fire Fighting System	Nos.	4		0.00	0.00
d)	**998736**		18%		Neutral formation for 220kV & 33kV side	Set	1		0.00	0.00
e)	**998736**		18%		On line Insulaing oil drying system	Set	1		0.00	0.00
f)	**998736**		18%		On line Dissolved Gas & Moisture Analyser	Set	1		0.00	0.00
A1.2					**Testing & Maintenance Equipments**					
a)			18%		Oil Storage Tank (10KL)	No.	1		0.00	0.00
b)			18%		Transformer Oil Filtration plant (6KLPH)	No	1		0.00	0.00
c)			18%		BDV TEST KIT	No.	1		0.00	0.00
d)			18%		OIL SAMPLING BOTTLE	No.	3		0.00	0.00
A.2					AUXILIARY TRANSFORMER					
a)			18%		250 kVA,33/0.433kV	Nos	2		0.00	0.00
A.3			18%		250KVA, 3 Phase, Automatic voltage Stablizer	Nos	1		0.00	0.00
B					**245KV Equipment**					
B.1					**245KV GIS Equipment**					
a)	**998736**		18%		245kV, SF6 GIS Bus Bars Module [Module description as per Section Project, Technical specification]	Set	2		0.00	0.00
b)	**998736**		18%		245kV, SF6 GIS Transformer bay Module [Module description as per Section Project, Technical specification]	Set	1		0.00	0.00
c)	**998736**		18%		245kV Auxiliary Bus Module to Connect Spare Unit of Transformer (module Description as per Section Project)	set	1		0.00	0.00
d)	**998736**		18%		245kV, SF6 GIS Line bay Module [Module description as per Section Project, Technical specification]	Set	4		0.00	0.00
e)	**998736**		18%		245kV, SF6 GIS Bus Coupler bay Module [Module description as per Section Project, Technical specification]	Set	1		0.00	0.00
f)	**998736**		18%		245kV, 1600A, 40kA SF6/Air Bushing for Connecting GIS to AIS (For Transformer and line feeders) alongwith support structure (Single Phase)	Nos.	15		0.00	0.00
g)	**998736**		18%		245kV, 1600A, 1-phase/ 3 Phase SF6 GIS Bus duct alongwith support structure from GIS building to C/L of SF6 to Air Bushing (* = Considered for Single Phase Duct)	Mtr*	200		0.00	0.00
B.2					**245KV Outdoor Equipment**					
i)			18%		216KV Surge Arrester (1-phase)	Nos.	16		0.00	0.00
ii)			18%		245kV BPI	Nos.	18		0.00	0.00
C					**36KV Equipment**					
C.1					**36KV, 2500Amps, 25KA for 3 Sec GIS Equipment**					
a)	**998736**		18%		36kV, SF6 GIS Bus Bar Enclosure Module including Bus sectionalizer, Bus PT's, Bus riser etc [Module description as per Section Project, Technical specification]	Set	1		0.00	0.00
b)	**998736**		18%		36kV, SF6 GIS Line bay Module [Module description as per Section Project, Technical specification]	Set	6		0.00	0.00
c)	**998736**		18%		36kV, SF6 GIS Transformer bay Module [Module description as per Section Project, Technical specification]	Set	2		0.00	0.00
d)	**998736**		18%		36kV, SF6 GIS Auxiliary transformer bay Module [Module description as per Section Project, Technical specification]	Set	2		0.00	0.00
C-2					**36kV Outdoor equipment**					
i)			18%		33 kV Isolators with earth switch	No.	7		0.00	0.00
ii)			18%		30 kV Surge Arrestors (1-phase)	Nos.	21		0.00	0.00
iii)			18%		33 kV BPI	Nos.	18		0.00	0.00
D.					**Testing & Maintenance Equipment for GIS**					
a)					SF6 Gas filling & evacuating plant					
			18%		For 245kV & 36kV GIS	Set	1		0.00	0.00
b)					Partial Discharge Monitoring System for GIS as per Technical Specification					
i)			18%		For 245kV GIS	Set	1		0.00	0.00
ii)			18%		For 36kV GIS	Set	1		0.00	0.00
c)					Dew Point meter					
			18%		For 245kV & 36kV GIS	Set	1		0.00	0.00
d)					SF6 Gas Leak Detector					
			18%		For 245kV & 36kV GIS	Set	1		0.00	0.00
e)			18%		EOT crane for 245kV GIS Hall	Set	1		0.00	0.00
f)			18%		SF6 Gas Analyser	Set	1		0.00	0.00
E					**RELAY PANELS (WITH AUTOMATION)**					
E.1					**245kV Simplex Panels**					
a)					Circuit Breaker Relay Panel					
i)			18%		With Auto Reclose	Set	5		0.00	0.00

Sl. No.	(SAC) Service Acounting Code	Whether SAC in column'2' is confirm. If not indicate applicable SAC*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Description	Unit	Quantity	Unit Erection Charges	Total Erection Charges	Total GST as confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=8x9	11
ii)			18%		With out Auto Reclose	Set	1		0.00	0.00
b)			18%		Line Protection Panel	Set	4		0.00	0.00
c)			18%		Transformer Protection Panel (For both HV & LV side)	Set	1		0.00	0.00
d)			18%		Bus Bar Protection Panel	Set	1		0.00	0.00
E.2					**Teleprotection Equipments**					
a)			18%		Digital protection coupler including cabling etc.	Set	2		0.00	0.00
b)			18%		Digital protection coupler including cabling etc. for other end	Set	2		0.00	0.00
c)			18%		Shifting and re-erection of existing panel of MirBazar/Wagoora as per Technical specification	LS	1		0.00	0.00
F					**COMMON EQUIPMENTS**					
a)			18%		Relay Test tool kit	Set	1		0.00	0.00
b)			18%		Time synchronisation equipment	No.	1		0.00	0.00
G.					**SUBSTATION AUTOMATION**					
G.1					Complete Substation Automation System (SAS) for substation including hardware and software for the substation & remote control stations alongwith associated equipments for the following bays as per Technical Specification					
a)					Main bays to be automated					
i)			18%		245 kV system	Bay Nos	6		0.00	0.00
ii)			18%		36 kV system	Bay Nos	11		0.00	0.00
iii)			18%		BCU for controlling & monitoring of Auxilary System	Set	1		0.00	0.00
H.					**LT Switchgear (As per Technical specification)**					
a)			18%		415V Main switchboard	Set	1		0.00	0.00
b)			18%		415V ACDB	Set	1		0.00	0.00
c)			18%		415V MLDB	Set	1		0.00	0.00
d)			18%		415V Emergency LDB	Set	1		0.00	0.00
e)			18%		220V DCDB	Sets	2		0.00	0.00
f)			18%		48V DCDB	Set	2		0.00	0.00
I.					**Batteries**					
a)					220V					
			18%		600 AH	Nos	2		0.00	0.00
b)					48V					
			18%		300 AH	Nos	2		0.00	0.00
J.					**Float Cum Boost Battery Charger**					
a)					220V Float Cum Boost Battery Charger					
			18%		80A/80A	Nos	2		0.00	0.00
b)					48V Float Cum Boost Battery Charger					
			18%		40A/40A	Nos	2		0.00	0.00
K.					**Diesel Generator with control Panel**					
a)			18%		100 kVA	Set	1		0.00	0.00
L.					**Fire Protection System**					
a)					Portable /Trolley/Wheel mounted extinguishers					
i)			18%		9 litre water type	Nos	5		0.00	0.00
ii)			18%		50 litre foam type	Nos	3		0.00	0.00
iii)			18%		4.5 kg CO2 type	Nos	15		0.00	0.00
iv)			18%		4.5 kg Dry Chemical Power (DCP) type	Nos	5		0.00	0.00
M.					**Cables along with clamps, glands, lugs and straight joints etc.**					
a)					**Power Cables - (36kV grade)**					
i)			18%		36kV Single Core H.T cable suitable for 1600Amps rating along with all accessories including termination kit as per specification (for Power transformer application). Number of runs and size of the cable per Phase to be decided by contractor	Metre	500		0.00	0.00
ii)			18%		36kV H.T cable of suitable size along with all accessories including termination kit as per specification (for Auxiliary transformer application)	Meter	100		0.00	0.00
iii)			18%		36kV Single core H.T cable suitable for 500Amps. Rating along with all accessories including termination kit as per specification (for Feeder Bay application)	Meter	600		0.00	0.00
b)					**Power cables - (1.1kV grade)**					
i)			18%		3.5Cx300 sqmm (XLPE) cable for filter Machine along with termination arrangement as per TS	Meter	150		0.00	0.00
N.					**Air conditioning System for Control room cum administrative building**					
a)			18%		High wall type split AC unit of 2 TR capacity	Nos	20		0.00	0.00
O.					**Fabrication, galvanising and supply of following Steel Structures including nuts, bolts, all types of washers, packplates, step bolts and gusset plates including foundation bolts.**					
a)			18%		Lattice Structure (Gantry Towers, Beams, LM and Equipment/support structure) including Foundation Bolts	MT	40		0.00	0.00
b)			18%		Fastners and Step Bolts (Nuts, Bolts and Washers	MT	1		0.00	0.00
P					**Telecommunication equipment**					
A					**SDH EQUIPMENTS(STM-4 MADM upto 5MSP Protected directions)**					
1.0 (I)					**Lassipora**					
			18%		Base equipments(Common cards,Cross connect/control cards, power supply cards, power cabling, other hardware and accessories including sub rascks, patch cord, DDF etc fully equipped excluding (ii) & (iii) below	Nos.	1		0.00	0.00
					Mirbazaar					
			18%		Base equipments(Common cards,Cross connect/control cards, power supply cards, power cabling, other hardware and accessories including sub rascks, patch cord, DDF etc fully equipped excluding (ii) & (iii) below	Nos.	1		0.00	0.00
					Wagora					

Sl. No.	(SAC) Service Acounting Code	Whether SAC in column'2' is confirm. If not indicate applicable SAC*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Description	Unit	Quantity	Unit Erection Charges	Total Erection Charges	Total GST as confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=8x9	11
			18%		Base equipments(Common cards,Cross connect/control cards, power supply cards, power cabling, other hardware and accessories including sub rascks, patch cord, DDF etc fully equipped excluding (ii) & (iii) below	Nos.	1		0.00	0.00
(ii)					**Optical Interface Cards/SFP#**					
					Iassipora					
a			18%		S4.1 SFP	Nos.			0.00	0.00
b			18%		L4.1 SFP	Nos.	4		0.00	0.00
					Mirbazaar					
a			18%		S4.1 SFP	Nos.	0		0.00	0.00
b			18%		L4.1 SFP	Nos.	4		0.00	0.00
					Wagora					
a			18%		S4.1 SFP	Nos.	0		0.00	0.00
b			18%		L4.1 SFP	Nos.	4		0.00	0.00
(iii)					**Tributary cards**					
					Iassipora					
a			18%		E1 Interface card(Min. 16 Interfaces per card)	Nos.	2		0.00	0.00
b			18%		Ethernet interface 10/100 Base T with Layer-2 switching (Min 8 Interfaces per card)	Nos.	2		0.00	0.00
					Mirbazaar					
a			18%		E1 Interface card(Min. 16 Interfaces per card)	Nos.	2		0.00	0.00
b			18%		Ethernet interface 10/100 Base T with Layer-2 switching (Min 8 Interfaces per card)	Nos.	2		0.00	0.00
					Wagora					
a			18%		E1 Interface card(Min. 16 Interfaces per card)	Nos.	2		0.00	0.00
b			18%		Ethernet interface 10/100 Base T with Layer-2 switching (Min 8 Interfaces per card)	Nos.	2		0.00	0.00
B			18%		**Equipment Cabinet one for each Lassipora,Mirbazaar,Wagora**	Nos.	3		0.00	0.00
2					**Network Manager System(NMS)**					
					Lassipora					
(I)					**Craft terminal**					
a			18%		Hardware	Set	1		0.00	0.00
b			18%		Software	Set	1		0.00	0.00
					Mirbazaar					
(I)					**Craft terminal**					
a			18%		Hardware	Set	0		0.00	0.00
b			18%		Software	Set	0		0.00	0.00
					Wagora					
(I)					**Craft terminal**					
a			18%		Hardware	Set	0		0.00	0.00
b			18%		Software	Set	0		0.00	0.00
3					**VOIP telephone instrument with one common switch(min. 8 port)**					
			18%		**Lassipora**	No.s	2		0.00	0.00
			18%		**Mirbazaar**	No.s	0		0.00	0.00
			18%		**Wagora**	No.s	0		0.00	0.00
4					**Approach Cable (24 fibres)**					
					Lassipora					
a			18%		24 Fibre(DWSM)	Kms	1		0.00	0.00
b			18%		Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable	Set	1		0.00	0.00
					Mirbazaar					
a			18%		24 Fibre(DWSM)	kms	0		0.00	0.00
b			18%		Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable	Set	0		0.00	0.00
					Wagora					
a			18%		24 Fibre(DWSM)	kms	0		0.00	0.00
b			18%		Installation hardware set for above 24 Fibre, Fibre Optic Approach Cable	Set	0		0.00	0.00
5					**FODP**					
					Lassipora					
a			18%		**48 Fibre**:Indoor Type,Rack Mounted with FCPC Coupling & Pigtails(5mtrs)	No.s	1		0.00	0.00
					Mirbazaar					
a			18%		**48 Fibre**:Indoor Type,Rack Mounted with FCPC Coupling & Pigtails(5mtrs)	No.s	1		0.00	0.00
					Wagoora					
a			18%		**48 Fibre**:Indoor Type,Rack Mounted with FCPC Coupling & Pigtails(5mtrs)	No.s	1		0.00	0.00
Q			18%		Training of employers personnel as per clause 11 of section project	LS	1		0.00	0.00
					Part-B: VENDOR ASSESSED QUANTITIES					
A.					**Erection Hardware**					
					Hardware, conductor, Al tube, bus-bar materials, cable trays, clamps, spacers, connectors including equipment connectors, Junction box, earthwire, buried cable trenches/pipe equipment & lighting, 36kV Cable Termination kit alongwith all accessories etc. for 245kV &36 kV Switch yard:					
i)			18%		Transformer Bay SF6 -Air bushing to Transformer bushing connection arrangement 245 KV and 36kV side	Set	1		0.00	0.00
ii)			18%		220kV line	Set	4		0.00	0.00
iii)			18%		33kV line + LT Transformer Bays	6+2=8	8		0.00	0.00
A1			18%		Earthing material including main Earth mat, Equipment earthing, structures etc. inside and outside GIS Hall for complete scope of work as per technical specifications	LS	1		0.00	0.00
B)					Fire detection & Alarm System for all buildings or					
i)			18%		245KV GIS hall	LS	1		0.00	0.00
ii)			18%		36KV GIS hall	LS	1		0.00	0.00
iii)			18%		Panel room of 245kV	LS	1		0.00	0.00
iv)			18%		Control room cum administrative building	LS	1		0.00	0.00
C.					Illumination System					
a)			18%		Control room cum administrative building illumination	LS	1		0.00	0.00
b)			18%		Switchyard lighting	LS	1		0.00	0.00
c)			18%		Street lighting	LS	1		0.00	0.00
d)			18%		245KV GIS hall	LS	1		0.00	0.00

Sl. No.	(SAC) Service Acounting Code	Whether SAC in column'2' is confirm. If not indicate applicable SAC*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Description	Unit	Quantity	Unit Erection Charges	Total Erection Charges	Total GST as confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=8x9	11
e)			18%		36KV GIS hall	LS	1		0.00	0.00
f)			18%		Panel room of 245kV	LS	1		0.00	0.00
g)			18%		Store	LS	1		0.00	0.00
h)			18%		Security room	LS	1		0.00	0.00
i)			18%		Parking Shed	LS	1		0.00	0.00
D.					Air conditioning & Ventilation System					
D.1					Air conditioning system					
a)			18%		Panel room of 245kV GIS Hall	LS	1		0.00	0.00
D.2					Ventilation system					
a)			18%		245KV GIS hall (AHU as per Annexure - IV of TS	LS	1		0.00	0.00
b)			18%		36KV GIS hall (Exhaust fan)	LS	1		0.00	0.00
E.					POWER & CONTROL CABLES					
a)			18%		Power Cables(PVC)- (1.1kV grade)	LS	1		0.00	0.00
b)			18%		Power Cables (XLPE) (**excluding** 3.5Cx300 sqmm (XLPE) cable for filter Machine)- (1.1kV grade)	LS	1		0.00	0.00
c)			18%		Control Cable (PVC)- (1.1kV grade)	LS	1		0.00	0.00
d)			18%		Cable glands, lugs & straight through joints for Power & Control cables	LS	1		0.00	0.00
					Part-C: Civil Works (As per Technical Specifications)					
1			18%		**Soil Investigation as per TS**	LS	1		0.00	0.00
2			18%		**Contouring and levelling of Plot**	LS	1		0.00	0.00
2.1			18%		Earth work filling with borrowed earth with all leads and lifts including etc (borrowed area to be deceided by contractor)	Cu. M	15600		0.00	0.00
3					**Design, Engineering and Construction of foundation for following equipments/Structures**					
i			18%		160MVA (3x53.33MVA+1x53.33MVA spare) Power Transformer	Nos.	4		0.00	0.00
ii			18%		250KVA Auxiliary Transformer Transformer	No.	1		0.00	0.00
iii			18%		100 KVA D.G.Set	No.	1		0.00	0.00
iv			18%		Tower Structure, Support structure for GIS 220kV, Lightning Mast	No	15		0.00	0.00
v			18%		Equipments structure for L.A, Isolator, BPI in 220kV/33kV AIS	No.	76		0.00	0.00
4					**Cable Trench of various sizes as per drg. given in specs.,Including crossings**					

Sl. No.	(SAC) Service Acounting Code	Whether SAC in column'2' is confirm. If not indicate applicable SAC*	Rate of GST Applicable (%)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Description	Unit	Quantity	Unit Erection Charges	Total Erection Charges	Total GST as confirmed by Bidder
1	2	3	4	5	6	7	8	9	10=8x9	11
4.1			18%		Section 3-3	RMt	100		0.00	0.00
4.2			18%		Section 4-4	RMt	50		0.00	0.00
5			18%		Buried Cable Trench for Auxiliary Power Supply arrangement	RMt	100		0.00	0.00
6					Design, Engineering and Construction of following buildings inclusive of PCC, RCC, reinforcement, internal cable trench (if required) internal and external finish, internal water supply, internal and external sanitation, septic tank and soak pit etc complete in all respects					
i)			18%		CONTROL ROOM & ADMINISTRATION BUILDING	Sq.M	500		0.00	0.00
ii)					245 KV GIS HALL					
(a)			18%		GIS Hall	Sq. M.	350		0.00	0.00
(b)			18%		AHU Room	Sq. M.	42		0.00	0.00
c)			18%		Panel Room	Sq. M.	70		0.00	0.00
iii)					36KV GIS ROOM/HALL					
(a)			18%		GIS ROOM	Sq. M.	100		0.00	0.00
iv)			18%		Security room	Sq. M.	12		0.00	0.00
v)			18%		Store (Covered 6 x 15)	Sq. M.	90		0.00	0.00
7					Design, Engineering and Construction of parking shed, store etc. inclusive of PCC,RCC, reinforcement, internal and External finishs etc. complete in all respects					
			18%		Parking shed for 5 Nos.	LS	1		0.00	0.00
8					Construction of Concrete (RCC) road					
			18%		Road 3.75m wide	Sq.M.	1000		0.00	0.00
			18%		Road 5.5m wide	Sq.M.	150		0.00	0.00
9			18%		All civil works for Boundary wall including excavation, concrete, reinforcement steel ,structural steel, plaster, painting, barbed wire and concertina coil etc all complete as per technical specification (2.5 m high R.C.C frame wall as per Drawing and 0.5 m high angle support on top).	RM	500		0.00	0.00
10			18%		Main boundary wall Gate (Steel) including all works complete as per technical specification	No.	1		0.00	0.00
11			18%		Chain link fencing as per technical sepcification and drawing	RMts	100		0.00	0.00
12			18%		Fencing Gate	No.	2		0.00	0.00
13			18%		Design and Construction of Drainage system	LS	1		0.00	0.00
14			18%		Antiweed Treatment	Sq. mt	2200		0.00	0.00
15			18%		75mm thick P.C.C (1:5:10) in switchyard area	sq.mt	2200		0.00	0.00
16			18%		Gravel Filling	Sq. mt	2200		0.00	0.00
17					Supplying & laying RCC hume pipe of grade (NP-3) for culverts and cable trench crossings of following dia.					
i)			18%		250mm dia	RM	10		0.00	0.00
ii)			18%		300mm dia	RM	10		0.00	0.00
iii)			18%		450mm dia	RM	10		0.00	0.00
18					Supplying and erecting dewatering pumps					
i)			18%		5.0 HP	Nos.	2		0.00	0.00
ii)			18%		1.0HP	Nos.	2		0.00	0.00
19					Providing and Laying of G.I. pipe (Medium Duty) for water supply from borewell/water source to control room building, Transit camp and security room.					
i)			18%		200 mm Dia GI pipe	RM	50		0.00	0.00
ii)			18%		50 mm Dia GI pipe	RM	25		0.00	0.00
iii)			18%		40mm Dia pipe	RM	40		0.00	0.00
iii)			18%		25mm Dia GI pipe	RM	50		0.00	0.00
20					Random rubble Masonary Retaining Wall					
20.1			18%		Random rubble Masonary with hard stone in foundation and plinth including levelling up with cement conctrete 1:6:12(1 cement: 6 coarse sand and 12 graded stone aggregate 20mm nominal size) upto plinth level with cement mortar 1:6 (1 cement : 6 coarse sand)	CuM	350		0.00	0.00
20.2			18%		P.C.C. 1:4:8	CuM	25		0.00	0.00
21			18%		Rain Water Harvesting	LS	1		0.00	0.00
22			18%		Miscellaneous Steel	MT	5		0.00	0.00
Grand Total of Schedule-3									0.00	
Total GST as confirmed by Bidder										0.00

Note :

1) To facilitate the bidders, Employer has indicated an HSN/SAC code and rate of GST against each item in the Price Schedule except for some of lumpsum quantities/lot/Set as mentioned at ITB 11.3.2. It shall entirely be the responsibility of the bidder to check the HSN/SAC code and rate of GST given against each item. The bidder may either confirm the HSN/SAC and rate of GST or if the bidder opts to classify the item in question under a different HSN/SAC code or opts to indicate a different rate of GST, bidder may indicate the same in the columns provided. The bidder shall solely be responsible for HSN/SAC classification and the rate of GST for each item. Employer's liability for reimbursement/payment of GST shall be lower of the GST applicable at the rate as confirmed/deemed confirmed in the bid or actual GST paid/payable by the bidder for that item.

2) For Supply of plants & equipment and Services from within India, HSN/SAC has not been indicated for some of lumpsum quantities/lot/Set as each of these consists of many items for which billing break up shall be furnished during contract execution. For the purpose of evaluation, the bidder has to indicate the rate of GST applicable on these items. As it is possible that the incidence of GST on each of these items may be different, provision has been made in the price schedules for quoting the bid price in different categories based on the incidence of GST. The bidder shall accordingly quote price in different tax categories. HSN /SAC for these items shall be furnished along with billing breakup prior to payment for these items. Employer's liability for reimbursement/payment of GST shall be lower of the GST applicable at the rate as confirmed/deemed confirmed in the bid or actual GST paid/payable by the bidder for that item.

3) In case the bidder leaves the cell of confirmation of the SAC code and/or GST rate "blank", the SAC code and corresponding GST rate indicated by the Employer shall be deemed to be the one confirmed by the Bidder.

4) HSN stands for Harmonized System of Nomenclature and SAC stands for Service Accounting Code, used for classification of Goods for GST purpose..

Date :
Place :

Printed Name:
Designation:

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

Click to Sch. 5

(SCHEDULE OF RATES AND PRICES)

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

REC

Traning Charges for Traning to be imparted .

All Prices are in Indian Rupees.

Sl. No.	SAC (Service Accounting Codes)	Whether SAC in column'2' is confirm. If not indicate applicable SAC*	Rate of GST applicable (in %)	Whether rate of GST in column'4' is confirm. If not indicate applicable GST*	Description	Unit	Quantity	Unit Chargers	Total Training Charges excluding GST	Total GST as Confirmed by Bidder
1	2		3		4	5	6	7	8= 6x7	
I					220/33kV New GIS Grid Substation at Lassipora					
1					**Design, operation and maintenance of GIS Substation including procedures for fault attending for the Power Transformer, Circuit Breaker, Isolators, Instruments Transformers , Relay & Protection system and substation automation at manufacturers'/suppliers' works for 20 personnel of Employer for 5 days**	MND	100		0	0
2					**Further training on FO based Communication equipment at manufacturers'/suppliers' works for 10 personnel of Employer for 5 days.**	MND	50		0	0
Total Traning Charges									0	
Total GST as Confitmed by Bidder										0

Date		**Printed Name:**	
Place		**Designation :**	

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"		
SUMMARY OF TAXES & DUTIES APPLICABLE ON PLANT & EQUIPMENT		
Bidder's Name and Address :		To: REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Name :		
Address :		
All Prices are in Indian Rupees.		

Sl. No.	Item Nos.	Total Price (INR)
1	**TOTAL GST ON GOODS**	
	Total GST for Supply of Goods (inter-alia including Type Test Charges) between the Contractor and the Employer (identified in Schedule 1') which are not included in the Ex-works price as per the provision of the Bidding Documents, as applicable.	0.00
2	**TOTAL GST ON SERVICES**	
	Total GST on Installation Services (Schedule-3) and Training to be imparted in India (Schedule-4)	0.00
	GRAND TOTAL [1+2]	0.00

Date :		**Printed Name:**	
Place :		**Designation :**	

Click to Sch. 7

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Schedule

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

(GRAND SUMMARY)

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

Sl. No.	Description	Total Price (INR)
1	**TOTAL SCHEDULE NO. 1**	**0.00**
	Ex-works price of Plant and Equipment including Type Test Charges	
2	**TOTAL SCHEDULE NO. 2**	**0.00**
	Local Transportation, In-transit Insurance, loading and unloading	
3	**TOTAL SCHEDULE NO. 3**	**0.00**
	Installation Charges	
4	**TOTAL SCHEDULE NO. 4**	**0.00**
	Training Charges	
5	**TOTAL SCHEDULE NO. 5**	**0.00**
	Taxes and Duties	
6	**TOTAL SCHEDULE NO. 7**	**NOT APPLICABLE**
	Type Test Charges [Total of this Schedule is included in Schedule - 1 above.]	
	GRAND TOTAL [1+2+3+4+5]	**0.00**

Date : --	**Printed Name :**
Place :	**Designation :**

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02		Schedule-6(After Discount)
Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"		
(GRAND SUMMARY: AFTER DISCOUNT)		
Bidder's Name and Address :		To: REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE'Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in
Name :		
Address :		
Sl. No.	**Description**	**Total Price (INR)**
1	**TOTAL SCHEDULE NO. 1**	**0.00**
	Ex-works price of Plant and Equipment including Type Test Charges	
2	**TOTAL SCHEDULE NO. 2**	**0.00**
	Local Transportation, In-transit Insurance, loading and unloading	
3	**TOTAL SCHEDULE NO. 3**	**0.00**
	Installation Charges	
4	**TOTAL SCHEDULE NO. 4**	**0.00**
	Training Charges	
5	**TOTAL SCHEDULE NO. 5**	**0.00**
	Taxes and Duties	
6	**TOTAL SCHEDULE NO. 7**	**0.00**
	Type Test Charges [Total of this Schedule is included in Schedule - 1 above.]	
	GRAND TOTAL [1+2+3+4+5]	**0.00**
Date : --	**Printed Name :**	
Place :	**Designation :**	

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02	Schedule-7

Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"

Click to Discount

(SCHEDULE OF RATES AND PRICES)

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

TYPE TESTS CHARGES

All Prices are in Indian Rupees.

Sl. No.	HSN Code	Rate of GST Applicable (%)	Item Description	Unit	Qty.	Unit Ex-works price(excluding GST)	Total Ex-works price(excluding GST)
1	2	3	4	5	6	7	8= 6x7
NOT APPLICABLE							

Date : --
Place :

Printed Name :
Designation :

TENDER PACKAGE No.:-RECTPCL/PIA/JKPDD/SS-02			Letter of Discount
LETTER OF DISCOUNT			
To: REC Transmission Projects Company Limited (A wholly owned subsidiary of REC, a 'Navratna CPSE' Under the Ministry of Power, Govt of India) ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Website: www.rectpcl.in			
Subject:	**Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"**		
Dear Sir			
With reference to the subject tender, we hereby offer unconditional discount on the prices quoted by us as per details given here below :			
1	Discount on lum-sum basis on the Schedules as given below : [The discount shall be proportionately applicable on all the relevent items of the respective Schdules.] In Percent (%)		
	Schedule-1: Ex Works prices	In Percent %	
	Schedule-2 : Freight & Insurance	In Percent %	
	Schedule-3 : Erection Charges	In Percent %	
	Schedule-4 : Training Charges	In Percent %	
	Schedule-7 : Type Test Charges	In Percent %	
Please consider this letter of discount as the integral part of our price bid.			
		Yours faithfully,	
		For and on behalf of	
Date :		**Printed Name :**	
Place :		**Designation :**	

Bid Form 2nd Envelope

BID FORM (Second Envelope)

Bid Proposal Ref. No.	
Date .	--

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

Name of Contract :	**Tender Package "Design, Manufacturing, Supply, Erection, Testing & Commissioning of 160 MVA, 220/33 kV Gas Insulated Substation (GIS) at Lassipora on Turnkey Basis associated with Strengthening of Transmission System of JKPDD under PMDP Scheme-15"**

Dear Ladies and/or Gentlemen,

1.0	In continuation of First Envelope of our bid, we hereby submit the Second Envelope of the Bid, both of which shall be read together and in conjuction with each other, and shall be construed as an integral part of our Bid. Accordingly, we the undersigned, offer to design, manufacture, test, deliver, install and commission (including carrying out Trial Operation, Performance & Guarantee Test as per provision of Technical Specification) under the above named package in full conformity with the said Bidding Documents for the sum of Rs 0 (Only) or such othersums as may be determined in accordance with the terms and conditions of the Bidding Documents. The above amounts are in accordance with the price schedules attached herewith and are made part of this bid.	
2.0	**Price Schedules**	
2.1	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	Plant and Equipment (Including Mandatory Spare Parts) to be supplied, including Type Test Charges.
	Schedule 2	Local Transportation, In-transit Insurance, loading and unloading
	Schedule 3	Installation Charges.
	Schedule 4	Training charges for training to be imparted.
	Schedule 5	GST not included in Schedule 1 & 3
	Schedule 6	Grand Summary [Schedule 1 to 5]
	Schedule 7	Break-up of Type Test Charges for Type Tests to be conducted

2.2	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.
2.3	We declare that as specified in Clause 11.5, Section –II:ITB, Vol.-I of the Bidding Documents, prices quoted by us in the Price Schedules shall be subject to Price Adjustment during the execution of Contract in accordance with Appendix-2 (Price Adjustment) to the Contract Agreement.
2.4	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.
2.5	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.
3.0	We confirm that except as otherwise specifically provided our Bid Prices in this Second Envelope include all GST and charges as may be assessed on us/our Associate (applicable for Foreign Bidder), 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.
3.1	100% of applicable GST which are payable by the Employer under the Contract, shall be reimbursed by the Employer on production of satisfactory documentary evidence by the Contractor in accordance with the provisions of the Bidding Documents.
3.2	We further understand that notwithstanding 3.0 above, in case of award on us, you shall also bear and pay/reimburse to us, GST applicable on supplies by us to you, imposed on the Plant & Equipment including Mandatory Spare Parts to be incorporated into the Facilities including Type Test charges for Type test to be conducted specified in Schedule No. 1, Installation Services specified in Schedule No. 3 and Charges for Training to be imparted specified in Schedule No. 4 of the Price Schedule in this Second Envelope by the Indian Laws.
3.3	We confirm that we have also registered/we shall also get registered in the GST Network with a GSTIN, in all the states where the project is located and the states from which we shall make our supply of goods.
4.0	# (For Joint Venture only) We, the partners of Joint Venture submitting this bid, do agree and confirm that in case of Award of Contract on the Joint Venture, we shall be jointly and severally liable and responsible for the execution of the Contract in accordance with Contract terms and conditions.

5.0	We, hereby, declare that only the persons or firms interested in this proposal as principals are named here and that no other persons or firms other than those mentioned herein have any interest in this proposal or in the Contract to be entered into, if the award is made on us, that this proposal is made without any connection with any other person, firm or party likewise submitting a proposal is in all respects for and in good faith, without collusion or fraud.		
Thanking you, we remain,			
			Yours faithfully,
			For and on behalf of
			Signature :
Date :			**Printed Name :**
Place :			**Designation :**
In case of bid from a Joint Venture, name & designation of representative of JV partner is to be provided and Bid Form is also to be signed bv him.			
Printed Name :			
Designation :			
Please provide additional information of the Bidder			
Business Address :			
Country of Incorporation :			
State/Province to be indicated :			
Name of Principal Officer :			
Address of Principal Officer :			
Note: Bidders may note that no prescribed proforma has been enclosed for Attachment 2 : Power of Attorney. Bidders may use their own proforma for furnishing the required information with the bid.			