DELHI TRANSCO LIMTIED
WEB NOTIFICATION

Two Part Open Tender (DCB) is invited through **e-tendering** system by Dy. General Manager (T), Contract Business Plan (CBP), Delhi Transco Limited, Room No.-504, 5th Floor, Shakti Sadan, Kotla Road, New Delhi-110002 (India), from the experienced companies/ contractors, in the relevant business for the following work:

S. No.	Tender No.	Name of work	Estimated Amount (in Rs.)	Earnest Money Deposit (EMD) (Rs)	Work Completion Period	Scheduled Date/Time	
1.	T20R220201	A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).	Package A:- Rs. 48,90,15,327/- (INR Forty Eight Crore Ninety Lakh Fifteen Thousand Three Hundred Twenty Seven Only)	Package A:- Rs. 97,80,307/- (INR Ninety Seven Lakh Eighty Thousand Three Hundred Seven Only)	Package A:- 12 Month	Date and Time of Start of downloading and submission of the bidding document	02.11.2020 at 03:00 PM
		B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).	Package B:- Rs. 39,84,79,960/- (INR Thirty Nine Crore Eighty Four Lakh Seventy Nine Thousand Nine Hundred Sixty Only)	Package B:- Rs. 79,69,599/- (INR Seventy Nine Lakh Sixty Nine Thousand Five Hundred Ninety Nine Only)	Package B:- 12 Month	Date and Time of Pre-Bid Conference	10.11.2020 at 11:30 AM
						Date and Time of Close of submission of bids	02.12.2020 at 01:30 PM
		C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).	Package C:- Rs. 9,87,90,507/- (INR Nine Crore Eighty Seven Lakh Ninety Thousand Five Hundred Seven Only)	Package C:- Rs. 19,75,810/- (INR Nineteen Lakh Seventy Five Thousand Eight Hundred Ten Only)	Package C:- 09 Month	Date and Time of Opening of Techno-Commercial part of bids (Part-I)	02.12.2020 at 03:00 PM

Note: -

- Complete Tender documents can be downloaded from the website of Delhi Govt. https://www.govtprocurement.delhi.gov.in **(Tender ID Nos. For Package 'A' T20R220201(A): 2020_DTL_193191_1, Package 'B' T20R220201(B): 2020_DTL_193268_1 & Package 'C' T20R220201(C): 2020_DTL_193270_1) and to be submitted individually for each Package through e-Tendering Process only.**
- The Pre-bid Conference may be held at Conference Hall, 4th Floor, Shakti Sadan, Kotla Road, New Delhi-110002 or through on-Line mode.

29.10.2020

Designation/ Deptt.-DGM (T) CBP
DGM (T) Contract Business Plan (CBP),
Delhi Transco Limited,
Room No.-504, 5th Floor,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India), Phone: 23230026,
Fax No. 011-23232721, Email: niraj.sharma@dtl.gov.in

DELHI TRANSCO LTD

(A Government of NCT of Delhi Undertaking)

Bidding Documents

For

A. Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B. Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C. Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

Volume – I, II & III

Tender No: T20R220201

DELHI TRANSCO LTD

(A Government of NCT of Delhi Undertaking)

Bidding Documents

For

A. Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B. Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C. Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

Volume – I

Tender No: T20R220201

VOLUME-I

CONDITIONS OF CONTRACT

CONTENTS

Section - I	**Invitation for Bid (IFB)**
Section - II	**Instruction to Bidders (ITB)**
Section - III	**Bid Data Sheet (BDS)**
Section - IV	**Conditions of Contract (CC)**
Section –V	**Special Conditions of Contract (SCC)**
Section - VI	**Forms and Procedures (F&P)**

SECTION-I

INVITATION FOR BID (IFB)

DELHI TRANSCO LIMITED

(A Government of NCT of Delhi Undertaking)

INVITATION FOR BID (IFB)

(DOMESTIC COMPETITIVE BIDDING)

WEB NOTIFICATION

Tender is invited in Two-part Bid system (i.e. Technical bid and Price bid) through e- procurement portal of **Delhi Govt.** by **DGM (T) Contract Business Plan (CBP), Delhi Transco Limited, Room No.-504, 5th Floor, Shakti Sadan, Kotla Road, New Delhi-110002 (India),** from eligible bidders who have registered with e- procurement portal of GNCTD and have obtained digital signature.

Tender Name	A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India). B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India). C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).
Tender Enquiry No.	**T20R220201**
Estimated Amount (in Rs.)	Package A:- Rs. 48,90,15,327/- (INR Forty Eight Crore Ninety Lakh Fifteen Thousand Three Hundred Twenty Seven Only) Package B:- Rs. 39,84,79,960/- (INR Thirty Nine Crore Eighty Four Lakh Seventy Nine Thousand Nine Hundred Sixty Only) Package C:- Rs. 9,87,90,507/- (INR Nine Crore Eighty Seven Lakh Ninety Thousand Five Hundred Seven Only)
Bid Security (BS) in Rs.	Package A:- Rs. 97,80,307/- (INR Ninety Seven Lakh Eighty Thousand Three Hundred Seven Only) Package B:- Rs. 79,69,599/- (INR Seventy Nine Lakh Sixty Nine Thousand Five Hundred Ninety Nine Only) Package C:- Rs. 19,75,810/- (INR Nineteen Lakh Seventy Five Thousand Eight Hundred Ten Only)
Tender Fee	Nil
Bid Validity	180 days from the date of bid opening.

Completion Period	Package A:- 12 Month Package B:- 12 Month Package C:- 09 Month		
		DATE	TIME
Date and Time of Start of downloading of the bidding document		-	-
Date and Time of Close of downloading of the bidding document		-	-
Date and time of Pre-Bid Conference		-	-
Date and time of start of submission of bids		-	-
Date and Time of Close of submission of bids		-	-
Date and Time of opening of Techno-Commercial part of bids (Part-I)		-	-

For details please visit web site www.dtl.gov.in (unique No.…….) Tender can only be submitted on e-tendering portal of Delhi Govt. website http://govtprocurement.delhi.gov.in or may contact office of **DGM (T) Contract Business Plan (CBP), Delhi Transco Limited, Room No.-504, 5th Floor, Shakti Sadan, Kotla Road, New Delhi-110002 (India), Phone: 23230026, Fax No. 011-23232721, Email: niraj.sharma@dtl.gov.in.** The Pre-Bid conference will be held on Dt….at conference Hall,4th Floor, Shakti Sadan, Kotla Road, New Delhi-110002.

General requirements for invitation of bids are as under:

1.0 **DELHI TRANSCO LIMITED** invites tenders for the aforesaid package A, B & C in Two-part Bid system (i.e. Techno-Commercial and Price bid) through e-procurement portal from eligible bidders who are registered **at e-procurement portal of Delhi Govt. website i.e. http://govtprocurement.delhi.gov.in** and have obtained digital signature.

1.1 Bidding Documents are available for downloading date and time mentioned in the web notification.

1.2 No purchase preference shall be given.

1.3 The submission of bids date and time has been mentioned in the web notification. Bids shall be received up to date and time mentioned in the web notification and Techno- Commercial Bid (Part-I) shall be opened on the same day through e-procurement portal of Delhi Govt. website **i.e. http://govtprocurement.delhi.gov.in** in the presence of Bidder's representative who chose to attend at the address given below:-

DGM (T) Contract Business Plan (CBP),
Delhi Transco Limited,
Room No.-504, 5th Floor,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India), Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

1.4 In case any of the above dates are declared holiday/ closing day, these shall be extended to next working day.

1.5 The complete Bidding Documents including tender drawings are available on DTL website https://www.delhitransco.gov.in and Delhi Govt. website **http://govtprocurement.delhi.gov.in**

1.6 The Qualifying Requirements are given in the bidding document of the subject package A, B & C. In addition to submission of scanned copies of mandatory documents through e-procurement portal, the bidder shall also submit (02) two copies of the bid in Book Bonded form, clearly marking each "Original Bid" and "Copy of bid" including, the signed hard copies of all relevant pre-qualification documents being submitted in support of Bid (all Forms, Annexures etc. Experience certificate, supporting documents copies, type test reports, Guaranteed Technical Particulars and any other documents required as per the bidding document etc.) at least one and half hour before the time of bid opening in the office of **DGM (T) Contract Business Plan (CBP), Delhi Transco Limited, Room No.-504, 5th Floor, Shakti Sadan, Kotla Road, New Delhi-110002 (India).** In the event of any discrepancy between original and copy of the hard bid, the original shall govern. Also in the event of any discrepancy between online bidding documents and the hard copy of the bid, the online bid shall govern. The Price Bid (Part-II) shall not be submitted in hard copy and shall only be uploaded on e-portal of Delhi Govt. website.

1.7 All bids must be accompanied by Bid Security amount mentioned in the web notification as per cl. No. 23 of Section ITB, Volume-I of the bidding document. The Scanned copy of Bid Security is to be submitted with online bid; however, the Bid Security in original shall be submitted in the office of **DGM (T) Contract Business Plan (CBP), Delhi Transco Limited, Room No.-504, 5th Floor, Shakti Sadan, Kotla Road, New Delhi-110002**, at least one and half hour before the time of bid opening, failing which the bids shall be rejected.

1.8 The Techno- Commercial Bid (Part-I) so opened shall be evaluated and the date of opening of the Price Bid (Part-II) of the techno-commercially successful bidders shall only be communicated to all techno commercially successful bidders.

1.9 Bidders are permitted to quote for one or all package(s). Multi-package rebate(s) offered if any, shall be considered in evaluation. Based on such evaluation, award of contracts would be made to one or more bidder(s) for one or all package(s) on the basis of least evaluated cost to the Purchaser.

2.0 Delhi Transco Limited shall not be responsible for any postal delays in respect of request for issuance of bidding documents and/or dispatch of bidding documents and/or submission of bids.

2.1 Delhi Transco limited reserves the right to cancel/withdraw this invitation to bids without assigning any reason and shall bear no liability whatsoever consequent upon such a decision.

2.2 All correspondence/communication regarding the NIT shall be made to: **DGM (T) Contract Business Plan (CBP), Delhi Transco Limited, Room No.-504, 5th Floor, Shakti Sadan, Kotla Road, New Delhi-110002 (India), Phone: 23230026, Fax No. 011-23232721, Email: niraj.sharma@dtl.gov.in**

2.3 Integrity Pact must be submitted alongwith the bid in physical form at the address given at para 1.7 above.

(Niraj Sharma)
DGM (T) CBP

SECTION-II

INSTRUCTION TO BIDDER (ITB)

SECTION- II

INSTRUCTION TO BIDDERS (ITB)

A. INTRODUCTION

1.0 GENERAL INFORMATION

1.1 Delhi Transco Limited (hereinafter called **'DTL'/ 'Owner'/'Employer'**) will receive bids in respect of equipment to be furnished and erected as set-forth in the accompanying Specifications. All bids shall be prepared and submitted in accordance with these instructions.

1.2 **Eligibility of bidders**

Bids can be submitted by firms: -

1.2.1 From within India including company (ies) registered and incorporated in India as per Companies Act, 2013 barring foreign bidders/MNCs not registered and incorporated in India and those bidders with whom business is banned by DTL and

1.2.2 Only 'Class-I local supplier' shall be eligible to bid as per PPP-MII order dt. 04.06.2020 & their latest amendments thereof, read in conjunction with MoP order dt. 28.07.2020 & their latest amendments thereof.

1.2.3 Any bidder from a country which shares a land border with India will be eligible to bid only if bidder is registered with a competent authority and the registration should be valid at the time of submission of bid and at the time of acceptance of bid as per Ministry of Finance order no-F.No.6/18/2019-PPD dt. 23.07.2020 and their latest amendment thereof.

2.0 QUALIFYING REQUIREMENTS OF BIDDERS

2.1 The Qualifying Requirements for the Bidders are given in **Annexure-A (BDS)** to this Volume-I of the Bidding Documents.

2.2 The above stated requirements are a minimum and the Owner reserves the right to request for any additional information and also reserves the right to reject the Proposal of any Bidder, if in the opinion of the Owner, the qualification data is incomplete or the Bidder is found not qualified to satisfactorily perform the contract.

3.0 COST OF BIDDING

3.1 The bidder shall bear all costs and expenses associated with preparation and submission of its bid including post-bid discussion, technical and other presentations etc., and the Owner will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

B. THE BIDDING DOCUMENTS

4.0 CONTENTS OF BIDDING DOCUMENT

4.1 The goods and services required, bidding procedures and Contract terms are prescribed in the Bidding Document.
In addition to the Invitation For Bids, the Bidding Document is a compilation of the following sections:

Volume - I: Conditions of Contract

i)	Section-I	Invitation For Bid (IFB)
ii)	Section-II	Instructions to Bidders (ITB)
iii)	Section-III	Bid Data Sheets (BDS)
iv)	Section-IV	Conditions of Contract (CC)
v)	Section-V	Special Conditions of Contract (SCC)
vi)	Section-VI	Forms and Procedures (F&P)

Volume -II: Technical Specification

Volume -III: Bid Form, Attachments, GTP and Price schedules

Section I	Bid Form
Section II	Attachments
Section III	Guaranteed Technical Particulars (GTP)
Section IV	Price Schedules

5.0 UNDERSTANDING OF BID DOCUMENTS

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

6.0 CLARIFICATIONS ON BID DOCUMENTS

6.1 A prospective Bidder finding discrepancies or omissions, in specifications and document or is in doubt as to the true meaning of any part; they shall at once make a request, in writing or by electronic media (hereinafter, the term cable is deemed to include Electronic Data Interchange (EDI) or telefax) at the Employer's mailing address indicated below interpretation/ clarification, to the Owner. The owner, then, will issue interpretation(s) and clarification(s) as he may think fit in writing. After receipt of such interpretation(s) and clarification(s), the Bidder may submit his bid but within the time and date as specified in the invitation for bid. All such interpretations and clarifications shall form a part of the biding document and shall accompany the Bidder's proposal. A prospective Bidder requiring any clarification on bidding document may notify the owner in writing. The Employer will respond in writing to any request for clarification or modification of the bidding documents that it receives within 15 days after appearing in the web site. Written copies of the owner's response (including an explanation of the query but without identifying its source) will be uploaded on the website as the part of bidding documents.

Address of Employer, telephone, facsimile numbers & E-mail address: ***(Refer BDS)***

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

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

6.4 The Bidder and any of its personnel or designated representative will be granted permission

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

6.5 The Bidder's designated representative(s) is/are invited to attend pre-bid meeting, which, if convened, will take place at the venue and time stipulated in the **BDS**.

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

Any modifications of the Bidding Documents which may become necessary as a result of the pre-bid conference shall be made by the Employer exclusively through an amendment pursuant to **IFB Clause 7.0** and not through the record notes of the pre-bid conference.

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

7.0 AMENDMENT TO BIDDING DOCUMENT

7.1 At any time prior to the deadline for submission of bids, the owner may, for any reason, whether as its own initiative or in response to a clarification requested by a prospective Bidder, modify the bidding document by amendment(s).

7.2 Each Amendment will be posted on owners as well as on Delhi Govt. website. The owner will not be responsible for checking the website by the bidder for the same in time or otherwise. It will be considered that the information contained therein will have been taken into account by the Bidder in its bid.

7.3 In order to afford prospective Bidders reasonable time in which to take the amendment into account in preparing their bids, the owner may, at its discretion, extend the deadline for the submission of bids.

7.4 Such amendments, clarification, etc, shall be binding on the Bidders and will be given due consideration by the Bidders while they submit their bids and invariably enclose such documents as a part of the bid.

C. PREPARATION OF BIDS

8.0 Language of Bid

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

9.0 LOCAL CONDITIONS

9.1 It will be imperative on each bidder to fully inform himself of all local conditions and factors which may have any effect on the execution of the contract covered under these documents and specification. The owner shall not entertain any request for clarifications from the Bidders, regarding such local conditions.

9.2 It must be understood and agreed that such factors have properly been investigated and considered while submitting the proposals. No claim for financial adjustment to the contract awarded under these specifications and documents will be entertained by the owner. Neither any change in the time schedule of the contract nor any financial adjustments arising thereof shall be permitted by the owner, which are based on the lack of such clear information or its effect on the cost of the Works to the Bidder.

10.0 DOCUMENTS COMPRISING THE BID

10.1 The bidder shall complete the Bid form inclusive of Price Schedules, Technical Data requirements etc. furnished in the Bidding Documents, indicating for the goods to be supplied and services to be rendered, a brief description of goods and services, quantity and prices.

10.2 The bidder shall also submit documentary evidence to establish that the Bidder meets the Qualification Requirements (QR) as detailed in Bid data sheets **(BDS)**

10.3 The Bid Security shall be furnished in a separate cover in accordance with clause 23.0 of Section ITB.

Each Bidder shall submit with its bid the following Attachments:

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

A bid security furnished in accordance with ITB Clause 23.

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

A power of attorney, duly authorized by a Notary Public, indicating that the person(s) signing the bid has the authority to sign the bid and thus that the bid is binding upon the Bidder during the full period of its validity in accordance with ITB Clause 24 .

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

In the absence of prequalification, documentary evidence that the Bidder is eligible to bid in accordance with ITB Clause 1.2 and is qualified to perform the contract if its bid is accepted.

The documentary evidence of the Bidder's qualifications to perform the contract, if its bid is accepted, shall establish to the Employer's satisfaction that the Bidder has the financial, technical, production, procurement, shipping, installation and other capabilities necessary to perform the contract, and, in particular, meets the experience and other criteria outlined in the Qualification requirements and ITB.

Qualification requirements for bidders are enclosed as Annexure-A, **Section BDS.**

(d) **Attachment 4: Subcontractors Proposed by the Bidder**

The Bidder shall include in its bid details of all major items of supply or services, that it

proposes to purchase and shall give details of the name and nationality of the proposed Subcontractor, including vendors, for each of those items. Bidders are free to list more than one Subcontractor against each item of the facilities. Quoted rates and prices will be deemed to apply to whichever Subcontractor is appointed, and no adjustment of the rates and prices will be permitted.

Vendors hired by the erector or the manufacturer or the lead player, shall be selected on considerations of quality and economy and DTL reserves the right to seek information in relation to any such vendor proposed to be hired by the erector or manufacturer or lead player. Subletting of either whole or part of the contract by the contractor, hired by DTL shall not be permissible.

The Employer reserves the right to delete any proposed Subcontractor from the list prior to award of contract, and after discussion between the Employer and the Contractor, attachment-4 to the form of Contract Agreement shall be completed, listing the approved Subcontractors for each item.

(e) **Attachment 5: Commercial Deviations**

In order to facilitate evaluation of bids, deviations, if any, from the Terms & Conditions Commercial Deviations Specifications shall be listed in Attachment 5 for Techno commercial Bid.

(f) **Attachment 6: Deviation on Important condition.**

In order to facilitate evaluation of bids, deviations on Important Condition shall be listed in Attachment 6 for important condition of Bid.

(g) **Attachment 7: Technical Deviation.**

In order to facilitate evaluation of bids, deviations, if any on technical specifications shall be listed in Attachment 7 for Techno commercial Bid.

(h) **Attachment 8: Additional Information**

In order to facilitate evaluation of bids, if any additional Information on technical/commercial specifications shall be listed in Attachment 8 for Techno commercial Bid.

(i) **Attachment 9: Bought-out & Sub-Contracted Item**

(j) **Attachment 10: Work Completion Attachment**

(k) **Attachment 11: List of Special Tools & Tackles**

(l) **Attachment 12: Information regarding ex-employees of Employer in Bidder's firm.**

(m) **Attachment 13: Deleted.**

(n**)** **Attachment 14: Price Adjustment Data**

(o) **Attachment 15: Guarantee Declaration**

(p) **Attachment 16: Integrity Pact**

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 format for Integrity Pact shall be as per Attachment 16.

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

Integrity Pact must be submitted in physical form at the address given at ITB 25.0 at or before the schedule time and date of opening of Techno-commercial part of the bid.

Bidder's failure to submit the Integrity Pact duly signed in Original alongwith the Bid or subsequently pursuant to ITB Sub-Clause 27.6 shall lead to outright rejection of the Bid.

(q) **Attachment 17: Deleted**

(r) **Attachment 18: Checklist**
(Bidder shall submit the information regarding documents submitted by them in the offer as per the checklist provided in Attachment)

(s) **Attachment 19:** Affidavit of Self certification regarding Local Content in line with PPP-MII order (submission of Hard Copy in 'Original'), to be submitted on a non-judicial stamp paper of Rs. 100/-.

In line with the as per PPP-MII order dt. 04.06.2020 & their latest amendments thereof, 'Class-I local supplier' shall be required to indicate percentage of local content and submit self-certification, in original, certifying that the item offered meets the local content requirement for 'Class-I local supplier'. They shall also give details of the location(s) at which the local value addition is made, as prescribed in the PPP-MII Order dt. 04.06.2020 & their latest amendments thereof, on a non-judicial stamp paper of Rs. 100/-.

Any False declarations will be in breach of the Code of Integrity under Rule 175(1)(i)(h) of the General Financial Rules for which a bidder or its successors can be debarred for up to two years as per Rule 151(iii) of the General Financial Rules along with such other actions as may be permissible under law.

(t) **Attachment 20:** Certificate from statutory auditor or cost auditor of the company(in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of Local Content in line with PPP-MII order dt. 04.06.2020 & their latest amendments thereof, (submission of Hard Copy in 'Original') to be submitted on the letter head of the auditor/cost accountant/chartered accountant.

In line with the PPP-MII order dt. 04.06.2020 & their latest amendments thereof, the 'Class-I local supplier' shall submit certificate on the letter head of the auditor/cost accountant/chartered accountant from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of local content.

Any False declarations will be in breach of the Code of Integrity under Rule 175(1)(i)(h) of the General Financial Rules for which a bidder or its successors can be debarred for up to two years as per Rule 151(iii) of the General Financial Rules along with such other actions as may be permissible under law.

(u) Attachment 21: Undertaking for not indulging in Corrupt & Fraudulent practice

It shall be the sole responsibility of bidder to provide the information based on the documents submitted by them.

(v) Attachment 22: Certificate regarding compliance of Ministry of Finance order no-F.No.6/18/2019-PPD dt. 23.07.2020.

Any false certificate given by a bidder whose bid is accepted will let to immediate termination and further legal action in accordance with law.

11.0 SCOPE OF THE PROPOSAL

11.1 The scope of the work covered under this package shall be on the basis of a single Bidder's responsibility, completely covering all the equipment specified under the section Project, Volume-II. It will include the following: -

a. Complete manufacture including shop testing.
b. Providing Engineering drawing, data, operational manual, etc for the Owner's approval.
c. Packing and transportation from the manufacturer's works to the site.
d. Receipt, storage, preservation and conservation of equipment at the site.
e. Pre-assembly, if any, erection, testing and commissioning of all equipment.
f. Reliability tests and performance and guarantee tests on completion of commissioning and
g. Furnishing of spares, if applicable.

The complete scope of work is defined in section project, Volume-II of this tender document.

11.2 Bids containing deviations from critical provisions relating to (i) to (xi) below will be considered as non responsive:

(i) Governing Laws, Clause 5, CC
(ii) Settlement of Disputes, Clause 6, CC
(iii) Taxes and Duties, Clause 14, CC
(iv) Appendix 2 to the Form of Contract Agreement (Price Adjustment): Clause No. 15 ITB
(v) Bid Security: Clause 23.0, Section ITB Volume-I, conditions of contract
(vi) Contract Performance Guarantee: Clause 43.0, Section ITB, Volume-I, Conditions of Contract.
(vii) Liquidated Damages & (Functional Guarantee): Clause 28 & 28.5 CC
(viii) Defect Liability: Clause No. 27 CC
(ix) Price Basis and Payment: Clause No.12 CC and Clause 14 Section ITB
(x) Completion Time : Section F&P Appendix-4
(xi) Patent Indemnity, Clause No.29, CC

However, the Bidders, wishing to propose deviations to any of the above provisions, must provide in the Commercial Deviations Attachment of Bid Form in their bid alongwith the cost of withdrawal of such deviations. If the deviation to any of these provisions is not priced, the bid will be rejected. The evaluated cost of the bid shall include, in addition to the cost

described in Price schedule, the cost of withdrawal of the deviations from the above provisions to make the bid fully compliant with these provisions.

Bidders are also required to quote the price for Commercial, contractual and Technical obligations outlined in the bidding document. If a Bidder wishes to make a deviation, such deviation shall be listed in deviation Attachment of Volume-III. The Bidder shall also provide additional price, if any, for withdrawal of the deviations. If the deviation to any of these provisions is not priced, the bid will be rejected.

At the time of Award of Contract, if so desired by the owner, the Bidder shall withdraw these deviations listed in commercial deviation Attachment of Bid Form in their Bid at the cost of withdrawal stated by him in the bid. In case the Bidder does not withdraw the deviations proposed by him, if any, at the cost of withdrawal stated by him in the bid, his bid will be rejected and his bid security forfeited.

The owner's determination of a bid's responsiveness is to be based on the contents of the bid itself without recourse to extrinsic evidence.

11.3 Bids not covering the above entire scope of works may be treated as incomplete and hence rejected.

12.0 BID PRICE

12.1 The Bidder shall quote in the appropriate Attachment of Bid form lump-sum price for the entire scope of works (covered under the Bidding document) and also the unit rates of the goods and services

12.2 The Bid price under the contract shall be on a firm price basis, unless otherwise specified in the conditions of contract.

12.3 The Bidder shall also furnish the price break-up in the appropriate Attachments of bid form to indicate the following:

i. Ex-works price of the equipment/materials (including tools and tackles etc.)
ii. Charges for transportation and insurance for delivery of the equipment/ materials up to their final destinations.
iii. Lump-sum charges towards unloading, storage, insurance, erection, testing & commissioning, exclusive of taxes and duties as per GST.
iv. Price break-up for spares, if applicable, in line with clause 17.0 of this section.
v. Taxes and duties and any other levies legally payable on the transactions between the owner and the Bidder.
vi. Any other charges as per the requirement of conditions of contract/Technical specifications.

12.4 Bidder can effect reductions in the prices already filled up in Price Schedules by way of discounts. Bidder can offer the discount either on lump sum basis or percent basis, which can be made applicable either on the total price or one or more of the price schedule(s).

The Bidder may note that in case they chooses to offer multiple discounts, all discounts shall be applicable simultaneously on the base prices of respective items on which the bidder has offered the discount(s) i.e., all the discounts shall be considered together on the Quoted Prices of such items (as quoted by the bidder without discount).

12.5 Examination of the bid shall be in accordance to Clause 34 of Section ITB.

13.0 ALTERNATE PROPOSALS

13.1 Based on their experience, capabilities, patented research, and development works etc., the bidder may, in addition to a base proposal, offer alternate proposal(s), for reasons of economy or better performance. But in all such cases, the base proposal shall be strictly in line with the requirements as stipulated in the bidding documents and only such base proposal shall be considered for the purposes of evaluation of the proposals. Should the bid by the successful bidder contain such alternate proposal then the owner at its discretion may accept the same at the time of award of contract.

14.0 PRICE BASIS AND PAYMENTS

14.1 The bidders shall quote in their proposals lump-sum price for the entire scope of works covered under section Project, Volume-II as required in the Bid Forms on a firm price basis unless otherwise specified in the Conditions of Contract. Bidders quoting a system of pricing other than that specified run the risk of rejection.

14.2 Bidder shall indicate bid prices in Indian Rupees only.

15.0 PRICE ADJUSTMENT: Refer BDS

16.0 TIME SCHEDULE

16.1 The basic consideration and the essence of the contract shall be strict adherence to the time schedule for performing the specified works.

16.2 The Owner's requirements of completion schedule for the works are mentioned in the accompanying conditions of contract.

16.3 The completion schedule as stated in the Conditions of Contract shall be one of the major factors in consideration of the bids.

16.4 The Owner reserves the right to request for a change in the work schedule during pre-award discussions with successful Bidder.

16.5 The Successful Bidder will be required to prepare detailed PERT network and finalize the same with the Owner as per the requirement of Clause 18.0, Section CC, Vol-I.

17.0 SPARE PARTS

17.1 In case where it is mandatory for the bidders to quote for certain identified spare parts, the same are included in the accompanying Technical Specifications. In such cases the item wise price breakdown of such spares on an Ex-works basis shall be indicated in the bid. The Bidder shall further indicate item wise price break-up on FOR site basis. In respect of Taxes, the provisions of Clause 14.0 CC shall be applicable. The above prices shall not be included in the lump-sum price but indicated separately in the Attachments and shall not be subject to escalation. The prices quoted for these spares will be taken into account for evaluation. The owner, however, reserves the right to vary the quantity of any of the spare and/or to delete any items of spares altogether or add new items of spares during award/detailed engineering stage limited to a period of six (6) months from date of contract unless such period is specified

otherwise in conditions of contract at the unit rate agreed to in the contract or to be agreed mutually in case unit rates are not identified in the Bid/Contract.

17.2 In addition the Bidder shall provide in the form of Attachment given in Bid Forms, the complete list of recommended spare parts for three (3) years operation of the equipment covered under the Proposal. In the list of recommended spare parts, the bidder shall identify the unit-wise population of each of the items recommended and anticipated normal life of the spare. Such list will also indicate the prices on FOR destination site basis for each item. No other basis of prices will be quoted. The prices of these spare parts shall be on firm price basis and shall remain valid till 120 days after the date on which the validity of the main bid expires. The prices of the spare parts thus quoted shall not be taken into consideration for the purpose of evaluation. Other relevant terms and conditions of these documents shall also be applicable to such spare parts.

17.3 Spare parts list will be used by the owner to decide about the spares to be procured against his spares requirement for equipment quoted. The quantities of the spares to be procured shall be decided by the owner and the Bidder shall furnish all those spares ordered.

17.4 In case where no mandatory spares are indicated, the Bidder shall comply with the requirement indicated in Clause 17.2 through 17.3 above.

18.0 CONTRACT QUALITY ASSURANCE

18.1 The Bidder shall include in his Proposal the Quality Assurance Programme containing the overall quality management and procedures, which he proposes to follow in the performance of the works during various phases as detailed in relevant clause of the General Technical Conditions.

18.2 At the time of Award of Contract, the detailed Quality Assurance Programme to be followed for the execution of the contract will be mutually discussed and agreed to and such agreed Programme shall form a part of the Contract.

19.0 INSURANCE

19.1 The Bidder's insurance liabilities pertaining to the scope of works are detailed out in Clauses titled 'Insurance' in Conditions of Contract (CC) of this Volume- I. Bidder's attention is specifically invited to these clauses. Bid price shall include all the cost in pursuance of fulfilling all the insurance liabilities under the Contract.

20.0 MAINTENANCE TOOLS AND TACKLES

The Proposal shall include all special tools and tackles required for the operation and maintenance of the equipment in each equipment package. The Bidder shall indicate all the above items in the Proposal sheets in the form of an Attachment given there in and the description and the quantity of each item. The lump sum price to be quoted by the Bidder shall include prices of these tools and tackles. These tools and tackles shall be delivered at site along with the last consignment of equipment and in no case earlier than this, unless otherwise specified in the Conditions of Contract and /or Technical Specifications, Volume-II.

21.0 ERECTION TOOLS & TACKLES

The Bidder, under a separate Attachment, in his Proposal shall include a list of all special equipment, tools & tackles etc. which he proposes to bring to site for the purpose of erection, handling, testing and commissioning including performance & guarantee tests of the

equipment. If any such equipment is listed anywhere else in the Proposal and not specially mentioned in the above Attachment, it shall be deemed to have been included in the Bidder's proposed scope of supply.

22.0 BRAND NAMES

22.1 The specific reference in these specifications and documents to any Material / Equipment by brand name, make or catalogue number shall be construed as establishing standards of quality and performance and not as limiting competition. However, Bidders may offer other similar material/equipment provided they meet the specified standard, design and performance requirements. The Bidder shall furnish adequate technical information about such alternative material/equipment to enable the owner to determine its acceptability. The Owner shall be the sole judge on the acceptability or other wise of such alternative material/equipment.

22.2 The Bidder shall note that standards for workmanship, material and equipment and reference to brand names or catalogue numbers designated by the Owner in its Technical Specifications are intended to be descriptive only and not restrictive. The Bidder may substitute alternative standards, brand name and/or catalogue numbers in its bid, provided that it demonstrates to the Owner's satisfaction that the substitutions are substantially equivalent or superior to those designed in the Technical Specifications.

23.0 BID SECURITY

23.1 The Bidder shall furnish, as part of its bid, Bid Security for an amount as specified in the **BDS** Bid security shall be valid for 60 days beyond validity of the bid.

23.2 The Bid Security is required to protect the Owner against the risk of Bidder's conduct, which would warrant the guarantee forfeiture, pursuant to Clause 23.7 The Bid Security shall be made payable to the Owner without any condition whatsoever.

23.3 The Bid Security shall be denominated in Indian Rupees only and shall be in one of the following forms:

(a) DD/Pay Order/FD receipt in favour of Delhi Transco Limited, New Delhi, payable at New Delhi, from a Scheduled Commercial Bank.

(b) E-payment from the account of the bidder. The detail of DTL's Bank account is as under:

Name	**Delhi Transco Ltd.**
Name of Bank with Address	**SBI, Chandni Chowk Delhi.**
Current Account No.	**10820056547**
Codes	**RTGS/IFSC No : SBIN0000631** **MICR No : 110002018**

(c) An irrevocable Bank Guarantee issued by a Scheduled Commercial Bank in favour of Delhi Transco Limited, New Delhi & BG (Bank Guarantee) should be valid for minimum **240** days from date of opening of tender. Performa for the Bank Guarantee is enclosed as Annexure-I, Section Forms & Procedure to this Volume-I.

23.4 Any bid not secured in accordance with paras 23.1 and 23.3 above will be rejected by the Owner as non-responsive.

23.5 EMD/Bid Security may be returned to bidders (except-1 bidder), after opening of price bids and recommendation of TEC deciding L-1 bidder for award /negotiation.

23.6 The successful Bidder's Bid Security will be discharged /returned upon the Bidder's executing the Contract and furnishing the Performance Security/ Guarantee pursuant to Clause 43.0 of ITB. The amount of Bid Security in whole or any part thereof is liable to be forfeited due to its non submission of performance security/guarantee or non-execution of contract.

23.7 The Bid Security may be forfeited:

a) If a Bidder withdraws/modifies his bid after opening during the period of bid validity specified by the Bidder on the Bid Form;

or

In case the Bidder does not withdraw the deviations proposed by him, if any, even after considering the cost of withdrawal stated by him in the bid;

or

If a Bidder does not accept the corrections to its bid price pursuant to Clause 35.0, A and B, Section-ITB;

or

If, as per the Qualifying Requirements the Bidder has to submit a Deed of Joint Undertaking (if any) and bidder 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 pre-award discussion.

b) In case of a successful Bidder, if the Bidder fails within the specified time limit,

(i) to sign the Contract, in accordance with NIT.

or

(ii) to furnish the Performance Security/ Guarantee, in accordance with NIT.

23.8 The Scanned copy of Bid Security is to be submitted with online bid, however, the Bid Security shall be submitted in separate sealed envelope in one original and one copy in the office of **DGM (T) CBP [***Address of Employer, telephone, facsimile numbers & E-mail address:* ***(Refer BDS)*** *]* at least one and half hour before the time of bid opening. Any bid not accompanied by the required bid security in accordance with provisions of this clause will be rejected by the Owner and bid shall not be opened.

23.9 No interest shall be payable by the Owner on the above Bid Security.

23.10 Bid security is required from all the bidders except Startups, Micro and Small Enterprises (MSEs)/NSIC registered firms as notified by Department of Micro, Small and Medium Enterprises (MSME) and OEM/OES from Govt. organization/PSU.

24.0 PERIOD OF VALIDITY OF BIDS

24.1 Bids shall remain valid for 180 days after the date of bid opening prescribed by the Owner unless otherwise specified in the accompanying Conditions of Contract. A bid valid for a shorter period will be rejected by the Owner as non-responsive.

24.2 In exceptional circumstances e.g. expiry of bid validity, the Owner may solicit the Bidder's consent to an extension of the period of validity of the bid on same terms and conditions

otherwise their bid shall not be considered. The request and the response thereto shall be made in writing (including cable or telex). The bid security provided under Clause 23.0 shall also be extended by the same period as the extension in the validity of the Bid. A bidder may refuse the request without forfeiting his bid security. A Bidder granting the request will not be required or permitted to modify its bid.

D. FORMAT OF BID

25.0 The on line offer complete in all respects will be submitted at e- procurement portal of Delhi Govt. website i.e. http://govtprocurement.delhi.gov.in**.** In addition to submission of scanned copies of mandatory documents through e-procurement portal, the bidder shall also submit (02) Two copies of the bid in Book Binded form, clearly marking each "Original Bid" and "Copy of bid" including, the signed hard copies of all relevant pre-qualification documents being submitted in support of Bid (all Forms, Annexures etc. Experience certificate and supporting documents copies, type test reports, Guaranteed Technical Particulars, any other documents required as per the bidding document, etc.) and un priced schedule at least one and half hour before the time of bid opening in the office of **DGM (T) CBP [*Address of Employer, telephone, facsimile numbers & E-mail address: (Refer BDS)]*.** In the event of any discrepancy between original and copy of the hard bid, the original shall govern. Also in the event of any discrepancy between online bidding documents and the hard copy of the bid, the online bid shall govern. **The Price Bid (Part-II) shall not be submitted in hard copy and shall only be uploaded on e-portal of Delhi Govt. website.**

25.1 The original and copy of the bid shall be typed or written in indelible ink and shall be signed by the Bidder or a person or persons duly authorized to bind the Bidder to the Contract. The letter of authorization shall be indicated by written Power-of-Attorney accompanying the bid. All pages of the bid, except for un-amended printed literature, shall be initialed by the person or persons signing the bid.

All document comprising Power of Attorney, Joint Deed of Undertaking (as applicable), Affidavit of self-certification regarding Minimum Local Content under PPP-MII order dt. 04.06.2020 & their latest amendments thereof, read in conjunction with MoP Order dt. 28.07.2020 & their latest amendments thereof, Certificate from statutory auditor/cost auditor/cost accountant/chartered accountant, giving the percentage of Local Content, under PPP-MII orders and MoP Orders, if applicable in separate envelop shall be submitted.

25.2 The Bidders must submit the qualifying data in (02) two copies, as required in this Instruction to Bidders in a separate envelope sealed and enclosed in the envelope submitting Proposals, super scribed as under:

QUALIFYING DATA FOR : BID TITLE (Refer BDS)

25.3 The bid shall contain no interlineations, erasures or overwriting except as necessary to correct errors made by the Bidder, in which case such corrections shall be initialed by the persons or persons signing the bid.

25.4 Documents to be uploaded on e-procurement portal of Delhi Government while bidding:

The following scanned copies of documents are required to be uploaded:

a) Bid Security
b) GST Registration No.
c) PAN and TIN No.
d) EPF Registration No.

e) Registration Certificate of the Company issued from the Competent Authority.
f) Details of technical experience along with performance certificates as per NIT.
g) Financial details as per NIT
h) Bid form, attachments and annexure's as per NIT
i) Price bid (Only Online)
j) Other documents as per NIT

26.0 SIGNATURE OF BIDS

26.1 The bid must contain the name, residence and place of business of the person or persons making the bid and must be signed and sealed by the Bidder with his usual signature. The names of all persons signing should also be typed or printed below the signature.

26.2 Bid by a partnership must be furnished with full names of all partners and be signed with the partnership name, followed by the signature(s) and designation(s) of the authorized partner(s) or other authorized representative(s).

26.3 Bids by Corporation/Company must be signed with the legal name of the Corporation/company by the President, Managing Director or by the Secretary or other person or persons authorized to bid on behalf of such Corporation/Company in the matter.

26.4 A bid by a person who affixes to his signature the word 'President' Managing Director', 'Secretary', 'Agent' or other designation without disclosing his principal will be rejected.

26.5 Satisfactory evidence of authority of the person signing on behalf of the Bidder shall be furnished with the bid.

26.6 The Bidder's name stated on the Proposal shall be exact legal name of the firm.

26.7 Bids not conforming to the above requirements of signing may be disqualified.

27.0 SEALING AND MARKING OF BIDS

27.1 The Bidders shall seal the original and each copy of the bid in an inner and an outer envelope, duly marking the envelopes as "Original" and "Copy".

27.2 The inner and outer envelopes shall be:

a). Addressed to the Owner at the following address:
Address of Employer, telephone, facsimile numbers & E-mail address: ***(Refer BDS)***

b). bear the name of package, the specification number, Details of Bid Guarantee, Validity of Bid, Name of the Bidder with address and the words "**DO NOT OPEN BEFORE date and time of opening as mentioned in web notification** , to be completed with the time and date specified in the Invitation for Bid, pursuant to ITB Sub-Clause 27.2.Other Annexure's/ Performa's / Attachments shall be enclosed in envelope on which above contents shall be super scribed. **The Price Bid (Part-II) shall not be submitted in hard copy, and shall be submitted online only however un priced schedules shall be submitted along with techno commercial bid Part I.**

27.3 The inner envelope shall indicate the name and address of the Bidder to enable the bid to be returned unopened in case it is declared "late" or "rejected".

27.4 If the outer envelope is not sealed and marked as required by para 27.2 above, the Owner will assume no responsibility for the bid's misplacement or premature opening or its secrecy, but this disclosure will not constitute grounds for bid rejection.

27.5 The Bid Security **(separate for each Package)** must be submitted in a separate sealed envelope on which the contents shall be super scribed.

27.6 The Bidder shall submit the sealed bids in Two Part System i.e. PART-I **(TECHNO-COMMERCIAL BID- ONLINE AND IN HARD COPY)** and PART-II **(PRICE BID-ONLINE ONLY) (separate for each Package)**. The Integrity Pact shall be submitted in two (2) originals in separate sealed envelope alongwith bid having marking as "Integrity Pact" **(separate for each Package)**. The separate envelopes containing original & copy of PART-I (TECHNO-COMMERCIAL BID)", and BID SECURITY and Integrity Pact shall then be sealed in an outer envelope.

PART-I (TECHNO-COMMERCIAL BID) - All supporting documents, Attachments, Annexures, Performa, Un-priced Schedules, Bid Form (un-priced) and Bid document **except price bid**.

PART-II (PRICE BID) - Price Schedules & Bid Form only. **(ONLINE ONLY) (separate for each Package).**

28.0 DEADLINE FOR SUBMISSION OF BIDS

28.1 The Bidders are required to submit the bid through e-procurement portal of Delhi Govt. website **i.e. http://govtprocurement.delhi.gov.in** not later than the time & date mentioned in the Invitation for Bid. In addition to submission of scanned copies of mandatory documents through e-procurement portal, the bidder shall also submit (02) Two copies of the bid in Book Binded form, clearly marking each "Original Bid" and "Copy of bid" including, the signed hard copies of all relevant pre-qualification documents being submitted in support of Bid (all Forms, Annexures etc. Experience certificate, supporting documents copies, type test reports, Guaranteed Technical Particulars and any other documents required as per the bidding document, etc.) atleast one and half hour before the time of bid opening in the office of **DGM (T) CBP [*Address of Employer, telephone, facsimile numbers & E-mail address: (Refer BDS)]***. In the event of any discrepancy between original and copy of the hard bid, the original shall govern. Also in the event of any discrepancy between online bidding documents and the hard copy of the bid, the online bid shall govern. **The Price Bid (Part-II) shall not be submitted in hard copy and shall only be uploaded on e-portal of Delhi Govt. website.** Bidders have the option of sending the hard copy of the bid by registered post or submitting the bid in person. Bids submitted by telex/telegram will not be accepted. No request from any Bidder to the Owner to collect the Proposals from airlines, cargo agents etc. shall be entertained by the Owner.

28.2 Hard Copy of the bids must be received by the Owner at the address specified under para 27.2, not later than the time & date mentioned in the Invitation for Bid. In the event of the specified date for submission of Bids, being declared a holiday for the Owner, the Bid will be received upto the appointed time on the next working day.

28.3 The Owner may, at its discretion, extend this deadline for the submission of bids by amending the Bidding Documents, in which case all rights and obligations of the Owner and Bidders previously subject to the deadline will thereafter be subject to the deadline as extended.

29.0 LATE BIDS

29.1 Any bid received by the Owner after the time & date fixed or extended for submission of bids prescribed by the Owner, will be rejected and/or returned unopened to the Bidder.

30.0 MODIFICATION AND WITHDRAWAL OF BIDS

30.1 The Bidder may modify or withdraw its bid after the bid's submission provided that written notice of the modification or withdrawal is received by the Owner prior to the deadline prescribed for submission of bids.

30.2 The Bidder's modification or withdrawal notice shall be sent by fax/e-mail but it should be followed by a signed confirmation copy by post and such signed confirmation should reach the owner/ purchaser not later than the bid submission date and the modified bid prepared, sealed, marked and dispatched in accordance with the provisions of Clause 27.0 clearly identified as such, in two inner envelopes duly marked "Bid Modifications-Original" and "Bid Modifications-Copies." The inner envelopes shall be sealed in an outer envelope, which shall be duly marked "Bid Modifications." The Bidder shall submit one (1) no. original and one (1) no. copy of the same.

Other provisions concerning the marking and dispatch of bid modifications shall be in accordance with ITB Sub-Clauses 27.2, 27.3 and 27.4.

30.3 No bid may be modified or withdrawn after the deadline for submission of bids. Withdrawal of a bid after the deadline for submission of bids will result in forfeiture of bidder's bid security.

30.4 Notice of withdrawal shall

a) be addressed to the Owner named in Clause. No. 27.2(a) of ITB.

b) bear the name of the package, tender/ specification number, and the words " Bid Withdrawal Notice"

Bid withdrawal notices received after the bid submission deadline will be ignored, and the submitted bid will be deemed to be a validly submitted bid.

31.0 INFORMATION REQUIRED WITH THE PROPOSAL

31.1 The bids must clearly indicate the name of the manufacturer, the type of model of each principal item of equipment proposed to be furnished and erected. The bid should also contain drawings and descriptive materials indicating general dimensions, materials from which the parts are manufactured, principles of operation, the extent of pre-assembly involved, major construction equipment proposed to be deployed, method of erection and the proposed erection organizational structure.

31.2 The above information shall be provided by the Bidder in the form of separate sheets, drawings, catalogues, etc. in (02) two copies.

31.3 Any bid not containing sufficient descriptive material to describe accurately the equipment proposed may be treated as incomplete and hence rejected. Such descriptive materials and drawings submitted by the Bidder will be retained by the Owner. Any major departure from these drawings and descriptive material submitted will not be permitted during the execution of the Contract without specific written permission of the Owner.

31.4 Oral statements made by the Bidder at any time regarding quality, quantity or arrangement of the equipment or any other matter will not be considered.

31.5 Standard catalogue pages and other documents of the Bidder may be used in the bid to provide additional information and data as deemed necessary by the Bidder.

31.6 The Bidder, along with his Proposal, shall submit a list of recommended erection equipment and materials which will be required for the purpose of erection of equipment and materials supplied under the Contract.

31.7 In case the 'Proposal' information contradicts specification requirements, the specification requirements will govern, unless otherwise brought out clearly in the Technical Commercial Deviations Attachment.

E. BID OPENING AND EVALUATION

32.0 OPENING OF BIDS BY OWNER

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

In first stage, the Owner will open the Part-I (Techno Commercial Bid) bids in the presence of Bidders' representatives (up to 2 persons) who choose to attend at the date and time for opening of bids in the Invitation to Bid or in case any extension has been given thereto, on the extended bid opening date and time notified to all the Bidders. The Bidders' representatives who are present shall sign in a register as well as proforma evidencing their attendance.

Bid Security will be checked and in case Bid Security is not found of required amount or not in acceptable mode, the offer of that particular bidder shall be considered invalid.

On the due date of opening as notified, Bidders, whose Bid Security will be found in order only their Techno Commercial offer will be opened on the date of opening.

32.2 Envelopes marked **"WITHDRAWAL**" shall be opened first and the name of the Bidder shall be read out. Bids for which an acceptable notice of withdrawal has been submitted pursuant to ITB clause 30.0 shall not be opened.

32.3 The Bidders' names, bid prices, modifications, bid withdrawals and the presence or absence of the requisite Bid Security and such other details as the Owner, at its discretion, may consider appropriate will be announced at the opening. Subsequently, all envelopes marked **"MODIFICATION**" shall be opened and the submissions therein read out in appropriate detail. No bid shall be rejected at bid opening except for late bids pursuant to ITB Clause 30.0.
Any bid not accompanied by an acceptable Bid Security shall be rejected by the Owner as being non responsive, pursuant to ITB clause 34.4. The bid guarantee of a Joint Venture must be in the name of all partners in the Joint Venture submitting the bid.

32.4 No electronic recording devices will be permitted during bid opening.

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

32.6 After Tenders/Bids have been opened no alterations, shall be permitted either in the Tendered/Bid amount or in the specifications or schedule or any altering offer entertained unless and until specifically asked for.

33.0 CLARIFICATION OF BIDS

33.1 To assist in the examination, evaluation and comparison of bids the Owner may, at its discretion, ask the Bidder for a clarification of its bid. The request for clarification and the response shall be in writing and no change in the price or substance of the bid shall be sought, offered or permitted.

34.0 PRELIMINARY EXAMINATION

34.1 The Owner 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.

34.2 Prior to the detailed evaluation of PART-I (TECHNO-COMMERCIAL BID)", the Owner/Employer will determine whether each bid is of acceptable quality, is generally complete and is substantially responsive to the bidding documents. For purpose of this Clause, a substantially responsive bid is one, which conforms to all the terms and conditions of the Bidding Document without material deviations, objections, conditions 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 Owner's rights or the successful Bidder's obligations under the contract; or (iii) whose rectification would unfairly affect the competitive position of other Bidders who are presenting substantially responsive bids.

The qualified bidders, whose bids are techno-commercially responsive and, who are considered to have the capacity and capability to perform the Contract based on the assessment, if carried out, price bids shall be opened.

The PART-II (PRICE BID) of only those bidders whose **TECHNO-COMMERCIAL BID** are of acceptable quality shall be opened **ONLINE ONLY**, thereafter. However technically acceptable party shall be informed for the opening of the Price Bid (Part-II).

34.3 A bid determined as not substantially responsive will be rejected by the Owner and may not subsequently be made responsive by the Bidder by correction of the non- conformity. The Owner's determination of a bid's responsiveness is to be based on the contents & compliance of the complete provisions of Techno-Commercial bid itself without recourse to extrinsic evidence.

34.4 The Owner may waive any minor informality or non-conformity or irregularity in a bid, which does not constitute a material deviation, provided such waiver does not prejudice or affect the relative ranking of any Bidder.

35A Detailed Technical & Commercial Evaluation (Part-I)

35A.1 The Owner will carry out a detailed evaluation of the Techno-Commercial (Part-I) of offer to determine whether the Technical/Commercial aspects are in accordance with the requirements set forth in the bidding documents. In order to reach such a determination, the Owner will examine and compare the technical/commercial aspects of the bids on the basis of the information supplied by the bidders, taking into account the following factors:

(a) Overall completeness and compliance with the Techno-Commercial Specifications and Drawings; deviations from the Technical Specifications as identified in Attachment-7 to the bid; suitability of the facilities offered in relation to the environmental and climatic conditions prevailing at the site; and quality, function and operation of any process control concept included in the bid. The bid that does not meet minimum acceptable standards of completeness, consistency and detail will be rejected for non- responsiveness.

(b) Achievement of specified performance criteria by the facilities & Qualifying Requirements as provided in **Annexure-A of BDS**. The evaluation will also take into account the Bidder's financial, technical and production capabilities.

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

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

(e) The bidder has to quote the complete scope of work for one or all subject package(s) as stated in Section- Technical Specification, Vol.-II of the Bidding Documents. Bids covering partial scope of the work as specified in Technical Specification will be treated as incomplete and shall be rejected.

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

(g) The cost of withdrawal of deviations shall also be considered for the purpose of evaluation of Bid.

35A.2 When alternative technical proposal have been permitted and offered in Section-ITB to the bid, the Owner will make similar evaluation of the alternatives, which will be treated in the technical and commercial evaluations as if they were base bids. Where alternatives are not permitted, but have been offered in any event, they shall be ignored.

35B Evaluation of Price Bids (Part-II)

35B.1 The Owner will carry out a detailed evaluation of the Price Bids Part (Part-II) of the bidders found techno-commercially successful. The Bid evaluation of Package A, B & C shall be carried out package-wise. Multi-package rebate(s) offered, if any, shall also be considered in evaluation. Based on such evaluation, Award of Contract(s) would be made to one or more bidder(s) for one or all the package(s) on the basis of least evaluated cost to the Employer. The comparison will be in line with the bidding documents and on the basis of Lumpsum price for the entire scope of work under the package. Based on such evaluation, L1 bidder would be decided on the basis of least evaluated cost to the Employer.

The lump sum price shall include:

i) F.O.R. destination (site) price of equipment/materials, including mandatory spares and special tools & tackles (if any) under the package.

ii) Charges for erection, which shall include unloading, handling, storage, insurance, erection, testing & commissioning of the complete equipment/materials under the package and all associated civil works.

The Owner's comparison will also include the costs resulting from application of the evaluation procedures described in ITB Sub-Clause 35B.3.

DTL’s evaluation of a bid, in addition to the lump sum price as above will take into account the applicable taxes, duties & levies payable/reimbursable by the Employer as per provisions of Clause 14.0 of CC, Volume I.

Discount(s)/ rebate(s) offered by the bidder shall be indicated either on lumpsum basis or percent basis. Bidder shall also indicate in his bid, the price component on which the percentage discount is to be applied. In case the price component(s) on which the percentage discount is applicable is not indicated in the bid, then the discount will be adjusted in the total bid price [i.e. proportionately on each price component], **for arriving the price of L1 bidder**. However, if lumpsum discount is offered, the same shall be adjusted in full from the ex-works price component (by proportionately reducing ex-works price of individual items), **for arriving the price of L1 bidder**

35B.2 The Owner's evaluation of a bid will take into account, in addition to the bid prices indicated in Price Schedules, the following costs and factors that will be added to each Bidder's bid price in the evaluation using pricing information available to the Owner, in the manner and to the extent indicated in ITB Sub-Clause 35.B.3 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 Attachment-5 to 7 to the bid.

(b) compliance with the time Attachment called for in Attachment-10 of Bid price Attachment and evidenced as needed in a milestone Attachment provided in the bid.

(c) *Performance and Productivity of the equipments offered*

Bidder shall state the guaranteed performance or efficiency in response to Technical Specifications. Equipment offered shall have minimum performance specified in Technical Specifications to be considered responsive. Bids offering Equipments with a performance less that of specified may be rejected.

35B.3Pursuant to ITB Sub-Clause 35.B.2, 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 document. In arriving at the evaluated cost, the price of withdrawal of deviations shown in relevant Attachment of the bid, price and other Attachments, will be used. If the deviation to any of the provisions is not priced, the bid will be rejected.

At the time of award of contract, if so desired by the Owner, the bidder will withdraw the deviations listed in relevant deviation Attachments of bid in their bid at the cost of withdrawal stated by him in the bid. In case the bidder does not withdraw the deviations proposed by him in the bid, his bid will be rejected and his Bid Security will be forfeited.

(b) Time Attachment (Program of Performance)

The plant and equipment covered by this bidding are required to be shipped and installed, and the facilities shall have the pre-commissioning completed within the period named in the Bid after the effective date specified in the Contract Agreement. Bidders are required to base their prices on the Time Attachment given in Attachment -10 of Bid Form to the form of Contract Agreement (Time Attachment) or, where no time Attachment is given, on the completion date(s) given in the Bid. No credit will be given for earlier completion. Bid offering completion beyond the named period is liable to be rejected.

(c) If the vendor has quoted higher than the scheduled delivery period the bids will be treated as non-responsive.

Any adjustments in price that result from the above procedures shall be added, for purposes of comparative evaluation only, to arrive at an "Evaluated Bid Price." Bid prices quoted by Bidders shall remain unaltered.

a) Arithmetical/computational errors will be rectified on the following basis.

(i) If there is a discrepancy between the unit price and the total price, which is obtained by multiplying the unit price and quantity of item, or between sub-total and the total price, the unit or sub-total price shall prevail, and the total price shall be corrected.

(ii) Further, if there is a discrepancy between the quantity specified by DTL in the bidding document and the indicated by the bidder in his bid, the former shall be taken to arrive at the computed price.

(iii) In case the unit rate of an item is not quoted but the total price of the item is indicated, the same shall be taken to arrive at the computed price.

(iv) If there is a discrepancy between words and figures (of unit price or sub-total price if total price is not quoted), the amount in words will prevail (Not applicable in case of total quoted price, in that case arithmetically corrected computed price shall prevail).

b) Wherever, as per the bidding documents, any shortfall in the rating and performance requirement of equipment/material/systems attracts consideration of differential price factor and the value of differential loss for evaluation, the same shall be worked out as per the methodology given in the bidding documents, for adding the same to the computed price of the bidders.

c) The value of the differential loss will be added to the computed price of each bidder and the price quoted by the bidder for extra scope of work will be deducted, as discussed above, to arrive at the computed bid price.

d) The computed price arrived at, as above, shall be considered for the purpose of further evaluation as well as award.

If the bidder does not accept the methodology of correction as mentioned above, its bid will be rejected and the bid security will be forfeited in accordance with ITB Clause 23.7.

36.0 DEFINITIONS AND MEANINGS

36.1 For the purpose of evaluation and comparison of bids, the following meanings and definitions will apply.

a). **'Bid Price'** shall mean the base price quoted by each Bidder in his Proposal for the completed scope of works.

b). **'Differential Price'** shall mean the summation of the equalizing elements of price for parameter differential or deficiencies in the equipment and services determined from the Bidder's Proposal.

c) 'Cost Compensation for Deviations' shall mean the Rupee value of deviations, which shall be provided by the Bidder with proper justification in his Bid.

d). **'Evaluated Bid Price'** shall be the summation of 'Bid Price', 'Differential Price' and 'Cost Compensation for Deviations'.

36.2 Calculation of Differential Price & Cost Compensation for Deviations, if applicable:

36.2.1 The Differential Price (if applicable) to be added to the Bid Price of each during evaluation and comparison shall be derived as under:

Differential Price (DP) =n1 F1+n2F2…+nnFn where F1, F2…..Fn are the various factors in Indian Rupees per unit of parameter differential or deficiency in the equipment and services offered as stipulated in these specification; n1, n2…..nn are the respective parameter differential or deficiency in the corresponding units to be determined from the Bidder's Proposal. The above factors and corresponding units of parameter differential are brought out in the Technical Specifications and/or Conditions of Contract.

37.0 COMPARISON OF BIDS

37.1 Lump-sum price includes all taxes and levies covering both supply of material as well as erection, installation and commissioning. However, while submitting the invoices/bills/ running bills, for making payments, bifurcation between taxable amount and applicable taxes should be enumerated on each and every invoices/bills/running bills.

37.2 For comparison purposes all the evaluated bid prices shall be in Indian Rupees as under:-

W = M+DP+D

Where,

W = Total Comparison Price

M = Bid price in Indian Rupees (Ex-works value of equipment + Components of erection cost + mandatory spares, taxes and duties and other Components, if any).

DP = Differential price (if-applicable) in Indian Rupees calculated according to para 36.2.1

D = Cost compensation for deviations.

37.3 All evaluated bid prices of all the Bidders shall be compared among themselves to determine the lowest evaluated bid and, as a result of this comparison; the lowest bid **will be term as L1 bidder.**

38.0 Purchase preference, Contacting the employer & Award of Contract

38.1 Purchase Preference:

38.1.1 Deleted.

38.1.2 Deleted.

38.1.3 Verification of local content:

a. The 'Class-I local supplier' at the time of tender, bidding or solicitation in his bid in the given format, shall be required to indicate percentage of local content and provide self-certification that the item offered meets the local content requirement for 'Class-I local supplier' as the case may be. They shall also give details of the location(s) at which the local value addition is made. Further,

b. the 'Class-I local supplier' shall also be required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of local content.

38.1.4 Any False declarations will be in breach of the Code of Integrity under Rule 175(1)(i)(h) of the General Financial Rules for which a bidder or its successors can be debarred for up to two years as per Rule 151(iii) of the General Financial Rules along with such other actions as may be permissible under law.

38.1.5 A supplier who has been debarred by any procuring entity for violation of PPP-MII Order, dt. 04.06.2020 & their latest amendments thereof read in conjunction with MoP Order dt. 28.07.2020 & their latest amendments thereof (mentioned above) for procurement by any other procuring entity for the duration of the debarment. The debarment for such other procuring entities shall take effect prospectively from the date on which it comes to the notice of other procurement entities.

38.2 CONTACTING THE OWNER

Bid shall be deemed to be under consideration immediately after they are opened and until such time official intimation of award/rejection is made by the Owner to the Bidders. While the bids are under consideration, Bidders and/or their representatives or other interested parties are advised to refrain from contacting by any means, the Owner and/or his employees/representatives on matters related to the bids under consideration. The owner, if necessary, will obtain clarifications on the bids by requesting for such information from any or all the Bidders, either in writing or through personal contacts as may be necessary. Bidders will not be permitted to change the substance of the bids after the bids have been opened.

38.3 Award of Contract

38.3.1 Post-Qualification

Deleted

38.3.2 The Employer will determine to its satisfaction whether the Bidder selected as Techno-Commercially qualified & lowest bidders considered for award is qualified to satisfactorily perform the contract in terms of the qualifying requirements stipulated in the INB 1.2 and 2.0

38.3.3 The determination will take into account the Bidder's financial, technical and production capabilities, in particular its contract, work in hand, future commitments and current litigation. It will be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder in Attachment 3 to the bid, as well as such other information as the Employer deems necessary and appropriate.

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

39.0 AWARD CRITERIA

39.1 The Owner will award the Contract to the successful Bidders whose bids have been determined to be substantially responsive and lowest bidder considered for award provided further that the Bidders are determined to be qualified to perform the Contract satisfactorily. The owner shall be the sole judge in this regard.

39.2 The Employer may request the Bidder to withdraw any of the deviations listed in Attachment 05 to 07 of the winning bid, at the price shown for the deviation in Attachment 05 to 07 to the bid. Bidder would be required to comply with all other requirements of the Bidding Documents except for those deviations which are accepted by the Employer.

39.3 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.

39.4 The mode of contracting with the successful bidder will be as briefly indicated below:
In the case of successful Bidder, the award shall be made as follows:

(i) First Contract: Supply of equipment and materials on the ex-works basis.

(ii) Second Contract: Transportation, storage, insurance, erection, testing and commissioning etc. of equipment/ materials in respect of all the equipments supplied under the "First Contract" and any other services specified in the Contract Documents.

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

40.0 OWNER'S RIGHT TO ACCEPT ANY BID AND TO REJECT ANY OR ALL BIDS

40.1 The Owner 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 Owner's action. DELHI TRANSCO LIMITED reserves the right to waive minor deviations if they do not materially affect the capability of the Bidder to perform the contract.

41.0 NOTIFICATION OF AWARD

41.1 Prior to the expiration of the period of bid validity and extended validity period, if any, the Owner will notify the successful Bidder in writing by registered letter or by cable or telex or fax or e-mail, that its bid has been accepted which shall be confirmed in writing by bidder. However if confirmation is not received from the bidder the notification shall be deemed to have been accepted by the bidder after expiry of the period mentioned in the notification.

41.2 The notification of award will constitute the formation of the Contract.

41.3 Upon the successful Bidder's furnishing of Contract performance Guarantee **(CPG)** pursuant to Clause 43.0 the Owner will promptly notify each unsuccessful Bidder and will discharge its bid security, pursuant to Clause 23.0.

42.0 **SIGNING OF CONTRACT**

42.1 At the same time as the Owner notifies the successful Bidder that its bid has been accepted, the Owner will send the Bidder the detailed Notification of Award, incorporating all agreements between the parties.

42.2 Within seven (07) days of receipt of the detailed Notification of Award, the successful bidder shall sign and date the same and return it to the Owner, failing which all the terms & conditions of the Notification of Award shall be binding upon the successful bidder and it shall be treated as a binding Contract between Delhi Transco Limited and the successful bidder.

42.3 The Bidder will prepare the Contract Agreement as per the Performa enclosed in Section- Forms & Procedure to this Volume-I and the same will be signed within 30 (thirty) days from the date of Notification of Award.

43.0 **CONTRACT PERFORMANCE GUARANTEE**

43.1 Within Twenty-Eight (28) days after receipt of the notification of award, the successful Bidder, to whom the work is awarded, shall be required to furnish a Performance Guarantee deposited in the form of Account Payee Demand Draft, Fixed Deposit Receipt from a Commercial bank, Bank Guarantee from a scheduled Commercial bank or any foreign Bank or subsidiary of a foreign Bank having its branch in India with overall international corporate rating or rating of long term debt not less than A- (A minus) or equivalent by reputed rating agency**,** in the form attached in Section- Forms & Procedure to this Volume-I in favour of the Owner or online payment in an acceptable form.

The guarantee amount shall be equal to ten percent (10%) of the total Contract Price and it shall guarantee the faithful performance of the Contract in accordance with the terms and conditions specified in these documents and specifications.
Performance Security shall be valid upto defect liability period but initially for 12 months from the date of taking over/operational acceptance. This Performance guarantee shall be renewed periodically every year upto the end of defect liability period. Every renewal of the Performance guarantee shall be done by the contractor one month prior to the expiry date.

Non submission of performance security within the stipulated period will constitute a sufficient ground for the annulment of the award and forfeiture of the bid security.

44.0 Corrupt or Fraudulent Practices

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

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

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

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

and open competition;

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

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

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

44.3 Bidder shall furnish undertaking for not indulging in corrupt & fraudulent practice as per Attachment 21.

45 GOODS AND SERVICE TAX

45.1 The bidder shall comply with the provision of section 171 of the GST Act, 2017 and all the benefits accrued to him on account of any reduction in rate of tax on any supply of goods or services will be supplied to DTL under this Tender **No.** ***Refer BDS*** will be passed on to Delhi Transco Limited by way of commensurate reduction in the prices. In future, if anything found contrary, the bidder will be accountable for any contravention of the law and shall indemnify Delhi Transco Limited for the loss suffered on account of not passing the aforesaid benefit.

SECTION-III

BID DATA SHEETS (BDS)

SECTION-III

BID DATA SHEETS (BDS)

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

S. No.	ITB Clause Ref. No.	Bid Data Details
1.	ITB 6.1, ITB 27.2	Address of the Employer: **Delhi Transco Limited**, Shakti Sadan, Kotla Road, New Delhi-110002 (India), Phone: 23230026, Fax No. 011-23232721, E-mail: niraj.sharma@dtl.gov.in
2.	ITB 6.5	**Venue, date and time for Pre-bid Meeting:** The Bidder's designated representative is invited to attend a pre-bid meeting, which will take place at the venue and time as given below: **Delhi Transco Limited,** Fourth Floor, Conference Room, Shakti Sadan, Kotla Road, New Delhi – 110002. Date :……. Time: …… hours (IST)
3.	ITB 15.0	**For a Completion Period Equal to or Less than 18 Months Cl. 10.6 to be followed as under:** "Prices as quoted by the bidder shall remain fixed during the Bidder's Performance of the Contract and not subject to variation on any account. A bid submitted with an adjustable price quotation will be treated as non-responsive and rejected."
4.	ITB 23.1	**Amount of Bid Security**: Package A:- Rs. 97,80,307/- (INR Ninety Seven Lakh Eighty Thousand Three Hundred Seven Only)

S. No.	ITB Clause Ref. No.	Bid Data Details
		Package B:- Rs. 79,69,599/- (INR Seventy Nine Lakh Sixty Nine Thousand Five Hundred Ninety Nine Only) Package C:- Rs. 19,75,810/- (INR Nineteen Lakh Seventy Five Thousand Eight Hundred Ten Only)
5.	ITB 23.7, ITB 25.0, ITB 28.1	Address for submission of Bid Documents and Bid Opening; Address in Person or by Post: DGM (T) Contract Business Plan (CBP), Delhi Transco Limited, Room No.-504, 5th Floor, Shakti Sadan, Kotla Road, New Delhi-110002 (India), Phone: 23230026, Fax No. 011-23232721, Email: niraj.sharma@dtl.gov.in
6.	ITB 25.2	**BID TITLE:** A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India). B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India). C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).
7.	ITB 35A.1 (b)	Addition of following: The determination shall also take into account the assessment of Bid Capacity of a bidder before considering them for award of contract(s). Such Bid Capacity for regulating award of

S. No.	ITB Clause Ref. No.	Bid Data Details
		contract(s) on a bidder during any Financial Year (i.e. April to March) shall be subject to the condition that aggregate of the Minimum Average Annual Turnover (MAAT) requirement specified in Qualification Requirement (Annexure-A (BDS), Volume-I of Bidding Documents) for various packages to be considered for award [shall mean the package(s) for which award has been placed on that Bidder/ Bidder is under the zone of consideration for award of the package(s)] during such Financial Year (i.e. April to March) shall not exceed 1.5 (one and half) times the Average Annual Turnover (MAAT) of the Bidder worked out in the manner as specified in Qualification Requirement for the Bidder(Annexure-A(BDS), Volume-I of Bidding Documents). The Employer may, seek clarification/ details related to Balance Bid Capacity, as may be considered appropriate.
8.	ITB 45.1	**Tender No. T20R220201**

Annexure-A

Qualifying Requirements

Qualifying Requirements of bidders for Establishment of 66kV GIS S/stn. Turnkey Projects.

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

Route-1:

1.1 The Bidder/Manufacturer must have designed, manufactured, type tested (as per IEC or equivalent standard), supplied, supervised erection and commissioning of at least two (2) nos. GIS circuit breaker bays***** of 66 kV or above voltage class in one (1) GIS substation or Switchyard during last seven (7) years and these bays must be in satisfactory operation**#** for at least two (2) years as on the originally scheduled date of bid opening.

OR

The Bidder/Manufacturer must have designed, manufactured, type tested (as per IEC or equivalent standard), supplied, erected and commissioned of at least two (2) nos. GIS circuit breaker bays* of 66 kV or above voltage class in one (1) GIS substation or Switchyard during last seven (7) years and these bays must be in satisfactory operation# for at least two (2) years as on the originally scheduled date of bid opening.

Route-2:

1.2 In case, the Bidder not meeting the requirement stipulated in para 1.1 above, he shall also be considered, provided he meets the following requirements:

a) The bidder/Manufacturer must have established manufacturing and testing facilities in India for 66 kV or above voltage class GIS and must have manufactured at least one (1) no. 66 kV or above voltage Class GIS Circuit Breaker bay* based on the technological support of the Collaborator(s). Further the bidder must have either supplied or type tested the above GIS bay* as per IEC as on the originally scheduled date of bid opening, provided further that the collaborator(s) of the bidder meets qualifying requirements as per para 1.1 mentioned above.

Further, the bidder shall also submit the following along with the bid:

i) A legally enforceable undertaking (jointly with the Collaborator(s)) to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s);
ii) A confirmation letter from the Collaborator(s) stating that the Collaborator(s) shall furnish performance guarantee for an amount of 10 % of the ex-works cost of such equipment(s). This performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder.
iii) A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 66 kV or above voltage class GIS equipment in India.

OR

Route-3:

1.3 In case, the Bidder is established as Subsidiary/JVC/ Group company by its parent/principal, he shall also be considered, provided he meets the following requirements:

a) The bidder/manufacturer must have established manufacturing and testing facilities in India for 66 kV or above voltage class GIS and must have manufactured at least one (1) no. 66 kV or above voltage Class GIS Circuit Breaker bay* based on the technological support of the parent/principal company. Further, the bidder must have either supplied or type tested the above GIS bay* as per IEC as on the originally scheduled date of bid opening, provided further that the parent/principal company of the bidder meets qualifying requirements as per para 1.1 mentioned above.

Further, the bidder shall also submit the following along with the bid:

i) A legally enforceable undertaking (jointly with the parent/principal company) to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s);
ii) A confirmation letter from the Bidder stating that they shall furnish performance guarantee for an amount of 10 % of the ex-works cost of such equipment(s). This performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder.
iii) A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 66 kV or above voltage class GIS equipment in India.

OR

Route-4:

1.4 EPC Contractor:

In Case, the bidder is not a GIS Manufacture he shall also be considered, provided the bidder have designed, supplied, constructed, erected, tested (as per IEC standard) and commissioned, including CIVIL works of at least two (2) nos. GIS circuit breaker bays* 66 kV or above voltage class in one (1) NEW GIS substation or Switchyard during last seven (7) years and these Sub-Stations/ bays must be in satisfactory operation# for at least two (2) years as on the originally scheduled date of bid opening.

In such case, GIS equipments should be offered from Indian manufactures who meets the clause no. 1.1 or 1.2 or 1.3, while fulfilling all additional requirements as per respective clauses no. 1.1 or 1.2 or 1.3.

Further, the bidder shall also submit the following along with the bid:

i) The bid shall include consent letter (as per format Annexure-D2) from the proposed GIS manufacturer.
ii) A legally enforceable undertaking (jointly with GIS manufacturer) to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s);
iii) A confirmation letter from the GIS manufacturer/ GIS Collaborator/ Parent/ Subsidiary/ JVC/ Group company etc. as applicable that they shall furnish performance guarantee for an amount of 10 % of the ex-works cost of such equipment(s). This performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder.

Note :

1. Manufacturer of GIS (Route1,2,& 3) may propose a GIS erector as sub-contractor who has erected, tested (as per IEC standard) and commissioned, including CIVIL works of at least two (2) nos. GIS circuit breaker bays of 66 kV or above voltage class in one (1) 66 kV GIS substation during last seven (7) years and these Sub-Stations/ bays must be in satisfactory operation# for at least two (2) years as on the originally scheduled date of bid opening. The bid shall include consent letter (as per format Annexure-D1) from the proposed Erector.

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

3. * For the purpose of qualifying requirement, one no. of circuit breaker bay shall be considered as a bay used for controlling a line or a transformer or a 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.

4. In case bidder is a holding company, the technical experience referred to in Route-1, 2 and 3 above as the case may be, shall be of that holding company only (i.e. excluding its subsidiary/group companies). In case bidder is a subsidiary of a holding company, the technical experience referred to in in Route-1, 2 and 3 above as the case may be, shall be of that subsidiary company only (i.e. excluding its holding company)

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 the best three years out of last five financial years as annualized should be not less than:

MAAT = (1.5 x Estimated Cost) / completion period in years

Package- A :- MAAT = Rs 73,35,22,990.5
Package- B:- MAAT = Rs 59,77,19,940/-
Package- C :- MAAT = Rs 14,81,85,760.5

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

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

LA = (3 x estimated cost) /completion period in months

Package-A:- LA = Rs. 12,22,53,831.75
Package-B:- LA = Rs. 9,96,19,990/-
Package-C:- LA = Rs. 2,46,97,626.75

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

d) Relaxation for Start-Ups^/ MSEs

Start-Ups^/ MSEs, meeting the specified requirements at Para 2.0 (a) above in Financial Position shall also be considered qualified if they meet Eighty (80) % of the requirement specified at Para 2.0 (b) & 2.0 (c) above in Financial Position.

^ Start-Ups as defined by DIPP, applicable as on the originally scheduled date of bid opening.

Note:

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

ii) In case bidder has established manufacturing facility in India and yet to complete three (3) financial years, the Net Worth and average of the turnover as per financial statement for completed financial years shall be considered for the purpose of compliance to the specified Net Worth and MAAT requirements

iii) In case of bidder qualifying through Route-3 but not meeting the Financial Position requirement as per note (i) read along with note (ii) above, the following shall be applicable:

In case bidder is yet to complete five (5) years from the date of commercial production of such equipment(s) but no later than seven (7) years from the date of incorporation of the said company as on the originally scheduled date of bid opening as above, the financial position requirement as per para 2.0 (b) & (c) of parent/principal company providing collaboration for Technological Support shall be considered. However, once he meets the turnover requirement on their own or completes five (5) years from the date of commercial production of such equipment (s) in India but no later than seven (7) years from the date of incorporation as on the originally scheduled date of bid opening as

above, the financial position requirements as specified at 2.0 (b) and (c) above shall also be required to be met by such bidder on their own as per note (i) above and not based on their Parent/Principal company. Further, in case the bidder is yet to complete one (1) financial year, the Net worth requirement as per para 2.0 (a) above of Parent/Principal shall be considered.

3.0 JOINT VENTURE BIDS:

a) In case a bid is submitted by a Joint Venture (JV) of two or more firms as partners, all the partners of Joint Venture shall meet collectively the complete requirements stipulated at para 1.0 and 2.0 (b) & (c) above. Further, the partner(s) of JV must also meet the following minimum criteria:

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

ii) The Lead Partner shall meet, not less than 40% of the minimum Financial Position[$] criteria given at para 2.0 (b) & (c)

iii) 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) above

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.

b) However, for a JV to be qualified, the partners of JV must also meet the following minimum criteria:

i) One of the partner(s) of JV must meet the Technical Experience criteria and the requirements stipulated under Route-1 or Route-2 or Route-3 as per para 1.0 above

ii) The remaining partner(s) of JV must meet the Technical Experience criteria and the requirements stipulated under Route-1 or Route-2 or Route-3 as per para 1.0 above

OR

Supplied, erected, tested and commissioned, including CIVIL works of at least Two (02) nos.GIS circuit breaker bays@ 66kV or above voltage class in one(1) NEW GIS substations or switchyard during last seven (7) years and these Sub-Stations/bays must be in satisfactory operation# for at least two (2) years as on the originally scheduled date of bid opening.

Note :

1. (#) Satisfactory operation means certificate issued by the Employer certifying the operation without any adverse remark.
2. (@) For the purpose of qualifying requirement, one no. of circuit breaker bay shall be considered as a bay used for controlling a line or a transformer or a 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.

3. ($) In case of a JV bid involving an Indian Entity qualifying through Route-3 and its Parent/ Principal company as partner(s), the Indian Entity shall meet the applicable Financial Position criteria on its own and not based on its Parent/Principal company.

4.0) Financial & Capacity Requirements

Bidder shall be financially sound.

i. Bidder shall submit a certificate from their Banker(s) as per format indicating various fund based/non fund based limits sanctioned to the bidder and the extent of utilization as on date. Such certificate should have been issued not earlier than three months prior to the originally scheduled date of bid opening.

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

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

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

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

i. Their statutory Auditor; or

ii. A Certified Public Accountant; or

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

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

i) Their statutory Auditor; or

ii) A Certified Public Accountant; or

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

5.0 General Requirements

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

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

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

4. The bidder should have adequate after sales support facility and shall ensure availability of technical support in India so as to attend warrantee provisions under this contract.

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

6. A Bidder shall submit only one bid in the same tendering process, either individually as bidder or as a partner of a Joint Venture or GIS manufacturer or EPC contractor. A bidder who submits or participates in more than one bid will cause all of the proposals in which the bidder has participated to be disqualified.

Annexure-D1

CONSENT LETTER FROM ERECTOR TO BE FURNISHED BY THE GIS MANUFACTURER

(To be submitted on the letterhead of the company)

To

Dt. …….

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

IN RESPECT OF TURNKEY PACKAGE (Name of tender)

TENDER NO. …….

Dear Sir,

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

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

2. That, we as a Erector meet the qualifying criteria as specified in Annexure A, BDS, Vol-I of the said Tender No. …….

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

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

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

For and on behalf of M/s……

Signature:……
Name:…….
Designation:……
Seal:……

Annexure-D2

CONSENT LETTER FROM GIS MANUFACTURER TO BE FURNISHED BY THE ERECTOR
(To be submitted on the letterhead of the company)

To

Dt. …….

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

IN RESPECT OF TURNKEY PACKAGE (Name of tender).

TENDER NO. ……..

Dear Sir,

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

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

2. That, we as a GIS Manufacturer meet the qualifying criteria as specified in Clause 1.1/1.2/1.3 of Annexure A, BDS, Vol-I of the said Tender No. …….

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

4. That, we shall undertake supervision of erection, testing & commissioning in case of award of contract to M/s……..(To be submitted by an erector who is not having GIS experience as provided in Cl. 1.4)

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

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

For and on behalf of M/s……

Signature:……
Name:…….
Designation:……
Seal:……

ANNEXURE-B

FORMAT FOR EVIDENCE OF ACCESS

TO OR AVAILABILITY OF CREDIT FACILITIES

BANK CERTIFICATE

This is to certify that M/s ……..... (Full Name & Address) ……

Who are submitting their bid to Delhi Transco Ltd. as sole bidder*/partner of Joint Venture# against their tender specification vide Ref. No._____ & date _____ is our Customer for the past _____ years.

Their financial transactions with our bank have been satisfactory. They enjoy the following fund based and non-fund based limits including for guarantees, L/C and other credit facilities with us against which the extent of utilization as on date is also indicated below :

S. No.	Type of Facility	Sanctioned Limit as on Date	Utilization as on Date

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

Sd/-

Name of Bank _____

Name of Authorised Signatory _____

Designation _____

Phone No. _____

Fax No. _____

SEAL OF THE BANK :

Separate details to be furnished by different partners of JV.

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

SECTION-IV

CONDITIONS OF CONTRACT (CC)

SECTION-IV

Condition of Contract (CC)

A. Contract and Interpretation:

1.0 Definitions:

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

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

"Contract Documents" means the documents listed in Article 1.1(Contract Documents) of the Form of Contract Agreement (including any amendments thereto).
"CC" means the Conditions of Contract hereof.

"Day" means calendar day of the Gregorian Calendar.

"Month" means calendar month of the Gregorian Calendar.

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

Delhi Transco Ltd.
Shakti Sadan
New Delhi-110002
Fax No. – 011-011-23232721,
Tel. No. -011-23230026

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

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

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

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

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

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

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

"Arbitrator" means the person or persons appointed by agreement between the Employer and the Contractor to make a decision on or to settle any dispute or difference between the Employer and the Contractor referred to him or her by the parties pursuant to CC Sub-Clause 6.2 (Arbitrator) hereof.

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

"Facilities" means the Plant and Equipment to be supplied and installed, as well as all the Installation

Services to be carried out by the Contractor under the Contract.

"Plant and Equipment" means permanent plant, equipment, machinery, apparatus, articles and things of all kinds to be provided and incorporated in the Facilities by the Contractor under the Contract (including the spare parts to be supplied by the Contractor under CC Sub-Clause 7.3 hereof), but does not include Contractor's Equipment.

"Installation Services" means all those services ancillary to the supply of the Plant and Equipment for the Facilities, to be provided by the Contractor under the Contract; e.g., transportation and provision of marine or other similar insurance, inspection, expediting, Site preparation works (including the provision and use of Contractor's Equipment and the supply of all construction materials required), installation, testing, Pre-commissioning, commissioning, operations, maintenance, the provision of operations and maintenance manuals, training, etc.

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

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

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

"**Taking Over"** means the Employer's written acceptance of the Facilities under the Contract, after successful Trial – Operation for the specified period in accordance with the Contract.

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

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

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

"Completion" means that the Facilities (or a specific part thereof where specific parts are specified in the CC) have been completed operationally and structurally and put in a tight and clean condition, and that all work in respect of Pre-commissioning of the Facilities or such specific part thereof has been completed and Commissioning has been attained as per Technical Specifications followed by successful Trial – Operation, as provided in CC Clause 24.0 (Completion of Facilities) & 25.0 (Commissioning and Operational Acceptance) hereof.

"Pre-commissioning" means the testing, checking and other requirements specified in the Technical Specifications that are to be carried out by the Contractor in preparation for Commissioning as provided in CC Clause 24 (Completion) hereof.

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

"Guarantee Test(s)" means the test(s) specified in the Technical Specifications to be carried out to ascertain whether the Facilities or a specified part thereof is able to attain the Functional Guarantees specified in the Technical Specifications in accordance with the provisions of CC Sub-Clause 25.2 (Guarantee Test) hereof.

"Operational Acceptance" means the acceptance by the Employer of the Facilities (or any part of the Facilities where the Contract provides for acceptance of the Facilities in parts), which certifies the Contractor's fulfillment of the Contract in respect of Functional Guarantees of the Facilities (or the relevant

part thereof) in accordance with the provisions of CC Clause 28 (Functional Guarantees) hereof and shall include deemed acceptance in accordance with CC Clause 25 (Commissioning and Operational Acceptance) hereof.

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

'**Local content**' means the amount of value added in India which shall, unless otherwise prescribed by the Nodal Ministry, be the total value of the item procured (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties) as a proportion of the total value, in percent.

*'**Class-I local supplier**'* means a supplier or service provider, whose goods, services or works offered for procurement, has local content equal to or more than 50%, as defined above or as defined under PPP-MII Order dt. 04.06.2020 & their latest amendments thereof

'Class-II local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, has local content more than 20% but less than 50%, as defined above or as defined under PPP-MII Order dt. 04.06.2020 & their latest amendments thereof

'Non - Local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, has local content less than or equal to 20%, as defined above or as defined under PPP-MII Order dt. 04.06.2020 & their latest amendments thereof.

*'**L l**'* means the lowest tender or lowest bid or the lowest quotation received in a tender, bidding process or other procurement solicitation as adjudged in the evaluation process as per the tender or other procurement solicitation.

*'**Margin of purchase preference**'* means the maximum extent to which the price quoted by a "Class-I local supplier" may be above the L 1 for the purpose of purchase preference.

*'**Procuring entity**'* means a Ministry or department or attached or subordinate office of, or autonomous body controlled by, the Government of India and includes Government companies as defined in the Companies Act.

2. Contract Documents

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

3. I**nterpretation**

3.1 Language

3.1.1 All Contract Documents, all correspondence and communications to be given, and all other documentation to be prepared and supplied under the Contract shall be written in English, and the Contract shall be construed and interpreted in accordance with that language.

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

3.2 Singular and Plural

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

3.3 Headings

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

3.4 Persons

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

3.5 Incoterms

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

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

3.6 Entire Agreement

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

3.7 Amendment

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

3.8 Independent Contractor

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

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

3.9 Joint Venture or Consortium

If the Contractor is a joint venture or consortium of two or more firms, all such firms shall be jointly and severally bound to the employer for the fulfillment of the provisions of the Contract and shall designate one of such firms to act as a leader with authority to bind the joint venture or consortium. The composition or the constitution of the joint venture or consortium shall not be altered without the prior consent of the Employer.

3.10 Non-Waiver

3.10.1 Subject to CC Sub-Clause 3.10.2 below, no relaxation, forbearance, delay or indulgence by either party in enforcing any of the terms and conditions of the Contract or the granting of time by either party to the other shall prejudice, affect or restrict the rights of that party under the Contract, nor shall any waiver by either party of any breach of Contract operate as waiver of any subsequent or continuing breach of Contract.

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

3.11 Severability

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

3.12 Country of Origin

"Origin" means the place where the materials, equipment and other supplies for the Facilities are mined, grown, produced or manufactured, and from which the services are provided.

4. Notices

4.1 Unless otherwise stated in the Contract, all notices to be given under the Contract shall be in writing, and shall be sent by personal delivery, airmail post, special courier, cable, telegraph, telex, facsimile, email id or Electronic Data Interchange (EDI) to the address of the relevant party set out in the Special Conditions of Contract, with the following provisions.

Employer's address for notice purposes: [Name, address and telephone, cable, email-id and facsimile numbers]

Contractor's address for notice purposes: [Name, address and telephone, cable, email-id and facsimile numbers]

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

4.1.2 Any notice sent by airmail post or special courier shall be deemed (in the absence of evidence of earlier receipt) to have been delivered ten (10) days after dispatch. In proving the fact of despatch, it shall be sufficient to show that the envelope containing such notice was properly addressed, stamped and conveyed to the postal authorities or courier service for transmission by airmail or special courier.

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

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

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

5. Governing Law

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

6. Settlement of Disputes

6.1. Adjudicator

Not applicable.

6.2 Arbitration

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

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

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

6.2.4 The arbitration shall be conducted at New Delhi, India. The language of arbitration shall be English.

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

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

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

6.2.7 Works to Continue

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

6.2.8 Time Limit for Arbitration

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

6.2.9 Law and Procedure

6.2.9.1 Applicable Law

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

6.2.9.2 Procedural Law

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

B. Subject Matter of Contract

7. Scope of Facilities

7.1. Unless otherwise expressly limited in the Technical Specifications, the Contractor's obligation cover the provision of all Plant and Equipment and the performance of all Installation Services required for the design, the manufacture (including procurement, quality assurance, construction, installation, associated civil works, Pre-commissioning and delivery) of the Plant and Equipment and the installation, completion, commissioning and performance testing of the facilities in accordance with the plans, procedures, specifications drawings, codes and any other documents as specified in the Technical specifications. Such specifications include, but are not limited to, the provision of supervision and engineering services the supply of labour, materials, equipment, spare parts (as specified in CC sub-clause 7.3 below) and accessories, Contractor's Equipment; construction utilities and supplies, temporary materials, structures and facilities, transportation (including without limitation, unloading and hauling to, from and at the Site); and storage except for those supplies, works and services that will be provided or performed by the Employer, as set forth in Appendix-6 (Scope of Works and Supply by the Employer) to the Contract Agreement.

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

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

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

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

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

(i) The Contractor shall send advance notification to the Employer of the pending termination, with 2(two) years time to permit the Employer to procure needed requirements, and

(ii) Following such termination, the contractor shall furnish at no cost to the Employer the blueprints, drawings and specifications of the spare parts, if requested.

8. Time for Commencement and Completion

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

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

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

9. Contractor's Responsibilities

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

9.2 The Contractor confirms that it has entered into this Contract on the basis of a proper examination of the data relating to the Facilities (including any data as to boring tests) provided by the Employer, and on the basis of information that the Contractor could have obtained from a visual inspection of the Site (if access thereto was available) and of other data readily available to it relating to the Facilities as at the date twenty-eight (28) days prior to bid submission. The Contractor acknowledges that any failure to acquaint itself with all such data and information shall not relieve its responsibility for properly estimating the difficulty or cost of successfully performing the Facilities.

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

9.4 The Contractor shall comply with all laws in force in the country where the Facilities are installed and where the Installation Services are carried out. The laws will include all national, provincial, municipal or other laws that affect the performance of the Contract and bind upon the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any and all liabilities, damages, claims, fines, penalties and expenses of whatever nature arising or resulting from the violation of such laws by the Contractor or its personnel, including the Subcontractors and their personnel, but without prejudice to CC Sub-Clause 10.1 hereof.

9.5 Any Plant, Material and Services that will be incorporated in or be required for the Facilities and other supplies shall have their origin as specified under CC Sub-Clause 3.12 (Country of Origin).

9.6 The Contractor shall permit the Employer to inspect the Contractor’s accounts and records relating to the performance of the Contractor.

10. Employer's Responsibilities

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

10.2 The Employer shall be responsible for acquiring and providing legal and physical possession of the Site and access thereto, and for providing possession of and access to all other areas reasonably required for the proper execution of the Contract, including all requisite rights of way, as specified in Appendix 6 (Scope of Works and Supply by the Employer) to the Contract Agreement. The Employer shall give full possession of and accord all rights of access thereto on or before the date(s) specified in Appendix 6.

10.3 The Employer shall acquire and pay for all permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the site is located which such authorities or undertakings require the Employer to obtain them in the Employer’s name, are necessary for the execution of the Contract (they include those required for the performance by both the

Contractor and the Employer of their respective obligations under the Contract), including those specified in Appendix 6 (Scope of works and supply by the Employer) to the Contract Agreement.

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

10.5 Unless otherwise specified in the Contract or agreed upon by the Employer and the Contractor, the Employer shall provide sufficient, properly qualified operating and maintenance personnel, shall supply and make available all raw materials utilities, lubricants, chemicals, catalysts, other materials and facilities, and shall perform all works and services of whatsoever nature, to enable the Contractor to properly carry out Pre-commissioning, Commissioning and Guarantee Tests, all in accordance with the provisions of Appendix 6 (Scope of works and supply by the Employer) to the Contract Agreement at or before the time specified in the program furnished by the Contractor under CC Sub-Clause 18.2 (Program of Performance) hereof and in the manner thereupon specified or as otherwise agreed upon by the Employer and the Contractor.

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

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

C. Payment

11. Contract Price

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

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

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

12. Terms of Payment

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

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

12.3 The currency or currencies in which payments are made to the Contractor under this Contract shall be specified in Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement, subject to the general principle that payments will be made in the currency or currencies in which the Contract Price has been stated in the Contractor's bid.

12.4 All payments shall be made in currency or currencies specified in the corresponding Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement, pursuant to CC 12.3.

13. Securities

13.1 Issuance of Securities

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

13.2 Advance Payment Security

13.2.1 The Contractor shall, within twenty-eight (28) days of the notification of contract award, provide a security in an amount equal to the advance payment calculated in accordance with Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement, and in the same currency or currencies with a validity of up to the date of completion of Facilities in accordance with CC clause 24.0 and it shall be kept alive till the recovery of the full amount of the advance with interest portion.

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

Procedure for effective reduction in the Advance Payment Security:

Recovery of the advance amount shall be made from each running bill proportionately. It should be clearly understood that reduction in the value of security for advance shall not in any way dilute the Contractor's responsibility and liabilities under the Contract including in respect of the Facilities for which reduction in the value of security is allowed.

13.3 Performance Security

13.3.1 The Bidder shall submit **performance** ***security*** **@**10% of the **total** contract ***price for the performance of contact*** within twenty eight days (28 days) ***from the issuance of*** notifications of award. **The Material shall not be accepted without depositing performance security**.

The performance ***security is to be deposited in the form of Account Payee Demand Draft, Fixed Deposit Receipt from a commercial Bank, Bank Guarantee from a commercial Bank*** **or online payment in an acceptable form safeguarding the purchaser's interest in all respect. Performance** ***security shall be*** **valid** up to **defect liability period but initially** for 12 Months from **the date of taking over/**operational acceptance. **This** performance guarantee shall be renewed periodically every year **upto the end of defect liability period**. Every renewal of performance guarantee shall be done by the contractor one month prior to the expiry date.

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

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

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

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

.13.3.5. No interest on Performance Security Deposit will be payable to the depositors.

13.3.6 Exemption from performance security deposit will not be permitted under any circumstance.

13.4 **Issuing Banks**

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

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

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

14. Taxes and Duties

14.1 Prices are to be quoted exclusive of GST and GST rate may also be indicated in the price bid and BOQ/ un-priced schedule.

14.2 The Contractor shall be entirely responsible for payment of all taxes, duties, licence fees and other such levies legally payable/incurred until delivery of the contracted supplies to the Employer. If it is statutory requirement to make deductions towards such taxes and duties or any other applicable taxes and duties, the same shall be made by the owner and a certificate for the same shall be issued to the Contractor.

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

14.4 In respect of transactions between the Employer and the Contractor, the Base Price is inclusive of all cost as well as duties and tax (custom duties & levies, Taxes and duties as per GST Rules) paid or payable on components, raw materials and any other items used /incorporated or to be incorporated in the Plants & Equipments and other final goods & services to be supplied by the contractor under the proposed contract. No separate claim shall be paid by the Employer for taxes and duties included in respect of these items stated herein.

14.5 Taxes, duties and levies as per GST Rules for the goods & Services under 'transactions' between contractor & Employer for destination site/state shall not be included in the base price. These amounts will be payable (along with subsequent statutory variation if any) on the supplies made by the Contractor, subject to submission of the documentary evidence indicating the said taxes paid by the contractor and GST credit is transferred to the Employer. But the amount of said taxes shall be limited to the tax liability on the transaction between the employer and the Contractor only. However, Employer will not bear any upward variation in GST rate due to change/disputes in classification relating to HSN/SAC code as quoted by the bidder at a later stage. Employer shall, however, deduct such taxes at source as per the rules and issue Tax Deduction at Source (TDS) Certificate to the Contractor as per the said rules. 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. 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 as mutually agreed upon. The payment of GST on advance payment 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. GST payment against Advance payment shall be against a proforma invoice. 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.

14.6 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.

14.7 DELETED

14.8 For payment in respect of dispatches made directly from Contractor's works, Tax invoices raised by the Contractor shall be accepted as documentary evidence and for payment of GST. The amount of GST as stated in Tax invoice will be paid only after the GST credit is transferred to the Employer. However, the employer from time to time may also verify the payment / deposit of various taxes by the contractor, which the later has already claimed and charged in the previous invoices from the employer against the aforesaid transactions between employer and the contractor.

14.9 In Case the Taxes, Duties and Levies as per GST Rules on transaction between Employer and the Contractor is covered under the Reverse Charge provision full Tax has to be stated / mentioned in the quoted prices/ bid. However, where the Reverse Charge Mechanism Provisions are applicable, DTL shall not pay the applicable tax amount to the contractor and will deposit directly to the Government treasury. To facilitate the bidders, Employer has indicated HSN/SAC code and rate of GST against each item in the price schedule. 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 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 of each item. Employer's liability for the reimbursement of GST shall be GST applicable at the rate as confirmed/ deemed confirmed in the bid and as accepted by the employer. The Input Tax Credit (ITC) available, if any, under the GST law as per the relevant Govt. policies wherever applicable shall be taken into account by the bidder while quoting bid price.

14.10 For the purpose of the Contract, it is agreed that the Contract Price specified in Article-2 (Contract Price and Terms of Payment) of the Contract Agreement is based on the taxes inclusive of duties, levies and charges prevailing at the date seven (07) days prior to the last date of bid submission. If any rates of Tax including service tax are increased or decreased or, a new Tax is introduced, or/an existing Tax is abolished in the course of the performance of the Contract, which was or will be assessed on the Contractor in connection with performance of the Contract, an equitable adjustment of the Contract price shall be made to take into account any such change by addition to the Contract price or deduction therefrom, as the case may be (changes in law & regulations) hereof. However, these adjustments would be applicable to all transactions between the employer and the Contractor for which the taxes and duties are reimbursable by the Employer as per the Contract. These adjustments shall not be applicable on procurement of raw materials, intermediary components etc by the Contractor.

14.11 In respect of raw materials, intermediary components etc forming part of base price of goods & services supplied under the contract, 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. However, Employer will not bear any upward variation in GST rate due to change/disputes in classification relating to HSN/SAC code as quoted by the bidder at a later stage.

D. Intellectual Property

15. Copyright

15.1 The copy right 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 Contactor by any third party, including supplies of materials, the copyright in such materials shall remain vested in such third party.

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

16. Confidential Information

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

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

16.3 The obligation of a party under CC Sub-Clauses 16.1 and 16.2 above, however, shall not apply to that information which

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

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

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

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

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

E. Execution of the Facilities

17. Representatives

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

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

17.2 Contractor's Representative & Construction Manager

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

17.2.2 The Contractor's Representative shall represent and act for the Contractor at all times during the currency of the Contract and shall give to the Project Manager all the Contractor's notices, instructions, information and all other communications under the Contract.
All notices, instructions, information and all other communications given by the Employer or the Project Manager to the Contractor under the Contract shall be given to the Contractor's Representative or, in its absence, its deputy, except as herein otherwise provided.

The Contractor shall not revoke the appointment of the Contractor's Representative without the Employer's prior written consent, which shall not be unreasonably withheld. If the Employer consents thereto, the Contractor shall appoint some other person as the Contractor's Representative, pursuant to the procedure set out in CC Sub-Clause 17.2.1.

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

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

17.2.3.1 Notwithstanding any thing stated in CC sub-Clause 17.1 and 17.2.1 above, for the purpose of execution of Contract, the Employer and the Contractor shall finalize and agree to a Contract Co-ordination Procedure and all the communication under the Contract shall be in accordance with such Contract Coordination Procedure.

17.2.4 From the commencement of installation of the Facilities at the site until Operational Acceptance, the Contractor's Representative shall appoint a suitable person as the construction manager, (hereinafter referred to as "the Construction Manager"). The Construction Manager shall supervise all work done at the site by the Contractor and shall be present at the site through-out normal working, hours, except when on leave, sick or absent for reasons connected with the proper performance of the Contract. Whenever the Construction Manager is absent from the Site, a suitable person shall be appointed to act as his or her deputy.

17.2.5 The Employer may by notice to the Contractor object to any representative or person employed by the Contractor in the execution of the Contract who, in the reasonable opinion of the Employer, may behave inappropriately, may be incompetent or negligent, or may commit a serious breach of the Site regulations

provided under CC Sub-Clause 22.3. The Employer shall provide evidence of the same, whereupon the Contractor shall remove such person from the Facilities.

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

18. Work Program

18.1 Contractor's Organization

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

18.2 Program of Performance

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

Within twenty-eight (28) days after the date of Notification of Award, the Contractor shall prepare and submit to the Project Manager a detailed program of performance of the Contract, made in the form specified in the CC and showing the sequence in which it proposes to design, manufacture, transport, assemble, install and pre-commission the Facilities, as well as the date by which the Contractor reasonably requires that the Employer shall have fulfilled its obligations under the Contract so as to enable the Contractor to execute the Contract in accordance with the program and to achieve completion, commissioning and Acceptance of the Facilities in accordance with the Contract. The program so submitted by the Contractor shall accord with the Time Schedule included in appendix-4 (Time Schedule) to the Contract Agreement and any other dates and periods specified in the Contract. The Contractor shall update and revise the program as and when appropriate or when required by the Project Manager, but without modification in the Times for Completion given in the CC and any extension granted in accordance with CC Clause 40, and shall submit all such revisions to the Project Manager.

18.3 Progress Report

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

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

18.4 Progress of Performance

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

18.5 Work Procedures

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

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

19. Subcontracting

19.1 Appendix 5 (List of Approved Subcontractors) to the Contract Agreement specifies major items of supply

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

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

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

20. Design and Engineering

20.1 Specifications and Drawings

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

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

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

20.2 Codes and Standards

Wherever references are made in the Contract to codes and standards in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards current at the date twenty-eight (28) days prior to date of bid submission shall apply unless otherwise specified. During Contract execution, any changes in such codes and standards shall be applied after approval by the Employer and shall be treated in accordance with CC Clause 39.3 (Changes Originating from Contractor).

20.3 Approval/Review of Technical Documents by Project Manager

20.3.1 The Contractor shall prepare (or cause its subcontractors to prepare) and furnish to the Project Manager the documents listed in Appendix-7(List of Documents for Approval or Review) to the Contract Agreement for its approval or review as specified and as in accordance with the requirements of CC sub-Clause 18.2 (Program of Performance).

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

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

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

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

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

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

20.3.5 If any dispute or difference occurs between the Employer and the Contractor in connection with or arising out of the disapproval by the Project Manager of any document and/or any modification(s) thereto that cannot be settled between the parties within a reasonable period, then such dispute or difference may be referred to an Arbitration for determination in accordance with CC Sub Clause 6.2 (Arbitration) hereof. If such dispute or difference is referred to Arbitration, the Project Manager shall give instructions as to whether and if so, how, performance of the Contract is to proceed. The Contractor shall proceed with the Contract in accordance with the Project Manager's instructions, provided that if the Arbitration upholds the Contractor's view on the dispute and if the Employer has not given notice under CC Sub Clause 6.2 (arbitration), then the Contractor shall be reimbursed by the Employer for any additional costs incurred by reason of such instructions and shall be relieved of such responsibility or liability in connection with the dispute and the execution of the instructions as the Arbitration shall decide, and the Time for Completion shall be extended accordingly.

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

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

21. Procurement

21.1 Plant and Equipment

Subject to CC Sub-Clause 18.2, the Contractor shall manufacture or procure and transport all the Plant and Equipment in an expeditious and orderly manner to the Site.

21.2 Employer-Supplied Plant, Equipment, and Materials

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

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

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

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

21.3 Transportation

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

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

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

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

21.4 Customs Clearance

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

21.5 Delivery and Documents

21.5.1 For Imported Goods

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

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

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

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

4) Original insurance policy certification (3 copies);

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

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

7) Certificate of origin.

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

21.5.2 For Domestic Goods

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

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

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

3) Railway receipt / Receipted LR ;

4) Manufacturer's / Contractor's guarantee certificate of Quality.

5) Material Inspection & Clearance Certificate (MICC) for dispatch issued by the Employer's representative and the Contractor's factory inspection report & test certificate (3 copies) and insurance certificate (3 copies); and

6) Certificate of origin.

21.6 **Packing**

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

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

21.7 Indemnity Bond

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

22. Installation

22.1 Setting Out/Supervision/Labour

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

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

22.1.2 Contractor's Supervision:

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

22.1.3 Labour:

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

(b) Unless otherwise provided in the Contract, the Contractor shall be responsible for the recruitment, transportation, accommodation and catering of all labour, local or expatriate, required for the execution of the Contract and for all payments in connection therewith.

(c) The Contractor shall be responsible for obtaining all necessary permit(s) and/or visa(s) from the appropriate authorities for the entry of all labour and personnel to be employed on the Site into the country where the Site is located.

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

(e) The Contractor shall at all times during the progress of the Contract use its best endeavors to prevent any unlawful, riotous or disorderly conduct or behavior by or amongst its employees and the labour of its Subcontractors.

(f) The Contractor shall, in all dealings with its labour and the labour of its Subcontractors currently employed on or connected with the Contract, pay due regard to all recognized festivals, official holidays, religious or other customs and all local laws and regulations pertaining to the employment of labour.

22.2 Contractor's Equipment

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

22.2.2 Unless otherwise specified in the Contract, upon completion of the Facilities, the Contractor shall remove from the Site all Equipment brought by the Contractor onto the Site and any surplus materials remaining thereon.

22.2.3 The Employer will, if requested, use its best endeavors to assist the Contractor in obtaining any local, state or national government permission required by the Contractor for the export of the Contractor's Equipment imported by the Contractor for use in the execution of the Contract that is no longer required for the execution of the Contract.

22.3 Site Regulations and Safety

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

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

22.3.1 Compliance with Labour Regulations

22.3.1.1 During continuance of the contract, the Contractor and his sub-contractors shall abide at all times by all applicable existing labour enactments and rules made there under, regulations notifications and bye laws of the State or Central Government or local authority and any other labour law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. The employees of the Contractor and the Sub-contractor in no case shall be treated as the employees of the Employer at any point of time.

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

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

22.3.1.4 Some major laws along with their latest amendments applicable to establishments engaged in building and other construction works:

a) Workmen Compensation Act 1923: The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

b) Payment of Gratuity Act 1972: Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

c) Employee P.F. and Miscellaneous Provision Act 1952: The Act provides for monthly contribution by the employer plus workers @ 10% or 8.33%. The benefits under the Act are:

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

d) Maternity Benefit Act 1951: The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

e) Contract Labour (Regulation & Abolition) Act 1970: The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by law. The Principal Employer is required to take Certification of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more labour contract labour.

f) Minimum Wages Act 1948: The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provision of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments.

g) Payment of Wages Act 1936: It lays down as to by what date the wages are to paid, when it will be paid and what deductions can be made from the wages of the workers.

h) Equal Remuneration Act 1979: The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.

i) Payment of Bonus Act 1965: The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs.3500/- per month or less. The bonus is to be paid to employees getting Rs.2500/- per month or above upto Rs.3500/- per month shall be worked out by taking wages as Rs.2500/-per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.

j) Industrial Dispute Act 1947: The Act lays down the machinery the procedure for resolution of Industrial disputes, in what situations a strike or lock out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

k) Industrial Employment (Standing Orders) Act 1946: It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.

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

m) 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.

n) Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state).The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home upto the establishment and back, etc.

o) The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996: All the establishments who carry on any building or other construction work and employ 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the government.

p) Factories Act 1948: The Act lays down the procedure for approval of 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.

22.3.2 Protection of Environment

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

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

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

The Water (Prevention and Control of Pollution) Act, 1974, This provides for the prevention and control of water pollution and the maintaining and restoring of wholesomeness of water. 'Pollution' means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful 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 or matters connected herewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under Environment (Protection) Act, 1986, and exceeding such quantity as be specified by notification by the Central Government.

22.4 Opportunities for Other Contractors

22.4.1 The Contractor shall, upon written request from the Employer or the Project Manager, give all reasonable opportunities for carrying out the work to any other contractors employed by the Employer on or near the Site.

22.4.2 If the Contractor, upon written request from the Employer or the Project Manager, makes available to other contractors any roads or ways the maintenance for which the Contractor is responsible, permits the use by such other contractors of the Contractor's Equipment, or provides any other service of whatsoever nature for such other contractors, the Employer shall fully compensate the Contractor for any loss or damage caused or occasioned by such other contractors in respect of any such use or service, and shall pay to the Contractor reasonable remuneration for the use of such equipment or the provision of such services.

22.4.3 The Contractor shall also so arrange to perform its work as to minimize, to the extent possible, interference with the work of other contractors. The Project Manager shall determine the resolution of any difference or conflict that may arise between the Contractor and other contractors and the workers of the Employer in regard to their work.

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

22.5 Emergency Work

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

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

22.6 Site Clearance

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

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

22.7 Watching and Lighting

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

22.8 Work at Night and on Holidays

22.8.1 Unless otherwise provided in the Contract, no work shall be carried out during the night and on public holidays of the country where the Site is located without prior written consent of the Employer, except where work is necessary or required to ensure safety of the Facilities or for the protection of life, or to prevent loss or damage to property, when the Contractor shall immediately advise the Project Manager, provided that provisions of this CC Sub-Clause 22.8.1 shall not apply to any work which is customarily carried out by rotary or double-shifts.

22.8.2 Notwithstanding CC Sub-Clauses 22.8.1 or 22.1.3, if and when the Contractor considers it necessary to carry out work at night or on public holidays so as to meet the Time for Completion and requests the Employer's consent thereto, the Employer shall not unreasonably withhold such consent.

23. Test and Inspection

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

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

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

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

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

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

23.6 If any Plant and Equipment or any part of the Facilities fails to pass any test and/or inspection, the Contractor shall either rectify or replace such Plant and Equipment or part of the Facilities and shall repeat the test and/or inspection upon giving a notice under CC Sub-Clause 23.3. If the inspection is not materialized due to the reasons attributable to contractor then all the expenses including to & fro airfare and TA, DA shall be to the account of the contractor.

23.7 If any dispute or difference of opinion shall arise between the parties in connection with or arising out of the test and/or inspection of the Plant and Equipment or part of the Facilities that cannot be settled between the parties within a reasonable period of time, it may be referred to an Arbitration for determination in accordance with CC Sub-Clause 6.2

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

23.9 The Contractor agrees that neither the execution of a test and/or inspection of Plant and Equipment or any part of the Facilities, nor the attendance by the Employer or the Project Manager, nor the issue of any test certificate pursuant to CC Sub-Clause 23.4, shall release the Contractor from any other responsibilities under the Contract.

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

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

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

24. Completion of the Facilities

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

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

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

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

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

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

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

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

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

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

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

25. Commissioning and Operational Acceptance

25.1 Commissioning

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

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

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

25.1.3 Trial – Operation

25.1.3.1 Trial – Operation of the Facilities or any part thereof shall be commenced by the Contractor immediately after the Commissioning is completed pursuant to CC Sub-Clause 25.1.1

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

25.1.3.3 At any time after the events set out in CC Sub-Clause 25.1.3.2 have occurred, the Contractor may give a notice to the Project Manager requesting the issue of an Taking Over Certificate in the form provided in the Bidding Documents or in another form acceptable to the Employer in respect of the Facilities or the part thereof specified in such notice as on the date of such notice.

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

25.1.4 Taking Over

25.1.4.1 Upon successful Trial – Operation of the Facilities or any part thereof, pursuant to CC Sub-Clause 25.1.3, the Project Manager shall issue to the Contractor a Taking Over Certificate as a proof of the acceptance of the Facilities or any part thereof. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of Contract after issue of such certificate.

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

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

25.2 Guarantee Test

25.2.1 The Guarantee Test (and repeats thereof) shall be conducted by the Contractor after successful trial-operation of the Facilities or the relevant part thereof to ascertain whether the Facilities or the relevant part can attain the Functional Guarantees specified in the Contract Documents. The Contractor's and Project Manager's advisory personnel shall attend the Guarantee Test. The Employer shall promptly provide the Contractor with such information as the Contractor may reasonably require in relation to the conduct and results of the Guarantee Test (and any repeats thereof).

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

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

25.2.3 Completion- Guarantee test- acceptance

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

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

a) the Time of Completion shall be extended for the period of suspension without imposition of liquidated damages pursuant to CC Sub-Clause 26.2.

b) payments due to the Contractor in accordance with the provisions specified in Appendix I (terms and Procedures of Payment) to the Contract Agreement, which would have not been payable in normal circumstances due to non-completion of the subject activities, shall be released to the Contractor against submission of a security in the form of a bank guarantee of equivalent amount acceptable to the Employer, and which shall become null and void when the Contractor will have complied with its obligations regarding these payments, subject to the provisions of Sub-Clause CC 25.2.3.2 below.

c) the expenses toward the above security and extension of other securities under the Contract, of which validity need to be extended, shall be reimbursed to the Contractor by the Employer.

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

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

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

25.3 Operational Acceptance

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

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

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

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

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

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

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

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

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

25.4 Partial Acceptance

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

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

F. Guarantees and Liabilities

26. Completion Time Guarantee

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

26.2 If the Contractor fails to comply with the Time for Completion in accordance with Clause CC 26 for the whole of the facilities, (or a part for which a separate time for completion is agreed) then the Contractor shall pay to the Employer a sum equivalent to half percent (0.5%) of the Contract Price as liquidated damages for such default and not as a penalty, without prejudice to the Employer's other remedies under the Contract, for each week or part thereof which shall elapse between the relevant Time for Completion pursuant to Clause 26.1 above and the date stated in **Taking Over Certificate** of the whole of the Works (or a part for which a separate time for completion is agreed) subject to the limit of five percent (5%) of Contract Price. The Employer may, without prejudice to any other method of recovery, deduct the amount of such damages from any monies due or to become due to the Contractor. The payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the Works, or from any other of his obligations and liabilities under the Contract.

For the application of liquidated damages, the schedule date for **Taking Over** of the entire system shall be the basis, and not intermediate schedule milestone.

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

27. Defect Liability

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

27.2 The Defect Liability Period shall be five years from the date of Operational Acceptance of the facilities (or any part thereof).

If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and Equipment supplied or of the work executed by the Contractor, the Contractor shall promptly in consultation and agreement with the Employer regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Contractor shall, at its discretion, determine) such defect as well as any damage to the Facilities caused by such defect

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

(a) any materials that are supplied by the Employer under CC Sub-Clause 21.2 (Employer-Supplied Plant, Equipment and Materials), are normally consumed in operation, or have a normal life shorter than the Defect Liability Period stated herein.

(b)any designs, specifications or other data designed, supplied or specified by or on behalf of the Employer or any matters for which the Contractor has disclaimed responsibility herein.

(c) any other materials supplied or any other work executed by or on behalf of the Employer, except for the work executed by the Employer under CC Sub-Clause 27.7.

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

27.5 The Employer shall afford the Contractor all necessary access to the Facilities and the Site to enable the Contractor to perform its obligations under this CC Clause 27. The Contractor may, with the consent of the Employer, remove from the Site any Plant and Equipment or any part of the Facilities that are defective if the nature of the defect, and/or any damage to the Facilities caused by the defect, is such that repairs cannot be expeditiously carried out at the Site.

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

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

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

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

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

Upon correction of the defects in the Facilities or any part thereof by repair/replacement, such repair/replacement shall have the Defect Liability Period extended by a period of Sixty (60) months from the time such replacement/repair of the facilities or any part thereof.

27.8.1 At the end of Defect Liability Period, the Contractor's liability ceases except for latent defects. The Contractor's liability for latent defects warranty shall be limited to period of five (5) years from the end of Defect Liability Period. For the purpose of this clause, the latent defects shall be the defects inherently lying within the material or arising out of design deficiency, which do not manifest themselves during the Defect Liability Period defined in this CC Clause 27, but later.

27.9 Except as provided in CC Clauses 27 and 33 (Loss of or Damage to Property/ Accident or Injury to Workers/Indemnification), the Contractor shall be under no liability whatsoever and howsoever arising, and whether under the Contract or at law, in respect of defects in the Facilities or any part thereof, the Plant and Equipment, design or engineering or work executed that appear after operational acceptance or any part thereof, except where such defects are the result of the gross negligence, fraud, criminal or willful action of the Contractor.

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

28. Functional Guarantee

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

28.2 If, for reasons attributable to the Contractor, the minimum level of the Functional Guarantees specified in Appendix 8 (Functional Guarantees) to the Contract Agreement are not met either in whole or in part, the Contractor shall at its cost and expense make such changes, modifications and/or additions to the Plant or any part thereof as may be necessary to meet at least the minimum level of such Guarantees. The Contractor shall notify the Employer upon completion of the necessary changes, modifications and/or additions, and shall request the Employer to repeat the Guarantee Test until the minimum level of the Guarantees has been met. If the Contractor eventually fails to meet the minimum level of Functional Guarantees, the Employer may consider termination of the Contract pursuant to CC Sub-Clause 42.2 and recover the payments already made to the Contractor.

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

(a) make such changes, modifications and/or additions to the Facilities or any part thereof that are necessary to attain the Functional Guarantees at its cost and expense within a mutually agreed time and shall request the Employer to repeat the Guarantee Test, or

(b) pay liquidated damages to the Employer in respect of the failure to meet the Functional Guarantees in accordance with the provisions in Appendix 8 (Functional Guarantees) to the Contract Agreement.

28.4 In case the Employer exercises its option to accept the equipment after levy of liquidated damages, the payment of liquidated damages under CC sub clause 28.3, upto the limitation of liability specified in the Appendix-8 (Functional Guarantees) to the Contract Agreement, shall completely satisfy the Contractor's guarantees under CC Sub clause 28.3, and the Contractor shall have not further liability whatsoever to the Employer in respect thereof. Upon the payment of such liquidated damages by the Contractor, the Project Manager shall issue the Operational Acceptance Certificate for the Facilities or any part thereof in respect of which the liquidated damages have been so paid.

28.5 Functional Guarantees, Liquidated Damages for Non-Performance (Applicable for Auxiliary transformer)

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

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

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

28.5.4 Differential Price Factors for Evaluation and Liquidated Damages

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

S.No.	Equipment	Parameter to be taken for applying differential price factor(F)	Value of F in Indian Rupees per unit of parameter differential per kW
Auxiliary Transformer			
a)		Differential copper loss (kw)	@ Rs.69900/-
b)		Differential iron loss(kw)	@ Rs.171300/-

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

29. **Patent Indemnity**

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

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

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

If the Contractor fails to notify the Employer within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the twenty-eight (28) day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim.

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

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

30. **Limitation of Liability**

30.1 Except in cases of criminal negligence or willful misconduct,

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

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

G. Risk Distribution

31. Transfer of Ownership

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

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

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

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

31.5 Notwithstanding the transfer of ownership of the Plant and Equipment, the responsibility for care and custody thereof together with the risk of loss or damage thereto shall remain with the Contractor pursuant to CC Clause 32 (Care of Facilities) hereof until Completion of the Facilities or the part thereof in which such Plant and Equipment are incorporated.

32. Care of Facilities

32.1 The Contractor shall be responsible for the care and custody of the Facilities or any part thereof until the date of Completion of the Facilities pursuant to CC Clause 24 (Completion of the Facilities) or, where the Contract provides for Completion of the Facilities in parts, until the date of Completion of the relevant part, and shall make good at its own cost any loss or damage that may occur to the Facilities or the relevant part thereof from any cause whatsoever during such period. The Contractor shall also be responsible for any loss or damage to the Facilities caused by the Contractor or its Subcontractors in the course of any work carried out, pursuant to CC Clause 27 (Defect Liability). Notwithstanding the foregoing, the Contractor shall not be liable for any loss or damage to the Facilities or that part thereof caused by reason of any of the matters specified or referred to in paragraphs (a), (b) and (c) of CC Sub Clauses 32.2 and 38.1.

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

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

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

(c) any use of or reliance upon any design, data or specification provided or designated by or on behalf of the Employer, or any such matter for which the Contractor has disclaimed responsibility herein, The Employer shall pay to the Contractor all sums payable in respect of the Facilities executed, notwithstanding that the same be lost, destroyed or damaged, and will pay to the Contractor the replacement value of all temporary facilities and all parts thereof lost, destroyed or damaged. If the

Employer requests the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Contractor shall make good the same at the cost of the Employer in accordance with CC Clause 39 (Change in the Facilities). If the Employer does not request the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Employer shall either request a change in accordance with CC Clause 39 (Change in the Facilities), excluding the performance of that part of the Facilities thereby lost, destroyed or damaged, or, where the loss or damage affects a substantial part of the Facilities, the Employer shall terminate the Contract pursuant to CC Sub-Clause 42.1 (Termination for Employer's Convenience) hereof, except that the Contractor shall have no entitlement to profit under paragraph (e) of CC Sub Clause 42.1.3 in respect of any unexecuted Facilities as at the date of termination.

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

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

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

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

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

If the Contractor fails to notify the Employer within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the twenty-eight (28) day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim.

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

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

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

34. Insurance

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

(a) Transit / Marine insurance: During supply of materials for Supply/ Supply portion of Contract

Covering loss or damage occurring while in transit from the manufacturer's or Contractor's or Subcontractor's works or stores until arrival at the Site, to the Plant and Equipment (including spare parts thereof) and to the Contractor's Equipment. Concerned supplier/Contractor shall take such policy and ensure its validity upto 90days of receipt of Plant and Equipment (including spare parts thereof) at employer's store or store of the contractor's as the case may be. Evidence of such policy shall be furnished by contractor alongwith dispatch documents.

(b) **Storage Cum Erection (SCE)/Installation Insurance: All Risks Coverage**

Covering physical loss or damage to all the equipment, material and facilities being supplied, under the contract, from point of receipt at site including handling, storage, erection, testing etc till Completion of the Facilities, with an extended maintenance coverage for the Contractor's liability in respect of any loss or damage occurring during the Defect Liability Period while the Contractor is on the Site for the purpose of performing its obligations during the Defect Liability Period. Concerned Erector /Contractor shall take such policy.

(c) **Materials/Plants/ Equipments supplied By Employer**

Covering physical loss or damage to all the equipment, material and facilities being supplied for erection or use, under the contract, from point of receipt at site including handling, storage, erection, testing etc till Completion of the Facilities.

(d) Third Party Liability Insurance

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

(e) Automobile Liability Insurance

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

(f) Workers' Compensation

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

(g) Employer's Liability

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

(h) Other Insurances

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

34.2 All the insurance policies pertaining to Storage Cum Erection /Installation & all Risk Coverage except transit insurance shall be taken in the name of DTL unless otherwise specified. All such policy shall indicate DTL as beneficiary and DTL shall be named as co-insured under all other insurance policies taken out by the Contractor pursuant to CC Sub-Clause 34.1, except for the Third Party Liability, Workers' Compensation and Employer's Liability Insurances, and the Contractor's Subcontractors shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to CC Sub-Clause 34.1 except for the Transit / Marine insurance During Transport, Workers' Compensation and Employer's Liability Insurances.. All insurer's rights of subrogation against such co-insured for losses or claims arising out of the performance of the Contract shall be waived under such policies.

34.3 The Contractor shall, in accordance with the provisions of Appendix 3 (Insurance Requirements) to the Contract Agreement, deliver to the Employer certificates of insurance (or copies of the insurance policies) as evidence that the required policies are in full force and effect. The certificates shall provide that no less than twenty-one (21) days' notice shall be given to the Employer by insurers prior to cancellation or material modification of a policy.

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

34.5 The Employer shall at its expense take out and maintain in effect during the performance of the Contract those insurances specified in Appendix 3 (Insurance Requirements) to the Contract Agreement, in the sums and with the deductibles and other conditions specified in the said Appendix. The Contractor and the Contractor's Subcontractors shall be named as co-insureds under all such policies. All insurers' rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies. The Employer shall deliver to the Contractor satisfactory evidence that the required insurances are in full force and effect. The policies shall provide that not less than twenty-one (21) days' notice shall be given to the Contractor by all insurers prior to any cancellation or material modification of the policies. If so requested by the Contractor, the Employer shall provide copies of the policies taken out by the Employer under this CC Sub-Clause 34.5.

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

34.7 Unless otherwise provided in the Contract, the Contractor shall prepare, lodge, pursue and conduct and settle all and any claims made under the policies effected by it pursuant to this CC Clause 34, with the insurance company in case of theft, pilferage, fire etc under information to employer and the monies payable by any insurers under all the insurance except Third Party Liability Insurance, Workers' Compensation, and Employer's Liability, shall be paid to the joint account of the Employer and the Contractor and such amounts paid shall be apportioned between the Employer and the Contractor in accordance with the respective responsibilities under the Contract. The Employer shall give to the Contractor all such reasonable assistance as may be required by the Contractor. With respect to insurance claims in which the Employer's interest is involved, the Contractor shall not give any release or make any compromise with the insurer without the prior written consent of the Employer. With respect to insurance claims in which the Contractor's interest is involved, the Employer shall not give any release or make any compromise with the insurer without the prior written consent of the Contractor. The Contractor shall replace the lost/ damaged plants/materials/ equipments/ works/ foundations or Employer supplied items promptly irrespective of the settlement of claims by the underwriter.

35. Unforeseen Conditions

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

(a) the physical conditions or artificial obstructions on the Site that could not have been reasonably foreseen

(b) the additional work and/or Plant and Equipment and/ or Contractor's Equipment required, including the steps which the Contractor will or proposes to take to overcome such conditions or obstructions

(c) the extent of the anticipated delay

(d) the additional cost and expense that the Contractor is likely to incur.

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

35.2 Any reasonable additional cost and expense incurred by the Contractor in following the instructions from the Project Manager to overcome such physical conditions or artificial obstructions referred to in CC Sub-

Clause 35.1 shall be paid by the Employer to the Contractor as an addition to the Contract Price.

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

36. Change in Laws and Regulations

36.1 If, after the date twenty-eight (28) days prior to the date of Bid submission, in the country where the Site is located, any law, regulation, ordinance, order or by-law having the force of law is enacted, promulgated, abrogated or changed (which shall be deemed to include any change in interpretation or application by the competent authorities) that subsequently affects the costs and expenses of the Contractor and/or the Time for Completion, the Contract Price shall be correspondingly increased or decreased, and/or the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been affected in the performance of any of its obligations under the Contract. However, these adjustments would be restricted to direct transactions between the Employer and the Contractor and not on procurement of raw materials, intermediary components etc. by the Contractor. Further, no adjustment of the Contract Price shall be made on account of variation in deemed export benefits. Notwithstanding the foregoing, such additional or reduced costs shall not be separately paid or credited if the same has already been accounted for in the price adjustment provisions where applicable, in accordance with the Appendix 2 to the Contract Agreement.

37. Force Majeure

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

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

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

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

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

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

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

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

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

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

37.5 No delay or nonperformance by either party hereto caused by the occurrence of any event of Force Majeure shall

(a) constitute a default or breach of the Contract

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

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

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

38. War Risks

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

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

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

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

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

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

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

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

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

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

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

38.5 If during the performance of the Contract any war risks shall occur that financially or otherwise materially affect the execution of the Contract by the Contractor with due and proper consideration given to the safety of its and its Subcontractors personal engaged in the work on the facilities, provided, however, that if the execution of the work on the facilities becomes impossible or is substantially prevented for a single period of more than sixty (60) days or an aggregate period of more the one hundred and twenty (120)

days on account of any war Risks, the parties will attempt to develop a mutually satisfactory solution, failing which the dispatch will be resolved in accordance with CC Clause.6.

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

H. Change in Contract Elements

39. Change in the Facilities

39.1 Introducing a Change

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

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

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

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

39.2 Changes Originating from Employer

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

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

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

(a) accept the Contractor's estimate with instructions to the Contractor to proceed with the preparation of the Change Proposal

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

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

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

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

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

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

39.2.6 If rates and prices of any change are not available in the contract, the parties thereto shall agree on specific rates for the valuation of the change. Upon receipt of the change proposal, the employer and the contractor shall mutually agree upon all matters therein contained. With in fourteen (14) days after such agreement, the employer shall, if it intends to proceed with change, issue the contractor with a change order.

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

If the employer decides not to proceed with the change for whatever reason, it shall, with in the said period of fourteen (14) days, notify the contractor accordingly. Under such circumstances, the contractor shall be entitled to reimbursement of all costs reasonably incurred by it in the preparation of the change proposal, provided that these do not exceed the amount given by the Contractor in its estimate for change proposal submitted in accordance with CC Sub – Clause 39.2.2.

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

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

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

39.3 Changes Originating from Contractor

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

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

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

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

conditions of the contract. However, the quantities of individual items of goods and services may vary up to any extent.

b) The contract price for (i) items for which quantities have been indicated as lumpsum / lot/ set (ii) items for which quantities were to be estimated by the bidder, including additional items (falling under (i) and /or (ii) considered necessary by the bidder for successful completion of the works as per TS and indicated by him in his bid, shall remain constant unless there is change made in the scope of work by the employer. The quantities and unit prices (a) subsequently arrived while approving the bill of quantities (BOQ)/ billing breakup of lumpsum/lot/set quantities and/ or (b) quantities estimated by the bidder /contractor shall be for on account payment purpose only. In case additional quantities, over and above the quantities in BOQ/ billing break up and/or estimated by the bidder/contractor are required for the successful completion of the scope of work as per technical specification, the contractor shall execute additional quantities of these items for which no additional payments shall be made over and above the lumpsum contract price.

In case quantities of these items supplied at site are in excess of that required for successful completion of scope of work, such additional quantities shall be property of the contractor and contractor shall be allowed to take back the same from the site for which no deduction from the lumpsum contract price shall be made. Further in case actual requirement of quantities for successful completion of scope of work is less than the quantities identified in the approved BOQ/ billing break up and/or estimated by the bidder/ contractor, the lumpsum contract price shall remain unchanged and no deduction shall be made from the lumpsum price due to such reduction of quantities. It shall be the responsibility of the bidder to pay all 6statutory taxes, duties and levies to the concerned authority's surplus material which would otherwise have been, lawfully payable. The bidder shall submit an indemnity bond to keep the employer harmless from any liability, before release to such martial to the bidder by the employer**.**

c) The quantity variation from the existing scope shall be notified to the contractor within the validity of contract.

40. Extension of Time for Completion

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

(a) any Change in the Facilities as provided in CC Clause 39 (Change in the Facilities)

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

(c) any suspension order given by the Employer under CC Clause 41 (Suspension) hereof or reduction in the rate of progress pursuant to CC Sub-Clause 41.2 or

(d) any changes in laws and regulations as provided in CC Clause 36 (Change in Laws and Regulations) or

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

(f) any other matter specifically mentioned in the Contract;

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

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

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

41. Suspension

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

If, by virtue of a suspension order given by the Project Manager, other than by reason of the Contractor's default or breach of the Contract, the Contractor's performance of any of its obligations is suspended for an aggregate period of more than ninety (90) days, then at any time thereafter and provided that at that time such performance is still suspended, the Contractor may give a notice to the Project Manager requiring that the Employer shall, within twenty-eight (28) days of receipt of the notice, order the resumption of such performance or request and subsequently order a change in accordance with CC Clause 39 (Change in the Facilities), excluding the performance of the suspended obligations from the Contract.

If the Employer fails to do so within such period, the Contractor may, by a further notice to the Project Manager, elect to treat the suspension, where it affects a part only of the Facilities, as a deletion of such part in accordance with CC Clause 39 (Change in the Facilities) or, where it affects the whole of the Facilities, as termination of the Contract under CC Sub-Clause 42.1 (Termination for Employer's Convenience).

41.2 In case,

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

(b) the Contractor is unable to carry out any of its obligations under the Contract for any reason attributable to the Employer, including but not limited to the Employer's failure to provide possession of or access to the Site or other areas in accordance with CC Sub-Clause 10.2, or failure to obtain any governmental permit necessary for the execution and/or completion of the Facilities; then the Contractor may by fourteen (14) days' notice to the Employer suspend performance of all or any of its obligations under the Contract, or reduce the rate of progress.

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

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

42. Termination

42.1 Termination for Employer's Convenience

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

42.1.2 Upon receipt of the notice of termination under CC Sub-Clause 42.1.1, the Contractor shall either immediately or upon the date specified in the notice of termination

(a) cease all further work, except for such work as the Employer may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition

(b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d)(ii) below

(c) remove all Contractor's Equipment from the Site, repatriate the Contractor's and its Subcontractors' personnel from the Site, remove from the Site any wreckage, rubbish and debris of any kind, and leave the whole of the Site in a clean and safe condition

(d) In addition, the Contractor, subject to the payment specified in CC SubClause 42.1.3, shall

(i) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination.

(ii) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant and Equipment as at the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors

(iii) deliver to the Employer all non-proprietary drawings, specifications and other documents prepared by the Contractor or its Subcontractors as at the date of termination in connection with the Facilities.

42.1.3 In the event of termination of the Contract under CC Sub-Clause 42.1.1, the Employer shall pay to the Contractor the following amounts:

a. The Contract Price, properly attributable to the parts of the Facilities executed by the Contractor as on the date of termination

b. The costs reasonably incurred by the Contractor in the removal of the Contractor's Equipment from the Site and in the repatriation of the Contractor's and its Subcontractors' personnel

c. The amounts to be paid by the Contractor to its Subcontractors in connection with the termination of any subcontracts, including any cancellation charges

d. Costs incurred by the Contractor in protecting the Facilities and leaving the Site in a clean and safe condition pursuant to paragraph (a) of CC Sub-Clause 42.1.2

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

42.2 Termination for Contractor's Default

42.2.1 The Employer, without prejudice to any other rights or remedies it may possess, may terminate the Contract forthwith in the following circumstances by giving a notice of termination and its reasons therefore to the Contractor, referring to this CC Sub-Clause 42.2 and Performance security (CPG) will be forfeited:

(a) if the Contractor becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, if the Contractor is a corporation, a resolution is passed or order is made for its winding up (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), a receiver is appointed over any part of its undertaking or assets, or if the Contractor takes or suffers any other analogous action in consequence of debt.

(b) if the Contractor assigns or transfers the Contract or any right or interest therein in violation of the provision of CC Clause 43 (Assignment).

(c) if the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.

For the purpose of this sub-clause :

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

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

42.2.2 If the Contractor

(a) has abandoned or repudiated the Contract

(b) has without valid reason failed to commence work on the Facilities promptly or has suspended (other than pursuant to CC Sub-Clause 41.2) the progress of Contract performance for more than twenty-eight (28) days after receiving a written instruction from the Employer to proceed

(c) persistently fails to execute the Contract in accordance with the Contract or persistently neglects to carry out its obligations under the Contract without just cause

(d) refuses or is unable to provide sufficient materials, services or labour to execute and complete the Facilities in the manner specified in the program furnished under CC Clause 18.2 (Program of Performance) at rates of progress that give reasonable assurance to the Employer that the Contractor can attain Completion of the Facilities by the Time for Completion as extended.

then the Employer may, without prejudice to any other rights it may possess under the Contract, give a notice to the Contractor stating the nature of the default and requiring the Contractor to remedy the same. If the Contractor fails to remedy or to take steps to remedy the same within fourteen (14) days of its receipt of such notice, then the Employer may terminate the Contract forthwith by giving a notice of termination to the Contractor that refers to this CC SubClause 42.2

42.2.3 Upon receipt of the notice of termination under CC Sub-Clauses.42.2.1 or 42.2.2, the Contractor shall, either immediately or upon such date as is specified in the notice of termination,

(a) cease all further work, except for such work as the Employer may specify in the notice of termination for the sole purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition

(b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d) below

(c) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination

(d) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Works and to the Plant and Equipment as at the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors

(e) deliver to the Employer all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as at the date of termination in connection with the Facilities.

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

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

42.2.5 Subject to CC Sub-Clause 42.2.6, the Contractor shall be entitled to be paid the Contract Price attributable to the Facilities executed as at the date of termination, the value of any unused or partially used Plant and Equipment on the Site, and the costs, if any, incurred in protecting the Facilities and in leaving the Site in a clean and safe condition pursuant to paragraph (a) of CC SubClause 42.2.3. Any sums due 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.

42.2.6 If the Employer completes the Facilities, the cost of completing the Facilities by the Employer shall be determined. If the sum that the Contractor is entitled to be paid, pursuant to CC SubClause 42.2.5, plus the reasonable costs incurred by the Employer in completing the Facilities, exceeds the Contract Price, the Contractor shall be liable for such excess.

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

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

42.3 Termination by Contractor

42.3.1 If

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

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

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

42.3.2 The Contractor may terminate the Contract forthwith by giving a notice to the Employer to that effect, referring to this CC Sub-Clause 42.3.2, if the Employer becomes bankrupt or insolvent, has a receiving order issued against it, compounds with its creditors, or, being a corporation, if a resolution is passed or order is made for its winding up (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), a receiver is appointed over any part of its undertaking or assets, or if the Employer takes or suffers any other analogous action in consequence of debt.

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

(a) cease all further work, except for such work as may be necessary for the purpose of protecting that part of the Facilities already executed, or any work required to leave the Site in a clean and safe condition

(b) terminate all subcontracts, except those to be assigned to the Employer pursuant to paragraph (d)(ii) below

(c) remove all Contractor's Equipment from the Site and repatriate the Contractor's and its Subcontractor's personnel from the Site

(d) In addition, the Contractor, subject to the payment specified in CC Sub-Clause 42.3.4, shall

(i) deliver to the Employer the parts of the Facilities executed by the Contractor up to the date of termination

(ii) to the extent legally possible, assign to the Employer all right, title and benefit of the Contractor to the Facilities and to the Plant and Equipment as on the date of termination, and, as may be required by the Employer, in any subcontracts concluded between the Contractor and its Subcontractors

(iii) deliver to the Employer all drawings, specifications and other documents prepared by the Contractor or its Subcontractors as on the date of termination in connection with the Facilities.

42.3.4 If the Contract is terminated under CC Sub-Clauses 42.3.1 or 42.3.2, the Employer shall pay to the Contractor all payments specified in CC Sub-Clause 42.1.3, and reasonable compensation for all loss or damage sustained by the Contractor arising out of, in connection with or in consequence of such termination.

42.3.5 Termination by the Contractor pursuant to this CC Sub-Clause 42.3 is without prejudice to any other rights or remedies of the Contractor that may be exercised in lieu of or in addition to rights conferred by CC Sub-Clause 42.3.

42.4 In this CC Clause 42, the expression "Facilities executed" shall include all work executed, Installation Services provided, and Plant and Equipment acquired (or subject to a legally binding obligation to purchase) by the Contractor and used or intended to be used for the purpose of the Facilities, up to and including the date of termination.

42.5 In this CC Clause 42, in calculating any monies due from the Employer to the Contractor, account shall be taken of any sum previously paid by the Employer to the Contractor under the Contract, including any advance payment paid pursuant to Appendix 1 (Terms and Procedures of Payment) to the Contract Agreement.

43. Assignment

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

44 Construction of the contract

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

For Domestic Bidder:

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

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

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

44.3 Deleted

44.4 Deleted

44.5 In case of two contracts entered into as above or 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 equipment through bill of lading or other dispatch documents, furnish trust receipt for plant, equipment and materials and also execute an Indemnity bond in favour of the employer in the form acceptable to the employer for keeping the equipment in safe custody and to utilize the same exclusively for the purpose of the said Contract. Samples of Performa for the Trust receipt and Indemnity bond are enclosed under Section IV (Sample forms and procedures). The employer shall also issue separate authorization letter to the Contractor to enable him to take physical delivery of plant, equipment and materials from the employer as per Performa enclosed under Section IV (sample forms and procedures).

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

44.7 The contractor shall provide free of cost to the employer all the engineering data, drawing and descriptive materials submitted with the bid, in at least two (2) copies to form a part of the contract immediately after notification of Award.

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

45. Specific Requirement

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

46. DTL not to be made party in case of dispute between Contactor and Sub contactor Vendor.

47. **BLACK-LISTING OF FIRMS/ BANNING OF BUSINESS**

DTL may decide to black-list firms or ban business with them, for specified time, based on facts and circumstances of the particular case generally on the following grounds:

i. Corrupt or Fraudulent practices resorted to by Contractor including mis-representation of facts.
ii. Willful indulgence by the Contractor in supplying sub-standard material irrespective of whether pre-dispatch inspection conducted by DTL or not.
iii. Repeated use of delaying tactic in fulfilling contractual obligations willfully.
iv. Established litigant nature of the contractor to derive undue benefit.
v. Poor performance in one or more contracts.

SECTION-V

SPECIAL CONDITIONS OF CONTRACT (SCC)

SECTION-V

SPECIAL CONDITIONS OF CONTRACT (SCC)

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

<table>
<tr><th>Sl. No.</th><th>CC Clause Ref. No.</th><th>Amendment/Supplement to CC</th></tr>
<tr><td>1.</td><td>CC 1.1 & Appendix -4 of Section-F&P</td><td><u>Time/Project Completion Schedule</u>
<table>
<tr><th>Description</th><th>Duration in Months form the effective date of contract</th></tr>
<tr><td>A :- Turnkey package “A” for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).</td><td>12 months</td></tr>
<tr><td>B :- Turnkey package “B” for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).</td><td>12 months</td></tr>
<tr><td>C :- Turnkey package “C” for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).</td><td>09 months</td></tr>
</table></td></tr>
</table>

Sl. No.	CC Clause Ref. No.	Amendment/Supplement to CC
2.	CC 42.2.1	"The Employer, without prejudice to any other rights or remedies it may possess, may terminate the Contract forthwith in the following circumstances by giving a notice of termination and its reasons therefore to the Contractor, referring to this CC Sub-Clause 42.2" may be read as "The Employer, without prejudice to any other rights or remedies it may possess, may terminate the Contract forthwith in the following circumstances by giving a notice of termination and its reasons therefore to the Contractor, referring to this CC Sub-Clause 42.2 and Performance security (CPG) will be forfeited."

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

SECTION-VI

FORMS AND PROCEDURES (F&P)

1. BID FORM

Please Refer Volume III

2. BANK GUARANTEE FOR BID SECURITY

Ref … Bank Guarantee No……
Date ...……

To

_____

_____

Dear Sir,

In accordance with your invitation for Bid under your Specification No……M/s…… ……..having its Registered Office ……..(hereinafter called the "Bidder") wish to participate in the said Bid for ……... and you, as a special favour, have agreed to accept Bank Bid Guarantee for an amount of Rs……(Rupees…….only) valid upto …….. on behalf of the Bidder in lieu of Bid deposit required to be made by the Bidder, as a condition precedent for participation in the said Bid.

We, ……. having our Registered Office at ……. guarantee and undertake to pay immediately on demand by Delhi Transco Limited the amount of Rs……./- (Rupees…….Only) without any reservation, protest, demur and recourse. Any such demand made by said 'Owner' i.e. Delhi Transco Limited or its authorized representative shall be conclusive and binding on us irrespective of any dispute or difference raised by the bidder.

This guarantee shall remain valid upto ……. If any further extension of this guarantee is required, the same shall be extended to such required period on receiving instructions from M/s……..on whose behalf this guarantee is issued.

In witness whereof the Scheduled Bank, through its authorized Officer, has set its hand and stamp on this …… day of ……at…….

Designation with Bank (Scheduled) Stamp

Name: _____
Phone No. _____
Domain e-mail Id _____
Official address _____

	WITNESS 1	WITNESS 2
Signatue		
Name		
Address		

3a. FORM OF NOTIFICATION BY THE EMPLOYER TO THE BIDDER FOR FORFEITURE OF BID GUARANTEE AMOUNT

M/s…….

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

Dear Sirs,

Whereas you have furnished as a part of your proposal the Bid Guarantee in the form of irrevocable and confirmed Letter of Credit No..... .dated.....…..... opened by ……..for a sum of…… .. (Bank's name) …….....payable to..... .....Name of the Employer) on demand without any reservation, demur or protest, contest and recourse at....……(Name and place of Bank).

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

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

(AUTHORISED SIGNATORY)

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

3b. FORM OF SIGHT DRAFT

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

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

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

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

(AUTHORISED SIGNATORY)

To,

(Name and Address of the Bank which opened L.C.)

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

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

Ref. No. :

Date :

…..(Contractor's Name & Address)…...

Attn : Mr.....

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

Dear Sir,

1.0 This has reference to the following:

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

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

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

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

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

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

(Applicable only if any clarification to the Bidding Documents has been issued subsequently)

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

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

letter no……dated ..... (Delete if not applicable).

(v) Our Fax message/letter No. ……...dated…….....
regarding extension of validity of bid and that of the Bank Guarantee towards Bid Security.

(Applicable only if any extension has been sought subsequently)

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

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

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

(a) Minutes of Meeting regarding Commercial issues (APPENDIX - ....)

(b) Minutes of Meeting on Technical issues (APPENDIX - ....)

(c) Minutes of Meeting regarding Work Schedule (APPENDIX - ....)

(d) Minutes of Meeting regarding Quality Assurance Aspects (APPENDIX- …...)

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

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

responsibility/obligations under this 'First Contract'. It is also expressly understood and agreed by you that the equipment/materials to be supplied by you under this 'First Contract' when installed and commissioned under the 'Second Contract' shall give satisfactory performance in accordance with the provisions of the Contract.

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

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

(ii) Ex-manufacturing works/place
……
of dispatch price (both in India)/ CIF/CIP port of entry price
(Use as Applicable)
for Mandatory Spares

(iii) Type test charges
……
(Delete if not applicable)

TOTAL (i + ii + iii)

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

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

6.0 This Notification of Award is being issued to you in duplicate. We request you to return its duplicate copy duly signed and stamped on each page including all the enclosed Appendices, by the authorized signatory of your company as a proof of your acknowledgement and confirmation.

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

Yours faithfully,
for and on behalf of
..(Name of the Employer)...

(Authorised Signatory)

Encl. : As above.

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

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

Ref. No. :

Date :

…(Contractor's Name & Address)...

Attn : Mr……...

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

Dear Sir,

1.0 This has reference to the following:

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

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

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

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

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

(Applicable only if any clarification to the Bidding Documents has been issued subsequently)

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

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

…….…….dated..... (Delete if not applicable).

(v) Our Fax message/letter no. …….. Dated..... regarding extension of validity of bid and that of the Bank Guarantee towards Bid Security.

(Applicable only if any extension has been sought subsequently)

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

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

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

(a) Minutes of Meeting regarding Commercial issues (APPENDIX - ....)

(b) Minutes of Meeting on Technical issues (APPENDIX - ....)

(c) Minutes of Meeting regarding Work Schedule (APPENDIX - ....)

(d) Minutes of Meeting regarding Quality Assurance Aspects (APPENDIX - …..)

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

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

equipment/materials to be supplied by you under the 'First Contract' when erected and commissioned under this 'Second Contract' shall give satisfactory performance in accordance with the provisions of the Contract.

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

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

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

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

TOTAL (i + ii + iii)

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

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

6.0 This Notification of Award is being issued to you in duplicate. We request you to return its duplicate copy duly signed and stamped on each page including all the enclosed Appendices, by the authorized signatory of your company as a proof of your acknowledgement and confirmation.

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

Yours faithfully,
for and on behalf of

..(Name of the Employer)...

(Authorised Signatory)

5. FORM OF CONTRACT AGREEMENT

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

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

and

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

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

……..... ("the Facilities") and the
(List of Facilities)
Contractor has agreed to such engagement upon and subject to the terms and conditions hereinafter appearing.

NOW IT IS HEREBY AGREED as follows:

Article 1. Contract Documents

1.1 Contract Documents (Reference CC Clause 2)

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

(1) This Contract Agreement and the Appendices hereto

(2) Notification of Award.

(3) Conditions of Contract and SCC

(4) Technical Specifications and Drawings

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

(6) Procedures (as listed)

(7) Any other documents shall be added here

1.2 Order of Precedence (Reference CC Clause 2)

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

1.3 Definitions (Reference CC Clause 1)

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

Article 2. Contract Price and Terms of Payment

2.1 Contract Price (Reference CC Clause 11)

The Employer hereby agrees to pay to the Contractor the Contract Price in consideration of the performance by the Contractor of its obligations hereunder. The Contract Price shall be the aggregate of:

……..

……... …….
(amount in words)

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

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

2.2 Terms of Payment (Reference CC Clause 12)

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

Article 3. Effective Date for Determining Time for Completion

3.1 Effective Date (Reference CC Clause 1)

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

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

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

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

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

3.2 If the Conditions listed under 3.1 are not fulfilled within two (2) months from date of Notification of Award because of reasons attributable to the Employer, the contract would become effective only from the date of fulfillment of the above conditions and, the parties shall discuss and agree on an equitable adjustment to the Contract Price and the time for completion and/or other relevant conditions of the Contract. The Contractor shall not however, benefit (in reckoning the Time for Completion) on account of its delay in providing the Performance Security or the Bank Guarantee for advance payment beyond the period provided in the Contract.

Article 4. It is expressly understood and agreed by and between the Contractor and the Employer that the Employer is entering into this Agreement solely on its own behalf and not on behalf of any other person or entity. In particular it is expressly understood and agreed that the Government of India (GoI) is not a party to this Agreement and has no liabilities, obligations or rights hereunder. It is expressly understood and agreed that the Employer is an independent legal entity with power and authority to enter into contracts solely on its own behalf under the applicable laws of India and the general principals of Contract Law.

The Contractor expressly agrees, acknowledges and understands that the Employer is not an Agent, Representative or Delegate of the GoI. It is further understood and agreed that the GoI is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the Contract. Accordingly, the Contractor expressly waives, releases and foregoes any and all actions or claims, including cross claims, impleader claims or counter claims against the GoI arising out of this Contract and covenants not to sue the GoI as to any manner, claim, cause of action or thing whatsoever arising of or under this Agreement.

Article 5. Appendices

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

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

Article 6. Deleted

Article 7. Notwithstanding the award of contract under two separate contracts, any breach under one contract shall be deemed to be a breach of the other contract(s).

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

Signed by for and on behalf of the Employer	Signed by for and on behalf of the Contractor
Signature	Signature
Title	Title
in the presence of	in the presence of

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

BETWEEN

("the Employer")

and

("the Contractor")

(Separate Contract Agreements shall be executed by the Employer and the Contractor in accordance with the Construction of the Contract stipulated at clause 44 of CC. The forms of Contract would be similar except for necessary changes required to suit the individual Contracts).

APPENDICES

Appendix 1	Terms and Procedures of Payment
Appendix 2	Price Adjustment
Appendix 3	Insurance Requirements
Appendix 4	Time Schedule
Appendix 5	List of Approved Subcontractors
Appendix 6	Scope of Works and Supply by the Employer
Appendix 7	List of Document for Approval or Review
Appendix 8	Functional Guarantees
Appendix 9	Integrity Pact (*to be appended at the Stage of Contract Award.)*

APPENDIX 1

1.0 TERMS AND PROCEDURES OF PAYMENT

The payment to the Contractor under the Contract will be made by the Owner in line with Clause 12.0 , Section-CC, Conditions of Contract, Volume-I of the Bidding Documents and as per the guidelines and conditions specified hereunder, on the basis of the Price Break-up given in the section on price schedules. Payments will be made in Indian currency i.e. INR. The Contractor may make applications for payment in respect of part deliveries as work proceeds.

In addition to the Conditions stipulated under Clause 12.0, Section-CC, Conditions of Contract, the following terms & Conditions will apply.

All payments made during the Contract will be on account payment only.

1.1 Supply Portion

a) Advance Payment

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

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

Note:

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

**The bank guarantee(s) for advance shall be kept valid till 90 days after issuance of Operational Acceptance Certificate. Recovery of the advance amount shall be made from each running bill proportionately.

b) Progressive Payment

i) Fifty percent (50%) [##] of the CIF / Ex-works price component (inclusive of mandatory spares) of each item (as identified in the price schedule) shipped shall be paid through irrevocable Letter of Credit (L/C) established in favour of the Contractor and on submission of documents specified in CC Clause 21.0.

[##] In case, the Contractor opts not to take interest bearing initial advance then this payment shall be 60% instead of 50%.

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

iii) For mandatory spares, balance Forty percent (40%) of the CIF / Ex-Works Price of each item shipped shall be paid after receipt and storage of material at site and on physical verification by the Employer.

c) Final Payment

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

1.2 DELETED

1.3 TRANSPORTATION & INSURANCE CHARGES

Hundred Percent (100%) of transportation and insurance charges shall be paid to the Contractor pro-rata to the value of the equipment received at site and on production of invoices by the Contractor. The aggregate of all such pro-rata payments shall, however, not exceed the total amount quoted by the bidder in his proposal and incorporated in the Contract.

1.4 ERECTION PRICE COMPONENT (INCLUDING CHARGES FOR CIVIL WORKS)

a) Advance

Ten Percent (10%) of the total Contract Price for services viz. installation (including civil works) component except transportation & insurance shall be paid as * interest bearing initial advance on establishment of Contractor's Site office and submission of a bank guarantee* of 110% of the advance amount valid till 90 days after issuance of Operational Acceptance Certificate.

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

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

In case, the Contractor opts not to take interest bearing advance as above, it would be mandatory for him to submit the documents listed at S. No.(i), (iv),(v) and (vi) of 1.1 (a) above within thirty (30)days of issuance of LOA.

b) Progressive Payment

Ninety Percent (90%) of the total installation (including civil works) component of the Contract price (In case the contractor opts not to take interest bearing advance as above) or Eighty percent (80%) of the total installation (including civil works) component of the Contract price (In case the contractor opts to take interest bearing advance as above) shall be paid on certification by employer representative for the successful completion of installation services based on mile stone.

c) Final Payment

The balance Ten Percent (10%) of the total installation (including civil works) price components of contracts price shall be paid on final issuance of Operational Acceptance Certificate after successful completion of erection, testing and commissioning, proof of submission of the required no. of reproducible, O&M manuals, approved drawings, data sheets, test reports, pamphlets and manual of spares, maintenance & testing equipment etc.

1.5 Deleted

1.6 "Commissioning" for the purpose of payments shall mean satisfactory completion of all supplies, erection, inspection, commissioning checks and successful completion of all site tests and continuous energisation of the equipment/ materials at rated voltage at site as per the Contract and to the satisfaction/ approval of DTL. The contractor will clear the sites and the balance materials, if any, will be shifted to proper place as per instruction of the Site Engineer. The necessary "No Dues Certificates" for electricity and water will required to be submitted, if any, from local agency(s)/ authority(s).

1.7 **Taxes & Duties**

Taxes & Duties in respect of transaction between Employer and the Contractor as applicable for destination site/state on all items of supply including bought-out finished items (as identified in the Contract), which shall be dispatched directly from the sub-vendor's works to the Employer's site will be paid after each shipment against documentary evidence. This payment shall be released by Employer directly to the Contractor against invoices to be submitted by the Contractor.

1.8 MODE OF PAYMENT

Payments shall be made by DTL within Thirty (30) days of receipt of Complete GST compliance tax invoices and supported by the requisite documents and fulfillment of stipulated conditions, if any. All the payment shall be released to the Contractor directly through ECS. For this the contractor shall have to provide their Bank Account No., Bank Name, RTGS / MICR / IFSC and other details to our AM(F)SB / AM(F)Works, II nd Floor, pre-fabricated building, Rajghat Power House, New Delhi - 110002.

Payment of GST component shall be made only if vendor deposited the GST and the credit for the same reflected in the form GSTR3 (Monthly Return) of the GST network and in case of dis- allowance of credit in GSTR3, the amount shall be recovered from vendor with the penalty as per the provision stipulated in GST Act/Law.

APPENDIX 2

PRICE ADJUSTMENT

The prices are to remain FIRM and FIXED for the duration of the Contract except for Civil Works.

Price adjustment for Civil Works

The cost of Civil Works as per approved indices of CPWD shall be calculated due to increase/decrease in price of cement and steel reinforcement bars after receipt of tender as given below:

CLAUSE: PAYMENT DUE TO INCREASE/DECREASE IN PRICES OF CEMENT AND STEEL REINFORCEMENT BARS AFTER RECEIPT OF TENDER.

If after submission of the tender, the price of cement and/or steel reinforcement bars incorporated in the works (not being a material supplied from the Engineer-in Charge's stores in accordance with relevant contract clause thereof) increase(s) beyond the price(s) prevailing at the time of the last stipulated date for receipt of tenders (including extensions, if any) for the work, then the amount of the contract shall accordingly be varied and provided further that any such increase shall not be payable if such increase has become operative after the stipulated date of completion of work in question.

If after submission of the tender, the prices of cement and/or steel reinforcement bars incorporated in the works (not being a material stipulated from the Engineers-in-Charge's stores in accordance with the relevant contract clause thereof) is decreased. DTL shall in respect of these materials incorporated in the works (not being materials supplied from the Engineers-in-Charge's stores in accordance with the relevant contract clause thereof) be entitled to deduct from the dues of the contractor such amount as shall be equivalent to the difference between the prices of cement and/or steel reinforcement bars as prevailed at the time of last stipulated date for receipt of tenders including extensions if any for the work and the prices of these materials on the coming into force of such base price of cement and/or steel reinforcement bars issued under authority of Director General (Works) CPWD.

The increase/decrease in prices shall be determined by the All India Wholesale Price Indices for Cement and Steel (bars and rods) as published by Economic Advisor to Government of India, Ministry of Commerce and Industry and base price for cement and/or steel reinforcement bars as issued under authority of Director General (Works), CPWD as valid on the last stipulated date of receipt of tender, including extension if any and for the period under consideration.

The amount of the contract shall accordingly be varied for cement and/or steel reinforcement bars and will be worked out as per the formula given below:

a) Adjustment for component of '**Cement**'

$$Vc = Pc \times Qc \times \frac{CI - CIo}{CIo}$$

Where,

Vc = Variation in cement cost i.e. increase or decrease in the amount in rupees to be paid or recovered.

Pc = Base price of cement as issued under authority of DG(W), CPWD valid at the time of the last stipulated date of receipt of tender including extensions, if any.

Qc = Quantity of cement used in the works since previous bill.

CIo = All India Wholesale Price Index for cement as published by the Economic Advisor to Government of India, Ministry of Industry and Commerce & issued by DG (W) CPWD as valid on the last stipulated date of receipt of tenders including extensions, if any.

CI = All India Wholesale Price Index for cement for period under consideration as published by Economic advisor to Government of India, Ministry of Industry and Commerce & issued by DG (W) CPWD.

b) Adjustment for component of '**Steel**'

$$Vs = Ps \times Qs \times \frac{SI - SIo}{SIo}$$

Where,

Vs = Variation in cost of steel reinforcement bars i.e. increase or decrease in the amount in rupees to be paid or recovered.

Ps = Base price of steel reinforcement bars as issued under authority of DG(W), CPWD at the time of the last stipulated date of receipt of tender including extensions, if any.

Qs = Quantity of steel paid either by way of secured advance or used in the works since previous bill (whichever is earlier)

SIo = All India Wholesale Price Index for Steel (bars & rods) for the period under consideration as published by Economic Advisor to Government of India, Ministry of Industry and Commerce & issued by DG (W) CPWD as valid on the last stipulated date of receipt of tenders including extensions, if any.

SI = All India Wholesale Price Index for steel (bars & rods) for the period under consideration as published by Economic advisor to Government of India, Ministry of Industry and Commerce & issued by DG (W) CPWD.

APPENDIX 3

INSURANCE REQUIREMENTS

Insurances to be taken out by the Contractor

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

(a) Transit / Marine insurance During supply of materials for supply/ Supply portion of Contract

covering loss or damage occurring, whilst in transit from the Contractor's or manufacturer's works or stores until arrival at the Site, to the Facilities (including spare parts therefore) and to the Construction Equipment to be provided by the Contractor or its Subcontractors.

(i) For Imported Plant/ Equipment/ Materials

Amount	**Deductible limits**	**Parties Insured**	**From**	**To**
125%* of the (CIF value)	NIL	Contractor & Employer	Warehouse	Warehouse + 90 Days

***Price variation @ 10 % per Annum of CIF cost shall be taken subject to a maximum of 30% or specified otherwise, whichever is lower.**

(ii) For Domestic Plant/ Equipment/ Materials

Amount	**Deductible limits**	**Parties Insured**	**From**	**To**
110%* of the (FOR value)	NIL	Contractor & Employer	Warehouse	Warehouse + 90 Days

*Price variation @ 10 % per Annum of CIF cost shall be taken subject to a maximum of 30% or specified otherwise, whichever is lower.

(b) Storage Cum Erection (SCE)/ Installation Insurance: All Risks Coverage

Covering physical loss or damage to all the equipment, material and facilities being supplied, under the contract, from point of receipt at site to Completion of the Facilities/ commissioning including handling, storage, erection, testing etc with an extended maintenance coverage for the Contractor's liability in respect of any loss or

damage occurring during the Defect Liability Period while the Contractor is on the Site for the purpose of performing its obligations during the Defect Liability Period.

Amount	Deductible limits	Parties Insured	From	To
105% of the (Contract Price)	NIL	Contractor / Sub-contractor & Employer	Receipt at site	Upto Defect Liability period

(c) Materials/Plants/ Equipments supplied By Employer As per (a) Above

(d) Third Party Liability Insurance

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

Amount	Deductible limits	Parties Insured	From	To
Rs. 0.5 million per person per occasion	NIL	Contractor / Sub-contractor	Commencement of work	Upto Defect Liability period

(e) Automobile Liability Insurance

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

(f) Worker's Compensation

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

(g) Employer's Liability

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

(h) Other Insurances

The Contractor is also required to take out and maintain at its own cost the following insurances:

Amount	Deductible limits	Parties Insured	From	To
	NIL	Contractor / Sub-contractor & Employer	Receipt at site	Upto Defect Liability period

The Employer shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to CC Sub-Clause 34.1 above except for the Third Party Liability, Worker's Compensation and Employer's Liability Insurances, and the Contractor's Subcontractors shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to CC Sub Clause 34.1 above except for the **Transit / Marine insurance**, Worker's Compensation and Employer's Liability Insurances, and all insurer's rights of subrogation against such co-insured for losses or claims arising out of the performance of the Contract shall be waived under such policies.

Insurances to be taken out by the Employer

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

Details:...

Amount	Deductible limits	Parties Insured	From	To

---------- NIL----------

APPENDIX 4

TIME SCHEDULE

1. The Project Completion Schedule shall be as follows :

Sl. No.	Activities	Duration in months from the effective date of Contract
1.	Taking Over by the employer upon successful completion of A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).	12 Months
	B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).	12 Months
	C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).	09 Months

1.1 The bidder shall include in his proposal his programme for furnishing and installation of the equipment including related civil work covered under this package. The programme shall be in the form of a master network plan (MNW) and shall identify the various activities like design, engineering, manufacturing, supply, installation, factory testing, transportation to site, site testing and commissioning guarantee test and operational acceptance etc. of the entire project work. The network plan shall confirm to the above completion schedule. No credit will be given for earlier completion.

This master network will be discussed and agreed before Award in line with above, engineering drawing and data submission schedule shall also be discussed and finalized before Award. Liquidated damages for delay in successful completion of taking over at rates specified in Clause 26.2 of CC shall be applicable beyond the date specified above.

1.2 The employer reserves the right to request minor changes in the work schedule at

the time of Award of Contracts to the successful Bidder.

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

APPENDIX 5

LIST OF APPROVED SUBCONTRACTORS

Prior to award of Contract, the following details shall be completed indicating those sub-contractors proposed by the Bidder by Attachment to its bid that are approved by the Employer for engagement by the Contractor during the performance of the contract.

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

Item of Facilities	**Approved Subcontractors**	**Nationality**

APPENDIX 6

SCOPE OF WORKS AND SUPPLY BY THE EMPLOYER

The following personnel, facilities, works and supplies will be provided/ supplied by the Employer, and the provisions of CC 10, 20, 21 and 24 as well as Employer responsibilities stated in technical specifications shall apply as appropriate.

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

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

Personnel ***Charge to Contractor – None***

NIL

Facilities **Charge to Contractor - None except as noted**

1. Permission will be arranged by the Employer for full site and facilities access as required for site surveys and for the installation, connection and testing of complete equipment and systems. Such permission shall be requested by the Contractor one month prior to the Scheduled need for such access, consistent with the Contractors "Project Implementation Plan", Subsequent to approval of such "Plan" by Employer.

Electricity and Water ***Charge to Contractor - as noted***

The Contractor shall be entitled to use for the purposes of the facilities such supplies of electricity and water as may be available on the Site and shall provide any apparatus necessary for such use. The Contractor shall pay the Employer at the applicable tariff plus Employer's overheads, if any, for such use. Where such supplies are not available, the Contractor shall make his own arrangement for provision of any supplies he may require.

Works **Charge to Contractor - None**

----------NIL----------

Supplies **Charge to Contractor - None**

----------NIL----------

APPENDIX - 7

LIST OF DOCUMENTS FOR APPROVAL OR REVIEW

Pursuant to CC Sub-Clause 20.3.1, the Contractor shall prepare or cause its Subcontractor to prepare, and present to the Project Manager in accordance with the requirements of CC Sub-Clause 18.2 (Program of Performance), the following documents for:

A. Approval

1.

2.

3.

B. Review

1.

2.

3.

Note :

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

APPENDIX – 8

FUNCTIONAL GUARANTEES
GUARANTEES, LIQUIDATED DAMAGES FOR NON PERFORMANCE

1. The equipment offered shall meet the rating and performance requirements stipulated in Technical Specification for various equipment or indicated in Data requirement.

2. The ratings and performance figures of L.T Transformers furnished by us are guaranteed. We further declare that in the event of any deficiencies in meeting the guarantees in respect of the characteristics mentioned below as established after conducting the factory test, you may at your discretion, reject or accept the equipment after assessing the liquidated damages as specified in relevant clause of Bid Documents.

Equipment	**Guaranteed Losses at rated output (KW) per unit**		
	Copper Loss At 75° C	**Iron Loss at rated voltage and frequency**	**Cooler loss at rated voltage and frequency**
Package-A			
630 KVA L.T. Transformer (170kVp BIL)			
630 KVA L.T. Transformer (95kVp BIL)			
Package-B			
400 KVA L.T. Transformer (170kVp BIL)			
400 KVA L.T. Transformer (95kVp BIL)			
Package-C	Not Applicable		

3. If the guarantees are not established at factory test in case of L.T Transformer then the Employer at his discretion may reject or accept the equipment after assessing the liquidated damages as per table below against the Contract and such amounts shall be deducted from the Contract Price or otherwise recovered from the Contractor.

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

5. The factors and the respective Indian Rupees Value per unit of differential loss over and above the guaranteed for the purpose of calculation of liquated damages for non-performances shall be as stipulated below :

Equipment	Parameter to be taken for applying differential price Factor (F)	Value of F on Indian Rupees per unit of parameter Differential per KW
L.T Transformer	Differential Copper Loss (KW)	@ Rs.69900/-
	Differential Iron Loss (KW)	@ Rs.171300/-

6. PROFORMA OF BANK GUARANTEE FOR PERFORMANCE SECURITY

Bank Guarantee No…… Date …….....

To: *[Name and address of the Employer]*

1) In consideration of the Delhi Transco Limited (hereinafter called "The Undertaking") having agreed to accept from M/s…….. (hereinafter called the said contractor(s) from the demand, under the terms & conditions of an agreement dated…….. between Delhi Transco Limited& M/s……. for supply of……... Nos.…… in respect of NOA No……. dated……. (hereinafter called the agreement) security deposit for the due fulfillment of the said contract of the terms & conditions contained in the said agreement on production of Bank Guarantee for Rs……..…. (Rupees……...……..). We Name of Bank with address) (hereinafter referred to as "The Bank") do hereby undertake to pay to the undertaking amount not exceeding Rs……(Rupees……) against any loss or damage caused to or suffered or would be caused to the said contractor of any of the terms & conditions in the said agreement. As such demand made on the bank shall be conclusive as regards the amount due and payable by the bank under this guarantee. However, our liability under this guarantee shall be restrict to an amount not exceeding Rs…….. (Rupees…….).

2) We (Name of Bank with address) do hereby undertake to pay the amount due and payable under this guarantee without any demur, merely on a demand for the undertaking stating that the amount claimed due by a way of loss or damage caused to or would be caused to suffered by the undertaking by reason of any breach, by the said contractor(s) or any of the terms & conditions contained in the said agreement. Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs…… (Rupees……).

3) We (Name of Bank with address), further agree that the guarantee herein contained shall remain I full force and effect during the period that would be taken for performance of the said agreement and that it shall continue to be enforceable till all the dues of the undertaking by virtue of the said agreement have been fully paid and its claims satisfied or discharged of till (Date of validity) the undertaking certified that the terms & conditions of the said agreement have been fully and properly carried out by the said contractor(s) and accordingly guarantee is made on us in writing on or before the (Date of validity).

4) We (Name of Bank with address), further agree with the undertaking that the undertaking shall have the fullest liberty without our consent and without effecting in any manner our obligations hereunder to vary any of the agreement or to enforce any of the performance by the said contractor and to forebear or enforce any of the terms & conditions relating to the said or any such variation, or extension being warrantee to the said contract(s) for any forbearance, act or omission on the part of the undertaking or any indulgence by the Undertaking to the contractor(s) or by any such matter or thing

whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

5) We, (Name of Bank with address), lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Undertaking in writing and to extend the period of guarantee, if required for any reason.

6) "Notwithstanding anything contained herein above, our liability under this guarantee is restricted to Rs…… (Rupees……..) and the guarantee shall remain in force upto (date of validity) unless a demand or claim in writing is presented on the bank within (date of validity). The Bank shall be relieved and discharged from all liabilities there under"

Dated the…….. Day of …….200

For (Name of Bank)

(BRANCH MANAGER)

WITNESS

1…….

7. BANK GUARANTEE FORM FOR ADVANCE PAYMENT

Date……..
Contract No……..

[Name of Contract]

To: *[Name and address of the Employer]*

Dear Ladies and/or Gentlemen,

We refer to the Contract ("the Contract") signed on..... between you and..... .... ("the Contractor") concerning design, execution and completion of (Brief description of the Facilities) …….....

Whereas, in accordance with the terms of the said Contract, the Employer has agreed to pay or cause to be paid to the Contractor an Advance Payment in the amount of Indian Rupees (INR)…….… ……
(Amount in words)
...…….....(.....)
(Amount in figures in INR)

By this letter we, the undersigned, ……..……., a Bank (or company) organized under the laws of ..... and having its registered/principal office at……... do hereby jointly and severally with the Contractor irrevocably guarantee repayment of the said amounts upon the first demand of the Employer without cavil or argument in the event that the Contractor fails to commence or fulfill its obligations under the terms of the said Contract, and in the event of such failure, refuses to repay all or part (as the case may be) of the said advance payment to the Employer.

Provided always that the Bank's obligation shall be limited to an amount equal to the outstanding balance of the advance payment, taking into account such amounts, which have been repaid by the Contractor from time to time in accordance with the terms of payment of the said Contract as evidenced by appropriate payment certificates.

This Guarantee shall remain in full force from the date upon which the said advance payment is received by the Contractor until the date upon which the Contractor has fully repaid the amount so advanced to the Employer in accordance with the terms of the Contract. At the time at which the outstanding amount is NIL, this Guarantee shall become null and void, whether the original is returned to us or not.

Any claims to be made under this Guarantee must be received by the Bank during its period of validity, i.e. upto 90 (ninety) days after the date of operational acceptance by the Employer i.e. on or before.....(year, month, date).

Yours truly,
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. The non-judicial stamp papers of appropriate value shall be purchased in the name of bank who issues the 'Bank Guarantee'.
2. Advance Bank Guarantee is to be provided by the successful bidder in the form of a bank guarantee which should be issued either:

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

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

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

8. FORM OF COMPLETION CERTIFICATE

Date……...

Name of Contract……
Contract No……...

To:

(Name and address of the Contractor)

Dear Ladies and/or Gentlemen,

Pursuant to CC 24 (Completion of the Facilities) of the Conditions of the Contract entered into between yourselves and the Employer dated ……..……... relating to the ...……...
(Brief description of the Facilities)

we hereby notify you that the following part(s) of the Facilities was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Employer hereby takes over the said part(s) of the Facilities, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below :

1. Description of the Facilities or part thereof ...……...

2. Date of Completion :…….

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defects Liability Period.

Very truly yours,

Title
(Project Manager)

9. FORM OF OPERATIONAL ACCEPTANCE CERTIFICATE

Date……...

Name of Contract……
Contract No……...

To:

(Name and address of the Contractor)

Dear Ladies and/or Gentlemen,

Pursuant to CC 25.3 (Operational Acceptance) of the Conditions of the Contract entered into between yourselves and the Employer dated.....…….
relating to the .....……...
(Brief description of the facilities)

we hereby notify you that the Functional Guarantees of the following part(s) of the Facilities were satisfactorily attained on the date specified below.

1. Description of the Facilities or part thereof .....……....

2. Date of Operational Acceptance : ……..

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defects Liability Period.

Very truly yours,

Title
(Project Manager)

10. CHANGE ORDER PROCEDURE

Contract No. ……

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1. GENERAL

2. CHANGE ORDER LOG

3. REFERENCE FOR CHANGES

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ANNEX 2	Estimates for Change Proposal
ANNEX 3	Acceptance of Estimates
ANNEX 4	Change Proposal
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CHANGE ORDER PROCEDURE

1. General

This section provides samples of procedures and forms for implementing changes in the Facilities during the performance of the Contract in accordance with CC 39 (Change in Facilities) of the Conditions of Contract.

2. Change Order Log

The Contractor shall keep an up-to-date change Order Log to show the current status of Requests for Change and Changes authorized or pending as Annex-8 Entries of the Changes in the Change Order Log shall be made to ensure that the log is up-to-date. The Contractor shall attach a copy of the current Change Order Log in the monthly progress report to be submitted to the Employer.

3. References for Changes

(i) Request for Changes as referred to in CC Clause 39 shall be serially numbered CR-X-nnn.

(ii) Estimate for Change Proposal as referred to in CC Clause 39 shall be serially numbered CN-X-nnn.

(iii) Acceptance of Estimate as referred to in CC Clause 39 shall be serially Numbered CA-X-nnn.

(iv) Change Proposal as referred to in CC Clause 39 shall be serially numbered CP-X-nnn.

(v) Change Order as referred to in CC Clause 39 shall be serially numbered CO-X-nnn.

Notes :

(a) Requests for Change issued from the Employer's Home Office and the site representatives of the Employer shall have the following respective references:

Home Office	CR-H-nnn
Site	CR-S-nnn

(b) The above number "nnn" is the same for Request for Change, Estimate for Change Proposal Acceptance of Estimate, Change Proposal Change Order.

[ANNEXURE 1]

REQUEST FOR CHANGE PROPOSAL

…….
(Employer's Letterhead)
…….

To : (Contractor's Name and Address) Date : ……

……
……
……

Attention : (Name and Title)
……
……

(Contract Name)…… (Contract No.)……..
……..
……..

Dear Ladies and/ or Gentlemen :

With reference to the captioned Contract, you are requested to prepare and submit a Change Proposal for the Change noted below in accordance with the following instructions within ……days of the date of this letter. (or on before[date])

1. Title of Change :……

2. Change Request No…… (Rev…… …….)

3. Originator of Change:
   Employer (Name)……..
   Contractor (by Application for Change Proposal No……*)
   * Refer to ANNEX 7.

4. Brief Description of Change :

   ……
   ……
   ……

5. Facilities and/ or Item No. of equipment related to the requested Change :
   ……
   ……
   ……

6. Reference drawings and /or technical documents for the request of Change :

Drawings No. / Document No.	**Description**
……	……
……	……
……	……

7. Detailed conditions or special requirements on the requested Change :

…… ……
…… ……
…… ……

8. **General Terms and Conditions** :

(1) Please submit your estimate to us showing what effect the requested Change will have on the Contract Price.

(2) Your estimate shall include your claim for the additional time, if any for completion of the requested Change.

(3) If you have any opinion negative to the adoption of the requested Change in connection with the conformability to the other provisions of the Contract on the safety of the Plant or Facilities Please inform us of your opinion in your proposal of revised provisions.

(4) Any increase or decrease in the work of the Contractor relating to the services of its personnel shall be calculated.

(5) You shall not proceed with the execution of the work for the requested Change Until we have accepted and confirmed the amount and nature in writing

…….
(Employer's Name)

(Signature)
……..

(Name of signatory)
…….……

(Title of signatory)

[**ANNEXURE 2]**

ESTIMATE FOR CHANGE PROPOSAL

……
(Contractor's Letterhead)
……

To : (Employer's Name and Address) Date : …….

Attention : (Name and Title)
……

Contract Name…….

Contract Number……

Dear Ladies and /or Gentlemen:

With reference to your Request for Change Proposal, we are pleased to notify you of the approximate cost of preparing the below-referenced Change Proposal in accordance with CC Sub-Clause 39.2.1 of the Conditions of Contract. We acknowledge that your agreement to the cost of preparing the Change Proposal, in accordance with CC Sub-Clause 39.2.2, is required before estimating the Cost for Change work.

1. Title of Change ……

2. Change Request No……..(Rev……)

3. Brief Description of Change :
   ……
   ……

4. Scheduled Impact of Change :
   ……
   ……

5. Cost for Preparation of Change Proposal (in the currencies of the Contract)
   ……
   ……

   (a) Engineering (Amount)

   (i) Engineer _____hrs x_____rate/hr = _____

   (ii) Draftsperson _____hrs x_____rate/hr = _____

   Sub-total _____hrs _____

   Total Engineering Cost _____

   (b) Other Cost _____

   Total Cost (a) + (b) _____

…….
(Contractor's Name)
…….
(Signature)
…….
(Name of Signatory)

(Title of signatory)

[ANNEXURE 3]

ACCEPTACE OF ESTIMATES

……
(Employer's Letterhead)
……

To : (Contractor's Name and Address) Date : ……

Attention : (Name and Title)…….
…….....

Contract Name : ……
Contract Number…….

Dear Ladies and /or Gentlemen :

We hereby accept your Estimate for Change Proposal and agree that you should proceed with the preparation of the Change Proposal.

1. Title of Change : …….

2. Change Request No. …….. (Rev ……)

3. Estimate for Change Proposal No. …… (Rev ……)

4. Acceptance of Estimate No…….. (Rev ……)

5. Brief Description of Change :
……..……..……..……..……
……..……..……..……..……

6. Other Terms and Conditions In the event that we decide not to order the Change accepted, you shall be entitled to compensation for the cost of preparation of Change Proposal described in your estimate for Change Proposal mentioned in para. 3 above in accordance with CC Clause 39.0 of the Conditions of Contract.

…….…….
(Employer's Name)
…….…….
(Signature)
…….…….
(Name and Title of signatory)

[ANNEXURE 4]

CHANGE PROPOSAL

……..……..……..
(Contractor's Letterhead)
……..……..……...

To : (Employer's Name and Address) Date : ……
……..……..……
……..……..……
……..……..……

Attention : (Name and Title)
……..……..…….
……..……..…….

(Contract Name) ……. (Contract No.) ……
……
……

Dear Ladies and / or Gentlemen

In response to your Request for Change Proposal No. ……we hereby submit our proposal as follows :

1. Title of Change : (Name) ……..…….

2. Change Request No. ……(Rev ……)

3. Originator of Change : Employer (Name) ……..
   Contractor (Name) …….

4. Brief Description of Change :
   ……..……..……
   ……..……..……

5. Reasons for Change :
   ……..……..……
   ……..……..……

6. Facilities and/ or Item No. of equipment related to the requested Change :
   ……..……..……
   ……..……..……

7. Reference drawings and/ or technical documents for the requested Change :

Drawing No. / Document No.	Description
……	……..
……	……..

8. Estimate of increase / decease / (in the currencies of the contract to the Contract Price resulting from Change Proposal

(Amount)

(a) Direct Material …….

(b) Major construction equipment ……..

(c) Direct field labour (Total hrs) …….

(d) Subcontracts …….

(e) Indirect material and labour …….

(f) Site supervision …….

(g) Head office technical staff salaries

Process engineer _____hrs @_____rate/hr_____
Project engineer _____hrs @_____rate/hr_____
Equipment engineer _____hrs @_____rate/hr_____
Procurement _____hrs @_____rate/hr_____
Draftsperson _____hrs @_____rate/hr_____
Total _____hrs @ _____

(h) Extraordinary costs (computer, travel, etc.) _____

(i) Fee for general administration_____% of Items _____

(j) Taxes and customs duties _____

Total lump sum cost of Change Proposal
[sum of Items (a) to (j)] _____

Cost to prepare Estimate for Change Proposal
(amount payable if Change is not accepted _____

9. Additional time for Completion required due to Change Proposal :

10. Effect on the other Functional Guarantees.

11. Effect on the other terms and Conditions of the Contract.

12. Validity of this Proposal : Within …….days after receipt of this Proposal by the Employer.

13. Other Terms and Conditions of this Change Proposal:

(a) You are requested to notify us of your acceptance, comments or rejection of this detailed Change Proposal within…….days from your receipt of this Proposal.

(b) The amount of any increase and/ or decrease shall be taken into account In the adjustment of the Contract Price.

(c) Contractor's cost for preparation of this Change Proposal :

(Note) This cost shall be reimbursed by the Employer in case of Employer's withdrawal or rejection of this Change Proposal without default of the Contractor in accordance with CC Clause 39.0 of the Conditions of Contract.

……..
(Contractor's Name)

……
(Signature)

……
(Name of signatory)

……
(Title of signatory)

ANNEXURE 5]

CHANGE ORDER

……..……..……..
(Contractor's Letterhead)
……..……..……...

To : (Employer's Name and Address) Date : ……
……..……..……
……..……..……
……..……..……

Attention : (Name and Title)
……..……..…….
……..……..…….

(Contract Name) ……. (Contract No.) ……
……
……

Dear Ladies and / or Gentlemen :

We approve the Change Order for the work specified in the Change Proposal No……..… and agree to adjust the Contract Price, Time for Completion and/ or other conditions of the Contract in accordance with CC Clause 39.0 of Conditions of Contract.

1. Title of Change : (Name) ……..…….

2. Change Request No. ……(Rev ……)

3. Change Order No…….(Rev……)

4. Originator of Change : Employer (Name) ……..
Contractor (Name) …….

5. Authorized Price :
Ref. No. …… ……(Number)
Date : ……..
Foreign currency portion ……plus Local currency portion…….

6. Adjustment of Time for Completion

None Increase ……..days Decrease ……..days

7. Other effects, if any
Authorized by :…….Date : …….
(Employer)
Accepted by : …….. ..Date : ……
(Contractor)

……..
(Contractor’s Name)

……
(Signature)

……
(Name of signatory)

……
(Title of signatory)

[**ANNEXURE 6]**

PENDING AGREEMENT CHANGE ORDER

……..……..……..
(Contractor's Letterhead)
……..……..……...

To : (Employer's Name and Address) Date : ……
……..……..……
……..……..……

Attention : (Name and Title)
……..……..…….
……..……..…….

(Contract Name) ……. (Contract No.) ……
……
……

Dear Ladies and / or Gentlemen :

We instruct you to carry out the work in the Change Order detailed below in accordance with CC 39.0 of the Conditions of Contract.

1. Title of Change : (Name) ……..…….
2. Employer Request for Change Proposal No……(Rev ……) Dated……
3. Contractor's Change Proposal No……(Rev…….) Dated……
4. Brief Description of Change :
   ……..……..……..
   ……..……..……
5. Facilities and/ or Item No. of equipment related to the requested Change :
   ……..……..……..
   ……..……..……..
6. Reference drawings and/ or technical documents for the requested Change

Drawing No. / Document No.	Description
……	……..……..
……	……..……..

7. Adjustment of time for completion :
8. Other change in the Contract terms :
9. Other terms and Conditions :

……..……
(Contractor's Name)

(Signature)
……..
(Name of signatory)
……..
(Title of signatory)

[ANNEXURE 7]

APPLICATION FOR CHANGE PROPOSAL

……..……..……...
(Contractor's Letterhead)
……..……..……...

To : (Employer's Name and Address) Date : ……
……..……..……
……..……..……
……..……..……

Attention : (Name and Title)
……..……..…….
……..……..…….

(Contract Name) ……. (Contract No.) ……
……
……

Dear Ladies and / or Gentlemen :

We hereby propose that the below mentioned work be treated as a Change in the Facilities.

1. Title of Change :
   (Name) ……..……..…….

2. Application for Change Proposal No……(Rev ……)
   Dated …….

3. Brief Description of Change :
   ……..……..……..…
   ……..……..…….

4. Reasons for Change :
   ……..……..……..
   ……..……..……..

5. Order of Magnitude Estimation (in the currencies of the Contract).
   …….
   …….
6. Scheduled Impact of Change :
   …….
   …….
7. Effect on Functional Guarantee. If any :
   …….
   …….

8. Appendix

…….
…….

……..……
(Contractor’s Name)

(Signature)

……..
(Name of signatory)

……..
(Title of signatory)

[ANNEXURE 8]

CHANGE ORDER LOG

……..…….…….....

(Contractor's Letterhead)

……..…..……..……...

To : (Employer's Name and Address) Date : ……

……..……..……

……..……..……

Attention : (Name and Title)

……..……..…….

……..……..…….

(Contract Name) ……. (Contract No.) ……

……

Dear Ladies and / or Gentlemen :

(Contract Name)……. (Contract No…….

……

We hereby furnish the up-to date change order log to show the current status of request for changes and authorized or pending.

S1. No.	Employer's Request for change proposal revision	Contractor application for change including revision	Contractor's Change proposal including revision	Change order No. including revision	Pending proposal No.	Remarks*

..……..……

(Contractor's Name)

(Signature)

……..……...

(Name of signatory)

…….

Title of Signatory

Note :

(i) *In case Employer has authorized to carryout the work pending agreement change order, the details of such authorization shall be furnished.

(ii) The contractor shall attach a copy of the current change order log in the monthly progress report to be submitted to the Employer every month.

11. FORM OF INDEMNITY BOND TO BE EXECUTED BY THE CONTRACTOR FOR THE EQUIPMENT HANDED OVER IN ONE LOT BY DELHI TRANSCO LTD. FOR PERFORMANCE OF ITS CONTRACT

INDEMNITY BOND

THIS INDEMNITY BOND is made this ……..… day of…… 200…… by…… a Company registered under the Companies Act, 1956/ Partnership firm/ proprietary concern having its Registered Office at……..(hereinafter called as 'Contractor' or "Obligor" which expression shall include its successors and permitted assigns) in favour of DELHI TRANSCO LTD, a Company incorporated under the Companies Act, 1956 having its Registered Office at Shakti Sadan, Kotla Road, New Delhi-110002.

WHEREAS DELHI TRANSCO LTD. has awarded to the Contractor a contract for ……...vide its Notification of Award/ Contract No……. ……..... dated ……..and its Amendment No…….(applicable when amendments have been issued) (hereinafter called the "Contract") in terms of which DTL is required to hand over various Equipments to the Contractor for execution of the Contract.

And WHEREAS by virtue of Clause No……of the said Contract, the Contractor is required to execute an Indemnity Bond in favour of DTL for the Equipment handed over to it by DTL for the purpose of performance of the Contract/ Erection portion of the contract (hereinafter called the "Equipment")

AND THEREFORE, This Indemnity Bond witnesseth as follows:

1. That in consideration of various Equipments as mentioned in the Contract, valued at (amount in words……) handed over to the Contractor for the purpose of performance of the Contract, the Contractor hereby undertakes to indemnify and shall keep DTL indemnified, for the full value of the Equipment. The Contractor hereby acknowledges receipt of the Equipments as per dispatch title documents handed over to the Contractor duly endorsed in their favour and detailed in the Schedule appended hereto. It is expressly understood by the Contractor that handing over of the dispatch title documents in respect of the said equipments duly endorsed by DTL in favour of the contractor shall be construed as handling over of the equipment purported to be covered by such title documents and the contractor shall hold such equipment in trust as a Trustee for and on behalf of DTL.

2. That the contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the equipment of DTL project Site against all risks whatsoever till the equipment are duly used/erected in accordance with the terms of the contract and the plant/package duly erected and commissioned in accordance with the terms of the contract, is taken over by DTL. The contractor undertakes to keep DTL harmless against any loss or damage that may be caused to the equipments.

3. The contractor undertakes that the equipment shall be used exclusively for the performance/execution of the contract strictly in accordance with its terms and

conditions and no part of the equipment shall be utilized for any other work or purpose whatsoever. It is clearly understood by the contractor that non observance of the obligations under this indemnity bond by the contractor shall inter-alia constitute a criminal breach of trust on the part of the contractor for all intents and purpose including legal/penal consequences.

4. That DTL is and shall remain the exclusive owner of the equipment free from all encumbrances, charges or liens of any kind, whatsoever. The equipment shall be all times be open to inspection and checking by the employer or employer's representative in this regard. Further DTL shall always be free at all times to take possession of the equipment in whatever form the equipment may be, if in its opinion, the equipments are likely to be endangered, mis-utilised or intended for use other than those specified in the contract, by any acts of omission or commission on the part of the contractor or any other person or on account of any reason whatsoever and the contractor binds himself and undertakes to comply with the directions of demand of DTL to return the equipment without any demur or reservation.

5. That this indemnity Bond is irrevocable. If at any time any loss or damage occurs to the Equipment or the same or any part thereof is mis-utilised in any manner whatsoever, then the Contractor hereby agrees that the decision of the Employer's Representative as to assessment of loss or damage to the Equipment shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and /or damaged Equipment at its own cost and/ or shall pay the amount of loss to DTL without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to DTL against the Contractor under the Contract and under this Indemnity Bond.

6. NOW THE CONDITION of this Bond is that if the Contractor shall duly and punctually comply with the terms and conditions of this Bond to the satisfaction of DTL, THEN. The above Bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS, the Contractor has hereunto set its hand through its authorized representative under the common seal of the Company, the day, month and year first above mentioned.

SCHEDULE

Particulars of the Equipment	Quantity	Particulars of Despatch title Documents RR/ GR No. Date of lading & Carrier	Value of the Equipment	Signature of Attorney in Handed token of receipt

For and on behalf of

M/s……..
WITNESS

1.	1.	Signature…….	Signature……
	2.	Name……	Name……
	3.	Address……	Address……
			Authorized representative
2.	1.	Signature…….	
	2.	Name……	(Common Seal) (In case of Company)
	3.	Address……	

Indemnity Bonds are to be executed by the authorized person and (i) in case of contracting Company under common seal of the Company or (ii) having the power of attorney issued under common seal of the company with authority to execute Indemnity Bonds, (iii) in case of (ii), the original Power of Attorney if it is General Power of Attorney and such documents should be attached to Indemnity Bond.

12. FORM OF INDEMNITY BOND TO BE EXECUTED BY THE CONTRACTOR FOR THE EQUIPMENT HANDED OVER IN INSTALLMENTS BY DELHI TRANSCO LTD FOR PERFORMANCE OF ITS CONTRACT

INDEMNITY BOND

THIS INDEMNITY BOND is made this …..…….day of ……..200…….by…..…… ……..…….a Company registered under the Companies Act, 1956/ Partnership firm/ proprietary concern having its Registered Office at ……..……(hereinafter called as 'Contractor' or 'Obligor' which expression shall include its successors and permitted assigns) in favor of DELHI TRANSCO LTD a Company incorporated under the Companies Act, 1956 having its Registered Office at Shakti Sadan, Kotla Marg, New Delhi-110002

WHEREAS DTL has awarded to the Contractor a Contractor for ……vide Its Notification of Award/Contract No. ……dated …….and Amendment No. ……..... (applicable when amendments have been issued) (hereinafter called the "Contract") in terms of which DTL is required to handover various Equipments to the Contractor for execution of the Contract.

AND WHEREAS by virtue of Clause No……of the said Contract, the Contractor is Required to execute an Indemnity Bond in favour of DTL for the Equipment handed over to it by DTL for the purpose of performance of the contract/ Erection portion of the Contract (hereinafter called the "Equipment".)

NOW THEREFORE, This Indemnity Bond witnessed as follows:

1. That in consideration of various Equipments as mentioned in the Contract, valued at (amount in words ……..) to be handed over to the Contractor in installments from time to for the purpose of performance of the contract, the Contractor hereby undertakes to indemnify and shall keep DTL indemnified, for the full value of Equipment. The Contractor hereby acknowledges receipt of the initial installment of the equipment per details in the schedule appended hereto. Further, the Contractor agrees to acknowledge receipt of the subsequent installments of the Equipment as required by DTL in the form of Schedules consecutively numbered which shall be attached to this Indemnity bond so as to form integral parts of this Bond It is expressly understood by the Contractor shall be construed as handing over the Equipment purported to be covered by such title documents and the Contractor shall hold Equipments in trust as a Trustee for and on behalf of DTL

2 That the contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the equipment of DTL project Site against all risks whatsoever till the equipment are duly used/erected in accordance with the terms of the contract and the plant/package duly erected and commissioned in accordance with the terms of the contract, is taken over by DTL. The contractor undertakes to keep DTL harmless against any loss or damage that may be caused to the equipments.

3. The contractor undertakes that the equipment shall be used exclusively for the performance/execution of the contract strictly in accordance with its terms and

conditions and no part of the equipment shall be utilized for any other work or purpose whatsoever. It is clearly understood by the contractor that non observance of the obligations under this indemnity bond by the contractor shall inter-alia constitute a criminal breach of trust on the part of the contractor for all intents and purpose including legal/penal consequences.

4. That DTL is and shall remain the exclusive owner of the equipment free from all encumbrances, charges or liens of any kind, whatsoever. The equipment shall be all times be open to inspection and checking by the employer or employer's representative in this regard. Further DTL shall always be free at all times to take possession of the equipment in whatever form the equipment may be, if in its opinion, the equipments are likely to be endangered, mis-utilised or intended for use other than those specified in the contract, by any acts of omission or commission on the part of the contractor or any other person or on account of any reason whatsoever and the contractor binds himself and undertakes to comply with the directions of demand of DTL to return the equipment without any demur or reservation.

5. That this indemnity Bond is irrevocable. If at any time any loss or damage occurs to the Equipment or the same or any part thereof is mis-utilised in any manner whatsoever, then the Contractor hereby agrees that the decision of the Employer's Representative as to assessment of loss or damage to the Equipment shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and /or damaged Equipment at its own cost and/ or shall pay the amount of loss to DTL without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to DTL against the Contractor under the Contract and under this Indemnity Bond.

6. NOW THE CONDITION of this Bond is that if the Contractor shall duly and punctually comply with the terms and conditions of this Bond to the satisfaction of DTL, then, the above Bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS, the Contractor has hereunto set its hand through its authorized representative under the common seal of the Company, the day, month and year first above mentioned.

SCHEDULE No. 1

Particulars of the Equipment	Quantity	Particulars of Despatch title Documents	Value of the Equipment	Signature of Attorney in Handed token of receipt
		RR/ GR No. Date of lading & Carrier		

For and on behalf of

M/s……..
WITNESS

1.	1.	Signature…….	Signature……
	2.	Name……	Name……
	3.	Address……	Address……
			Authorized representative
2.	1.	Signature…….	
	2.	Name……	(Common Seal) (In case of Company)
	3.	Address……	

Indemnity Bonds are to be executed by the authorized person and (i) in case of contracting Company under common seal of the Company or (ii) having the power of attorney issued under common seal of the company with authority to execute Indemnity Bonds, (iii) in case of (ii), the original Power of Attorney if it is General Power of Attorney and such documents should be attached to Indemnity Bond.

13. FORM OF AUTHORIZATION LETTER: DELHI TRANSCO LIMITED.

REF. No.

DATE:

TO,

M/s…….

……

……

REF: Contract No…… dated …… for…… awarded by Delhi Transco limited.

Dear Sir,

Kindly refer to Contract No. ……. Dated …….. for …….. You are hereby authorized on behalf of Delhi Transco Limited, having its registered office at Delhi Transco Limited, Shakti Sadan, Kotla Road New Delhi-110002 and its project at …….to take physical delivery of materials/equipments covered under Dispatch Document/Consignment Note No……dated…… and as detailed in the enclosed schedule for the sole purpose of successful performance of the aforesaid contract and for no other purpose, whatsoever.

(Signature of Project Authority)**

Designation …….
Date …….

Encl: As above

** To be signed not below the rank of Manager.

- Mention LR/RR No.

14. FORM OF TRUST RECEIPT FOR PLANT, EQUIPMENT AND MATERIALS RECEIVED

We M/s (Contractor's Name)_____ having our Principal place of business at _____having been awarded a Contract No. _____ dated _____for (Contract Name) by (Name of Employer) _____.

We do hereby acknowledge the receipt of the Plant, Equipment and Materials as are fully described and mentioned under Documents of Title/RR/LR etc and in the schedule annexed here to, which shall form an integral part of this receipt as "Trustee" of _____ (Name of Employer). The aforesaid materials etc. so received by us shall be exclusively used in the successful performance of the aforesaid contract and for no other purpose whatsoever. We undertake not to create any charge, lien or encumbrance over the aforesaid materials etc, in favour of any other person /institution (s) / Banks.

For M/s _____
(Contractor's Name)

Dated:_____

Place: _____

(AUTHORISED SIGNATORY)

SEAL OF COMPANY

15. FORM OF EXTENSION OF BANK GUARANTEE

Ref. No…….. **Dated……**

Delhi Transco Limited,
Shakti Sadan, Kotla Road
New Delhi 110002.
India

Dear Sirs,

Sub: - Extension of Bank Guarantee No. …… for…….. favoring yourself expiring on …… On account of M/s…….. in respect of Contract No……. dated …….. (hereinafter called original Bank Guarantee).

At the request of M/s ……. We …….. Bank branch office at……. Having its Head Office at …… do hereby extend our liability under the above mentioned Guarantee No…… dated …….. for a further period of ……. Years/Month from ……. 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.

Yours Faithfully,

For…….

Manager. Agent/Accountant

Power of attorney No…….

Dated …….

SEAL OF BANK

Note : The non. Judicial stamp paper of appropriate value shall be purchased in the name of the bank who has issued the bank Guarantee.

16. FORM OF POWER OF ATTORNEY FOR JOINT VENTURE/CONSORTIUM

(On Non-judicial Stamp paper of Appropriate Value to be purchased in the name of joint venture/ Consortium)

KNOW ALL MEN BY THESE PRESENTS THAT WE, the partners whose details are given hereunder …….. have formed a Joint venture/ Consortium under the laws of ……. And having our Registered Office(S) / Head Office (s) at …… (hereinafter called the Joint venture/ Consortium which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assigns) acting through M/s ……being the partner in-charge do hereby constitute, nominate and appoint M/s …… a Company incorporated under the laws of ……and having its registered / Head Office at …….. as our duly constituted lawful Attorney (hereinafter called " Attorney" or " Authorized Representative" or " Partner In- charge") to exercise all or any of the powers for and on behalf of the joint venture/ Consortium in regard to Specification No…… Package …… the bids for which have been invited by Delhi Transco Limited, Shakti Sadan Building, Kotla Road, New Delhi, India (hereinafter called the " Employer") to undertaking the following acts :

i) To submit proposal and participate in the aforesaid Bid Specification of the Employer on behalf of the "Joint venture/ Consortium".
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/ CONSORTIUM'.
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/ Consortium".

It is clearly understood that the partner In-charge (Lead Partner) shall ensure performance of the Contract(s) and if one or more partner fail to perform their respective portions of the Contract(s), the same shall be deemed to be default by all the partners.

It is expressly understood that this Power of Attorney shall remain valid binding and irrevocable till completion of the Defect Liability Period in terms of the Contract.

The joint venture/ Consortium hereby agrees and undertakes to ratify and confirm all and whatsoever the said Attorney/ Authorized Representatives/Partner in- charge quotes in the bid, negotiates And signs the Contract with Employer and / or proposes to act on behalf of the Joint venture/ Consortium by virtue of this Power of Attorney and the same shall bind the joint venture/ Consortium as if done by itself.

In WITNESS THEREOF the partners Constituting the joint venture/ Consortium as aforesaid have executed these present on this …… day of ……. Under the Common Seal(s) of their Companies.

for and on behalf of the

Partners of joint venture/ Consortium

...……..

…….

The Common Seal of the above Partners of the Joint venture/ Consortium:

The Common Seal has been affixed the unto in the presence of:

WITNESS

1. Signature……..
   Name……..
   Designation ……..
   Occupation…….

2. Signature……..
   Name……..
   Designation ……..
   Occupation…….

17. FORM OF JOINT VENTURE/ CONSORTIUM AGREEMENT

(On non-judicial stamp paper of appropriate value to be purchased in the name of joint venture/ Consortium)

PERFORMA OF JOINT VENTURE/ CONSORTIUM AGREEMENT BETWEEN ……. AND …….. FOR BID SPECIFICATION NO……. OF DELHI TRANSCO LIMITED

THIS joint venture/ Consortium agreement executed on this …… day of Two thousand……. between M/s ……. a company incorporated under the laws of …….. and having its registered office at……(hereinafter called the "Lead partner" which expression shall include its successors executors and permitted assigns), M/s …… ……..…… a company incorporated under the laws of ……. and having its registered office at……(hereinafter called "the partner" which expression shall include its successors executors and permitted assigns) and M/s …….. a company incorporated under the laws of …… and having its registered office at…… …..……(hereinafter called "the partner" which expression shall include its successors, executors and permitted assigns) for the purpose of making a bid and entering into a contract (in case of award) against the specification No…… for……(Name of the Package) ……..under……..(Name of the project) …….of Delhi Transco limited ,a company incorporated under the Companies Act of 1956 having its registered Shakti Sadan, Kotla Road New Delhi-110002, India (hereinafter caller the; "Employer")

Whereas the employer invited bids as per the above mentioned Specification for the design, engineering, manufacture, supply, installation, testing and commissioning of equipment/materials stipulated in the bidding documents for……(Name of the Package) …….under…….(Name the project)

AND WHEREAS Annexure-A, section-CC (qualification of the bidder) forming part of the bidding documents, .stipulates that a joint venture/ Consortium of two or more qualified firms as partners, meeting the joint venture/ Consortium fulfills all other requirements under Annexure-A, Section CC (qualification of the bidder) and in such a case, the BID FROM shall be signed by all the partners so as to legally bind all the partners of the Joint venture/ Consortium, who will be jointly and severally liable to perform the contract and all obligations hereunder.

The above clause further states that the joint venture/ Consortium agreement shall be attached to the bid and the contract performance guarantee will be as per the format enclosed with the bidding document without any restriction or liability for either party.

AND WHEREAS the bid has been submitted to the Employer vide proposal No…….. dated…….by Lead partner based on the joint venture/ Consortium agreement between all the partners under these present and the bid in accordance with the requirements of Annexure-A, section CC (Qualification of the Bidders), has been signed by all the partners.

NOW THIS INDENTURE WITNESS AS UNDER:

In consideration of the above premises and agreements all the partners to this joint venture/ Consortium do hereby now agree as follow:

1. In consideration of the award of the contract by the Employer to the joint venture/ Consortium partners, we, the partners to the joint venture/ Consortium agreement do hereby agree that M/s …….. shall act as lead partner and further declare and confirm that we shall joint and severally be bound unto the Employer for the successful performance of the Contract and shall be fully responsible for the design, engineering, manufacture, supply, and successful performance of the equipments in accordance with the Contract.

2. In case of any breach of the said Contract by the Lead Partner or other partner(s) of the joint venture/ Consortium agreement, the partner(s) do hereby agree to be fully responsible for the successful performance of the contract and carry out all the obligations and responsible under the Contract in accordance with the requirements of the Contract.

3. Further if the Employer suffers any loss or damage on account of any breach in the Contract or any shortfall in the performance of the equipment in meeting the performance guaranteed as per the specification in terms if the Contract, the partner(s) of these present undertake to promptly make good such loss or damages caused to the Employer, on its demand without any demur. It shall not be necessary or obligatory for the Employer to proceed against Lead Partner to these presents before proceeding against or dealing with the other Partner(s).

4. The financial liability of the partner of this joint venture/ Consortium agreement to the Employer, with respect to any of the claims arising out of the performance or non-performance of the obligations set forth in the said joint venture/ Consortium agreement, read in conjunction with the relevant conditions of the Contract shall, however, not be limited in any way so as to restrict or limit the liabilities of any of the partners of the joint venture/ Consortium agreement.

5. It is expressly understood and agreed between the partners to the joint venture/ Consortium agreement that the responsibilities and obligations of each of the partners shall be as delineated in Appendix-I (* To be incorporated suitably by the partners) to this agreement. It is further agreed by the partners that the above sharing of responsibilities and obligations shall not in any way be a limitation of joint and servable responsibilities of the partners under this Contract.

6. This joint venture/ Consortium agreement shall be constructed and interpreted in accordance with the laws of India and the courts of Delhi shall have the exclusive jurisdiction in all matters arising there under.

7. In case of an award of a Contract, we the partners to the joint venture/ Consortium agreement do hereby agree that we shall be jointly and severe ally responsible for furnishing a contract performance security from a bank in favour of the Employer in the currency of the Contract.

8. It is further agreed that the venture agreement shall be irrevocable and shall from an integral part of the Contract, and shall continue to be enforceable till the Employer

discharges the same. It shall be effective from the date first mentioned above for all purpose and intents.

IN WITNESS WHEREOF, the partners to the joint venture/ Consortium agreement have through their authorized representatives executed these present and affixed Common Seals of their companies, on the day, month and year first mentioned above.

1. Common Seal of ……
has been affixed in my/our
presence pursuant to the
Board of Director's resolution dated...
Signature.....
Name.....
Designation……..

For Lead partner

(Signature of authorized representative)
Name.....
Designation.....
Common Seal of the company
…….....

2. Common Seal of ……
has been affixed in my/our
presence pursuant to the
Board of Director's resolution dated...
Signature.....
Name.....
Designation……..

For partner

(Signature of authorized representative)
Name.....
Designation.....
Common Seal of the company
…….....

WITNESSES:

1 ……..
(Signature)
Name……..
…….
(Official address)

2. ……..
(Signature)
Name……..
…….
(Official address)

18. PROFORMA OF JOINT UNDERTAKING BY THE COLLABORATOR/ PARENT COMPANY/PRINCIPAL ALONGWITH THE BIDDER/MANUFACTURER

(On non-judicial stamp paper of appropriate value)

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/Parent Company/Principal" which expression shall include its successors, administrators, executors and permitted assigns) and M/s…..…….a company incorporated under the laws of …….. and having its registered office at…… ……(hereinafter called the "Bidder/Manufacturer" which expression shall include its successors, administrators, executors and permitted assigns) in favour of Delhi Transco Limited, having its Registered office at Shakti Sadan, Kotla Marg, New Delhi.(herein after called the "Employer" which expression shall include its successors, executors and permitted assigns)

WHEREAS the "Employer" invited Bid as per Specification No. …….. for the execution of ……..(Insert name of the Project)…….

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/parent company/principal 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 Contract.

AND WHEREAS the bidder has submitted its bid to the Employer vide Proposal No. ……..dated …….based on the collaboration /association of the collaborator/parent company/principal with the Bidder/Manufacturer.

NOW THEREFORE THIS UNDERTAKING WITNESSTH as under.

1.0 In consideration of the award of Contract by the Employer to the Bidder (herein after referred to as the "Contract") we, the collaborator/parent company/principal and the Bidder/Contractor and /or manufacturer do hereby declare that we shall be jointly and severally bound unto the DELHI TRANSCO LIMITED , for the successful performance of the * …….. and shall be fully responsible for the design, manufacturer , testing, supply on FOR destination delivery at site basis and supervision of unloading at site, storage, erection, testing & commissioning and successful performance of the *…….in accordance with the Contract Specifications.

2.0 Without in any way affecting the generality and total responsibility in terms of deed of Undertaking, the Collaborator in particular hereby agrees to depute their technical experts from time to time to the Bidder/Contractor's/Manufacture's Works/ Owner's project site as mutually considered necessary by the Owner, bidder/Contractor, Manufacturer and the collaborator to ensure proper design, engineering, manufacturer, testing ,supply on for destination delivery at site basis and supervision of unloading at site , storage, erection, testing and commissioning and successful performance of the collaborator shall advise the manufacturer/ contractor suitable modifications of designs and implement necessary corrective measures to discharge the obligations under the contract.

3.0 This deed of undertaking shall be construed and interpreted in accordance with the laws of India and the Courts in Delhi shall have exclusive jurisdiction in all matters arising under the undertaking.

4.0 As a security, the bidder shall apart from the contractor's performance guarantee furnish a contract performance guarantee from its Bank in favour of the Employer on a form

acceptable to the Employer. The value of such guarantee shall be equivalent to 10% of price of such equipments 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 Project 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/parent company/principal and bidder/contractor and /or manufacturer agree that this undertaking shall be irrevocable and shall from 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/parent company/principal and bidder/contractor and /or manufacturer, have through their Authorized Representatives executed these present and affixed common seals of their respective Companies, on the day, month and year first above mentioned.

WITNESSES:

For Collaborator/parent company/principal

1.---------- Signature of Authorized Representative

(Signature)

(Name in Block Letter) Name----------

(Office Address) Common seal of Company ----------

2.---------- Signature of Authorized Representative

(Signature)

(Name in Block Letter) Name----------

(Office Address) Common seal of Company----------
-

For Manufacturer

3.---------- Signature of Authorized Representative

(Signature)

(Name in Block Letter) Name----------

(Office Address) Common seal of Company----------

Note:

(i) This deed of Joint undertaking duly certified by the Company Secretary shall be submitted along with the bid. Further, the deed of Joint Undertaking attested by Notary Public of the place(s) of the respective executants (s) or registered with the Indian Embassy/ High Commission in the country shall be submitted by the bidder before opening of price bid. In case the bidder fails to submit the deed of Joint Undertaking as mentioned above, the bidders bid guarantee may be forfeited.

(ii) In the event the bidder is a Manufacturer and the collaboration is between collaborator and the Bidder, then the Joint deed of Undertaking shall be continued accordingly.

(iii) *The name(s) of equipment for which Joint deed of undertaking is to be submitted is to be inserted.

(iv) The manufacturer may be having ongoing collaboration agreement or had collaboration agreement in the past with the collaborator.

19. 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 CC 24 & 25 of the Conditions of the Contract entered into between yourselves and the Employer dated ……..……relating to the ...……...
(Brief description of the Facilities)

we hereby notify you that the following part(s) of the Facilities was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Employer hereby takes over the said part(s) of the Facilities, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below:

1. Description of the Facilities or part thereof... ……...

2. Date of Completion…

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defects Liability Period.

Very truly yours,

Title
(Project Manager)

DELHI TRANSCO LTD

(A Government of NCT of Delhi Undertaking)

Bidding Documents

For

A. Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B. Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C. Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

VOLUME – II

TECHNICAL SPECIFICATIONS

Tender No: T20R220201

VOLUME-II

TECHNICAL SPECIFICATIONS

This Technical Specification is only applicable to 220kV & 66kV voltage level. Purchaser has standardized its technical specification for various equipments and works for different voltage levels.

Items, which are not applicable for the scope of this package as per schedule of quantities described in Bid Price Schedule, the technical specification for such items should not be referred to.

VOLUME-II

TECHNICAL SPECIFICATIONS

SECTION 1: PROJECT

SECTION 2: GAS INSULATED SWITCHGEAR (GIS)

SECTION 3: GENERAL TECHNICAL REQUIREMENTS (GTR)

SECTION 4: SPECIAL EQUIPMENTS

SECTION 5: FIRE PROTECTION SYSTEM

SECTION 6: LT SWITCHGEAR

SECTION 7: BATTERY & BATTERY CHARGER

SECTION 8: LIGHTING SYSTEM

SECTION 9: LT TRANSFORMER

SECTION 10: DIESEL GENERATOR SET

SECTION 11: SWITCHYARD ERECTION

SECTION 12: CIVIL WORKS

SECTION 13: SUBSTATION AUTOMATION SYSTEM

SECTION 14: C&R PANELS

SECTION 15: POWER & CONTROL CABLES

SECTION 16: CCTV

SECTION 17: FIBRE OPTIC TERMINAL EQUIPMENT (FOTE)

SECTION 18: LIGHTNING ARRESTOR (LA)

SECTION-I

PROJECT

SECTION : 1

PROJECT

1.0 GENERAL

Preamble:

1.1 Delhi Transco Ltd. hereinafter termed as DTL or Owner/Purchaser is a company incorporated under Company Act 2013, fully owned by govt. of NCT of Delhi.

1.2 Delhi Transco Ltd. (DTL) is State Transmission Utility and responsible for Bulk Power Transmission of Electrical Energy in National Capital Delhi.

1.3 Delhi Transco Ltd. (DTL) is now establishing new 66kV GIS Sub-Stations at (a) 220kV BTPS substation, Delhi (India) & (b) at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India) and extension of existing 66 kV GIS at (c) 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

2.0 INTENT OF SPECIFICATION:

2.1 **Package-A**

The specification covers the design, engineering, manufacture, fabrication, testing at manufacturers works, delivery, unloading at site, storage, insurance, erection, testing and commissioning at site of the complete 66kV switchyard including indoor SF6 gas insulated metal enclosed switchgear (GIS), foundations for 03 nos. 160 MVA Transformers with fire protection system (NIFPES) and associated civil works, connection of 220 kV GIS with 160MVA Power Transformer, 216 kV outdoor type lightening arrestor, connection of 66kV GIS with 160MVA Power Transformer will be made through 66kV XLPE cable of suitable size, connection of 66kV cable with the 66kV bushings of transformer will be made through Al/Cu bus-bar, Indoor and outdoor End Termination Boxes (Lead sheath shall not be allowed in 66kV XLPE cable) , Substation Automation with Relay & Protection, CCTV and remote monitoring, optical fiber equipments & Communication (Converter) Equipments, FOTE, associated civil works, internal roads, drains, necessary buildings etc. and other electrical and mechanical auxiliary systems on turnkey basis. Replacement of old/outlived 220kV equipments of transformer bays & Dismantling of the of 220/6.6kV, 63 MVA & 31.5 MVA Transformers, 1600KVAR,6.9kV Series Reactor, etc & store shed to free up the space for the transformer are also in the scope of work. 220kV equipments shall be connected with the 3" IPS AL tube and required droppers by ACSR zebra conductor to moose conductor bus by suitable clamps and connectors. Connection of 220kV equipment with transformers will be through AL tube. Bidder shall also ensure GIS compatibility for line feeder/cable termination and provide the ancillary equipment required for the same. 11kV Cable (from Metering Cubicle onward) inside the substation and room for Discom (if required) shall be in the scope of Bidder.

Package-B

The specification covers the design, engineering, manufacture, fabrication, testing at manufacturers works, delivery, unloading at site, storage, insurance, erection, testing and commissioning at site of the complete 66kV switchyard including indoor SF6 gas insulated metal enclosed switchgear (GIS), foundations for 03 nos. 160 MVA Transformers with fire protection system (NIFPES) and associated civil works, connection of 220 kV GIS with 160MVA Power Transformer, 216 kV outdoor type lightening arrestor, connection of 66kV GIS with 160MVA Power Transformer will be made through 66kV XLPE cable of suitable size & connection of 66kV cable with the 66kV bushings of transformer will be made through Al/Cu bus-bar, Indoor and outdoor End Termination Boxes, (Lead sheath shall not be allowed in 66kV XLPE cable), Substation Automation with Relay & Protection, CCTV and remote monitoring, optical fiber equipments & Communication (Converter) Equipments, associated civil works, internal roads, drains, necessary buildings etc. and other electrical and mechanical auxiliary systems on turnkey basis. Bidder shall also ensure GIS compatibility for line feeder/cable termination and provide the ancillary equipment required for the same. The extension & distribution of DC and AC supply from 220kV control room to 66kV GIS building shall be made by providing sub panels in 66kV GIS building along with switchyard lightening boards.11kV Cable (from Metering Cubicle onward) inside the substation and room for Discom (if required) shall be in the scope of Bidder.

Package-C

The specification covers the design, engineering, manufacture, fabrication, testing at manufacturers works, delivery, unloading at site, storage, insurance, erection, testing and commissioning at site of the complete 66kV indoor SF6 gas insulated metal enclosed switchgear (GIS) bays along with coupling arrangement for making compatibility to connect with existing GIS bus bar, associated civil works, Substation Automation with Relay & Protection of 66kV GIS bays with integration to existing Substation Automation system and control room/remote monitoring, optical fiber equipments & Communication (Converter) Equipments, necessary buildings etc and other electrical and mechanical auxiliary systems on turnkey basis. Bidder shall also ensure 66 kV GIS bays compatibility for line feeder/cable termination and provide the ancillary equipment required for the same.

2.2 The supply will include all supporting structures, auxiliary equipments, mechanical linkages, hydraulic piping (if applicable) for control devices with pumps, SF6 gas piping, auxiliary circuits wiring, interlocking devices, current and voltage transformers, cable end boxes and SF6 bus ducts.

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

2.4 The specification is not intended to specify the complete details of various practices of 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

A. Package-A

I. 66kV System :-

72.5kV SF_6 gas insulated switch gear shall have double bus bar arrangement with the following bays:-

S. No.	Bay type	Number of bay(s)
01	Transformer/ I/C bays	04
02	Bus-coupler	02
03	Feeder bays.	14
04	Bus Sectionliser	02
05	Total	22

The SF_6 gas insulated switchgear rated for 66kV, 3-phase, 50 H_Z shall be of the indoor metal-enclosed type, comprising of following items:

(A) Double bus bar arrangement (3000A), Three -phase or single phase encapsulated SF_6 gas insulated, metal enclosed bus bars, each bus comprising of:

a. Bus bar enclosures running along the length of the switchgear to interconnect each of the circuit breaker bay modules in double main bus system.
b. Three, 3-core, single phase voltage transformers/ PTs.
c. One 3-phase, single pole, group operated isolator/disconnector with two 3-phase, single pole, group operated earthing switches with manual and motor driven operating mechanisms.
d. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.
e. Interconnecting wiring/piping
f. Grounding, support structures and platforms
g. Local control cubicle.

(B) 72.5kV, Bus Coupler bay module comprising of :

a. One 2500 A, 3-phase, SF6 Circuit Breaker, complete with operating mechanism
b. Three 3-core single phase current transformers.
c. Two 3-phase, single pole, group operated isolator switches each with three phase single pole group operated Earthing switch complete with manual and motor driven operating mechanisms.
d. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.
e. Local control cubicle.

(C) 72.5kV, bays for Incomer from 220/66kV Transformer, each comprising of :

a. One 2000A, 3-phase, SF6 circuit breaker, complete with operating mechanism for incomer bay from 220/66 kV transformer.
b. Three 4-core single phase current transformers.
c. One 2000A, 3-phase, single pole, group operated isolator without earthing switch, complete with manual and motor driven operating mechanisms.
d. One 2000A, 3-phase, single pole, group operated isolator with one 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
e. One 2000A, 3-phase, single pole, group operated isolator with one normal and one high speed fault make 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
f. SF6 type Surge Arrester.

g. Suitable provision for testing of cable.
h. SF_6 ducts for connection with power transformer through SF6/XLPE cable termination.
i. GIS Cable(s) termination enclosure suitable for connecting 66kV XLPE cable with accessories (The cable shall be designed by the bidder considering 110% continuously loading of 66kV side of the 160MVA Transformer). It shall be minimum two run per phase for 66kV transformer incomer bay.
j. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.
k. Local control cubicle.

(D) Outgoing 72.5kV Line Feeder Circuit Breaker bay modules, each comprising of :

a. One 2000A, 3-phase, SF6 circuit breaker, complete with operating mechanism for outgoing feeder.
b. Three 3-core , single phase current transformers.
c. One 2000 A, 3-phase, single pole, group operated isolator without earthing switch, complete with manual and motor driven operating mechanisms.
d. One 2000A, 3-phase, single pole, group operated isolator with one 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
e. One 2000 A, 3-phase, single pole, group operated isolator with one normal and one high speed fault make 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
f. Three, 3-core, single phase voltage transformers/ PTs with disconnector switch.
g. SF6 type Surge Arrester.
h. Suitable provision for testing of cable.
i. GIS Cable terminal connection with enclosures suitable for connecting 1x1000 sq.mm XLPE cable and accessories. However, actual size shall be finalized during detailed engineering.
j. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.
k. Local control cubicle.

(E) 72.5kV, Bus Sectionliser bay module comprising of :

f. One 2500 A, 3-phase, SF6 Circuit Breaker, complete with operating mechanism
g. Three 3-core single phase current transformers.
h. Two 3-phase, single pole, group operated isolator switches each with three phase single pole group operated Earthing switch complete with manual and motor driven operating mechanisms.
i. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.
j. Local control cubicle

(F) The scope of work also covers connection of 66kV GIS with 160MVA Power Transformer through single phase SF6 / XLPE cable terminations. 66kV GIS and 160 MVA Power Transformer shall be connected through double run 66kV Power cable. The 66 kV cable shall be designed by the bidder considering 110% continuously loading of 66kV side of the 160MVA Transformer including indoor, outdoor termination and connection with 66kV bushings of transformer through Al/Cu bus-bar. The outdoor type Lightening Arrestor (L.A.) 60KV 10KA, with surge/discharge counter, milli-ampere meter and suitable terminal connectors etc shall also be in the scope of work.

The scope of work also covers the 66kV GIS feeder bays termination on H-pole outdoor arrangement through 66kV 1x1000 sq. mm. cable including indoor & outdoor termination (single run from 66kV GIS to H-Pole) & H-Pole for outgoing feeder termination.

II. Complete sub-station automation system based on IEC 61850 including hardware and software for remote control station, relay and protection system along with associated equipments and kiosk for following bays (bay as defined in technical specification, section : sub-station automation):

- 66 kV : 22 Bays

The sub-station should have the provision to be controlled from a remote location and mode of communication shall be optical fiber for all voltage levels. Bidder shall provide FOTE equipments alongwith Tele-protection cards for remote end sub-station also. FO cable inside the substation and FODB alongwith patch chord at local and remote ends for successful operation are in contractor's scope. FOTE for both ends shall also have provision for eight command tele-protection and two current differential protection interface. The protection requirement shall be fulfilled by the contractor for successful commissioning. Location details to be made available during detailed engineering. Suitable Converters/provision shall be made by Contractors for commissioning of FOTE system and only 220V Battery System shall be used.

III. Complete relay and protection system.

IV. Bus post Insulators, insulator strings and hardwares, clamps & connectors, terminal connector, Conductor, earth wire and earthing materials, tubular conductor, spacers, cable supporting angles/channels, Cable trays & covers, Junction box, buried cable trenches etc.

V. Replacement of old/outlived 220kV equipments of transformer bays & Dismantling of the of 220/6.6kV, 63 MVA & 31.5 MVA Transformers, 1600KVAR,6.9kV Series Reactor, etc & store shed to free up the space for the transformer.

VI. ACDB and DCDB along with proper wiring by replacing existing ACDB & DCDB along with required cables and connectors.

VII. One no. 630kVA, 11kV/433V LT Transformer having 170kVp BIL at 11kV side including bushings, accessories and first filling of oil & One no. 630KVA, 11kV/433V LT Transformer having 95kVp BIL at 11kV side including bushings, accessories and first filling of oil.

VIII. Tertiary loading equipments for one 160 MVA transformer like Circuit breaker, isolator, current transformer, PT, surge arrestor.

IX. 11 kV equipments for loading of 630KVA Auxilary Transformer like 11kV switchgear, 2 Panel Board (1 incomer and 1 outgoing) alongwith associated control & relay system, 11kV cables etc.

X. Fire Detection, Alarm & Protection for GIS building & associated building, DG set etc. (Portable type fire extinguishers system)

XI. Air Conditioning System as per specification in section substation automation system.

XII. Ventilation system for 66kV GIS hall.

XIII. LT switchgear.

XIV. 250KVA Outdoor Silent type DG Set.

XV. 220V Battery bank with necessary connections up to battery charger and DCDB.

XVI. 1.1kV grade Power & Control cables along with complete accessories.

XVII. Earth mat (Measurement of resistivity is in the scope of contractor).

XVIII. Complete lighting and illumination of the installation. This shall include the illumination for GIS Building, associated building including street lights (if any). The specification for illumination shall be as per Annexure-IV.

XIX. Provision of CCTV camera for complete supervision of 66kV GIS hall, main entrance gate of substation, LT room, outdoor camera for monitoring of transformers and switchyard equipments from control room as well as from remote location other than substation. The cameras should be installed in such a way that the complete substation should be visible from remote for unmanned operation. The provision of Online viewing of camera from remote substation should be made by contractor.

XX. Special Equipments for testing and maintenance.

XXI. Bidder shall arrange suitable provision for testing of 66kV cables after isolation from the main GIS. Provision for space for termination of cable/ Overhead line shall be kept during designing stage.

XXII. Bidder has to submit a 'Model' of the substation before starting actual work at site.

XXIII. Mandatory Spares.

XXIV. 11kV protection IEDs shall have integration with SCADA. ACDB and DCDB shall be communicable and integrated with SCADA.

XXV. The work to be done under this specification comprises the provision of all labour, plant, equipment and material and the performance of all work necessary for the complete installation and commissioning of switchyard. It is hereby required that the contractor should provide all apparatus, appliances, material and labour etc. not specifically mentioned or included, but are necessary to complete the entire work or any portion of the work in compliance with the requirements implied in this specification is deemed to be included in the scope of contractor.

XXVI. The scope of work shall cover in complete conformity with the specifications, the followings:-

A single line schematic of the 66kV SF6 gas insulated switchgear with double bus bar arrangement is enclosed with the specification. In case any additional equipment is required, the same should be included in the scope of the supply and the offer should be complete and comprehensive. In addition all necessary platforms, supports, ladders and catwalks etc. for operation & maintenance work shall also be supplied. A tentative layout of the switchyard is enclosed with this specification. Bidder may adopt similar arrangement or optimize the same further without affecting any of the functional requirements specified.

XXVII. Any other equipment/material required for completing the specified scope.

XXVIII. Connectivity and integration of Transformer Bays with 160MVA Power Transformers alongwith associated equipments & works, cabling, provision of DC/AC supply, earthing for transformers is in the scope of this package. All civil works pertaining to foundations for transformers, accessories and NIFPES rail track, soak pit & sump pit, fire resistant wall, grating etc. shall be in the scope of GIS bidder. DTL shall furnish all relevant drawing/data for design of foundation to the bidder within **Four Months** from the date of award. Transformer

and accessories with spares etc. supplied by Transformer Manufacturer shall be received by DTL and provision for separate stores for it shall be provided by GIS bidder until the commissioning of sub-station. The watch and ward of complete site shall however be in the scope of GIS Bidder. Power supply for oil filter machine, transformer testing and erection work until commissioning shall be provided by the bidder**.**

XXIX. Civil works - The work shall include but not limited to the following:-

i. **Soil Investigation.**

ii. **Design, Engineering and civil work for:**

a. 66kV GIS building having well furnished GIS hall, office rooms, store room, 01 no. battery bank, display sign board etc. as per details in Section civil works. Each GIS hall shall be provided with EOT crane and the requirement of crane shall be as per section GIS.
b. Foundation of 03 nos.160 MVA Power Transformers including soak pit, sump pit, fire protection wall etc.
c. Foundation of 02 nos.630KVA LT transformers.
d. Foundation of 66kV Surge Arrester.
e. Modification in the foundation for 220kV CB, 220kV LA, 220kV Isolators & 250kVA DG Set.
f. All civil works associated with erection of SF6 gas insulated metal enclosed switchgear including their foundation.
g. Foundation for lighting poles, panels & control cubicles of equipments wherever required.
h. Foundation for Lattice and pipe structures.
i. RCC in foundation including earth work in excavating disposal of surplus earth PCC, RCC, reinforcement steel for structures and equipments.
j. All roads including all crossings & main road infront of ICTs with connecting rail.
k. Site surfacing (gravelling) and anti weed treatment of complete switchyard area with provision of anti-termite treatment in buildings.
l. Cable trenches including all types of crossings (including power cable trench).
m. Rain Water harvesting.
n. Drainage system in the substation including storm water drainage.
o. Transformer fire walls.
p. RCC frame boundary wall with brick panneling, concertina wire etc.
q. Demolishing/dismantling Work of store shed, firewalls, disposal of malba etc.
r. Land filling (if required).
s. Car/Scooter Parking.
t. All the dismantled equipments / material are to be shifted to DTL site/store along with proper stacking.

Any other work required for functional requirement of establishment of the substation.

B. <u>Package-B</u>

I. <u>66kV System :-</u>

72.5kV SF_6 gas insulated switch gear shall have double bus bar arrangement with the following bays:-

S. No	Bay type	Number of bay(s)
01	Transformer/ I/C bays	04
02	Bus-coupler	02
03	Feeder bays.	12
04	Bus Sectionliser	02
05	Total	20

The SF_6 gas insulated switchgear rated for 66kV, 3-phase, 50 H_Z shall be of the indoor metal-enclosed type, comprising of following items:

(A) Double bus bar arrangement (3000A), Three -phase or single phase encapsulated SF_6 gas insulated, metal enclosed bus bars, each bus comprising of:

a. Bus bar enclosures running along the length of the switchgear to interconnect each of the circuit breaker bay modules in double main bus system.
b. Three, 3-core, single phase voltage transformers/ PTs.
c. One 3-phase, single pole, group operated isolator/disconnector with two 3-phase, single pole, group operated earthing switches with manual and motor driven operating mechanisms.
d. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.
e. Interconnecting wiring/piping
f. Grounding, support structures and platforms
g. Local control cubicle.

(B) 72.5kV, Bus Coupler bay module comprising of :

a. One 2500 A, 3-phase, SF6 Circuit Breaker, complete with operating mechanism
b. Three 3-core single phase current transformers.
c. Two 3-phase, single pole, group operated isolator switches each with three phase single pole group operated Earthing switch complete with manual and motor driven operating mechanisms.
d. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.
e. Local control cubicle.

(C) 72.5kV, bays for Incomer from 220/66kV Transformer, each comprising of :

a. One 2000A, 3-phase, SF6 circuit breaker, complete with operating mechanism for incomer bay from 220/66 kV transformer.
b. Three 4-core single phase current transformers.
c. One 2000A, 3-phase, single pole, group operated isolator without earthing switch, complete with manual and motor driven operating mechanisms.
d. One 2000A, 3-phase, single pole, group operated isolator with one 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
e. One 2000A, 3-phase, single pole, group operated isolator with one normal and one high speed fault make 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
f. SF6 type Surge Arrester.
g. Suitable provision for testing of cable.
h. SF6 ducts for connection with power transformer through SF6/XLPE cable termination.
i. GIS Cable(s) termination enclosure suitable for connecting 66kV XLPE cable with accessories (The cable shall be designed by the bidder considering 110% continuously loading of 66kV side of the 160MVA Transformer). It shall be minimum two run per phase for 66kV transformer incomer bay.
j. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.

k. Local control cubicle.

(D) Outgoing 72.5kV Line Feeder Circuit Breaker bay modules, each comprising of :

a. One 2000A, 3-phase, SF6 circuit breaker, complete with operating mechanism for outgoing feeder.
b. Three 3-core , single phase current transformers.
c. One 2000 A, 3-phase, single pole, group operated isolator without earthing switch, complete with manual and motor driven operating mechanisms.
d. One 2000A, 3-phase, single pole, group operated isolator with one 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
e. One 2000 A, 3-phase, single pole, group operated isolator with one normal and one high speed fault make 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
f. Three, 3-core, single phase voltage transformers/ PTs with disconnector switch.
g. SF6 type Surge Arrester.
h. Suitable provision for testing of cable.
i. GIS Cable terminal connection with enclosures suitable for connecting 1x1000 sq.mm XLPE cable and accessories. However, actual size shall be finalized during detailed engineering.
j. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.
k. Local control cubicle.

(E) 72.5kV, Bus Sectionliser bay module comprising of :

a. One 2500 A, 3-phase, SF6 Circuit Breaker, complete with operating mechanism
b. Three 3-core single phase current transformers.
c. Two 3-phase, single pole, group operated isolator switches each with three phase single pole group operated Earthing switch complete with manual and motor driven operating mechanisms.
d. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.
e. Local control cubicle (if required).

(F) The scope of work also covers connection of 220 kV GIS with 160MVA Power Transformer, 216 kV outdoor type lightening arrestor, connection of 66kV GIS with 160MVA Power Transformer through single phase SF6 / XLPE cable terminations. 66kV GIS and 160 MVA Power Transformer shall be connected through double run 66kV Power cable. The 66 kV cable shall be designed by the bidder considering 110% continuously loading of 66kV side of the 160MVA Transformer including indoor, outdoor termination and connection with 66kV bushings of transformer through Al/Cu bus-bar. The outdoor type Lightening Arrestor (L.A.) 60KV 10KA, with surge/discharge counter, milli-ampere meter and suitable terminal connectors etc shall also be in the scope of work.

The scope of work also covers the 66kV GIS feeder bays termination on H-pole outdoor arrangement through 66kV cable including indoor & outdoor termination (single run from 66kV GIS to H-Pole) & H-Pole for outgoing feeder termination.

II. Complete sub-station automation system based on IEC 61850 including hardware and software for remote control station, relay and protection system along with associated equipments and kiosk for following bays (bay as defined in technical specification, section: sub-station automation):

- 66 kV : 20 Bays

The sub-station should have the provision to be controlled from a remote location and mode of communication shall be optical fiber for all voltage levels.

III. Complete relay and protection system.

IV. Bus post Insulators, insulator strings and hardwares, clamps & connectors, terminal connector, Conductor, earth wire and earthing materials, tubular conductor, spacers, cable supporting angles/channels, Cable trays & covers, Junction box, buried cable trenches etc.

V. ACDB and DCDB for extension and distribution from 220kV GIS building along with proper wiring and required cables and connectors.

VI. One no. 400kVA, 11kV/433V LT Transformer having 170kVp BIL at 11kV side including bushings, accessories and first filling of oil & One no. 400KVA, 11kV/433V LT Transformer having 95kVp BIL at 11kV side including bushings, accessories and first filling of oil.

VII. Tertiary loading equipments for one 160 MVA transformer like Circuit breaker, isolator, current transformer, PT, surge arrestor.

VIII. 11 kV equipments for loading of 400 KVA Auxilary Transformer like 11kV switchgear, 2 Panel Board (1 incomer and 1 outgoing) alongwith associated control & relay system, 11kV cables etc.

IX. Fire Detection, Alarm & Protection for GIS building & associated building, DG set etc. (Portable type fire extinguishers system) Fire for GIS room and control room building, DG Set etc.

X. Air Conditioning System as per specification in section substation automation system.

XI. Ventilation system for 66kV GIS hall.

XII. LT switchgear.

XIII. 250KVA Outdoor Silent type DG Set.

XIV. 1.1kV grade Power & Control cables along with complete accessories.

XV. Earth mat (Measurement of resistivity is in the scope of contractor).

XVI. Complete lighting and illumination of the installation. This shall include the illumination for GIS Building, associated building including Switchyard/Street light system (High Mast lighting System). The specification for illumination shall be as per Annexure-IV.

XVII. Provision of CCTV camera for complete supervision of 66kV GIS hall, main entrance gate of substation, LT room, outdoor camera for monitoring of transformers and switchyard equipments from control room as well as from remote location other than substation. The cameras should be installed in such a way that the complete substation should be visible from remote for unmanned operation. The provision of Online viewing of camera from remote substation should be made by contractor.

XVIII. Special Equipments for testing and maintenance.

XIX. Bidder shall arrange suitable provision for testing of 66kV cables after isolation from the main GIS. Provision for space for termination of cable/ Overhead line shall be kept during designing stage.

XX. Bidder has to submit a 'Model' of the substation before starting actual work at site.

XXI. Mandatory Spares.

XXII. 11kV protection IEDs shall have integration with SCADA. ACDB and DCDB shall be communicable and integrated with SCADA.

XXIII. The work to be done under this specification comprises the provision of all labour, plant, equipment and material and the performance of all work necessary for the complete installation and commissioning of switchyard. It is hereby required that the contractor should provide all apparatus, appliances, material and labour etc. not specifically mentioned or included, but are necessary to complete the entire work or any portion of the work in compliance with the requirements implied in this specification is deemed to be included in the scope of contractor.

XXIV. The scope of work shall cover in complete conformity with the specifications, the followings:-
A single line schematic of the 66kV SF6 gas insulated switchgear with double bus bar arrangement is enclosed with the specification. In case any additional equipment is required, the same should be included in the scope of the supply and the offer should be complete and comprehensive. In addition all necessary platforms, supports, ladders and catwalks etc. for operation & maintenance work shall also be supplied. A tentative layout of the switchyard is enclosed with this specification. Bidder may adopt similar arrangement or optimize the same further without affecting any of the functional requirements specified.

XXV. Any other equipment/material required for completing the specified scope.

XXVI. Connectivity and integration of Transformer Bays with 160MVA Power Transformers alongwith associated equipments & works, cabling, provision of DC/AC supply, earthing for transformers is in the scope of this package. All civil works pertaining to foundations for transformers, accessories and NIFPES rail track, soak pit & sump pit, fire resistant wall, grating etc. shall be in the scope of GIS bidder. DTL shall furnish all relevant drawing/data for design of foundation to the bidder within **Four Months** from the date of award. Transformer and accessories with spares etc. supplied by Transformer Manufacturer shall be received by DTL and provision for separate stores for it shall be provided by GIS bidder until the commissioning of sub-station. The watch and ward of complete site shall however be in the scope of GIS Bidder. Power supply for oil filter machine, transformer testing and erection work until commissioning shall be provided by the bidder**.**

XXVII. Civil works - The work shall include but not limited to the following:-

i. **Soil Investigation.**

ii. **Design, Engineering and civil work for:**

a. Buildings for control room and well furnished GIS hall building as per details in Section civil works. Each GIS hall shall be provided with EOT crane and the requirement of crane shall be as per section GIS.

b. Foundation of 03 nos.160 MVA Power Transformers including soak pit, sump pit, fire protection wall etc.

c. Foundation of 02 nos.400KVA LT transformers.

d. Foundation of 250KVA DG set.

e. Foundation of 220kV & 66kV Surge Arrester.

f. All civil works associated with erection of SF6 gas insulated metal enclosed switchgear including their foundation.

g. Foundation for lighting poles, panels & control cubicles of equipments wherever required.

h. Foundation for Lattice and pipe structures.

i. RCC in foundation including earth work in excavating disposal of surplus earth PCC, RCC, reinforcement steel for structures and equipments.
j. All roads including all crossings & main road infront of ICTs with connecting rail.
k. Site surfacing (gravelling) and anti weed treatment of complete switchyard area with provision of anti-termite treatment in buildings.
l. Cable trenches including all types of crossings (including power cable trench).
m. Switchyard fencing along with gates.
n. Rain Water harvesting.
o. Drainage system in the substation including storm water drainage.
p. Pump house building along with pump set.
q. Lighting cum lightening mast with fixtures.
r. Transformer fire walls.
s. RCC frame boundary wall with brick panneling, concertina wire including gate etc.
t. Land filling (if required).
u. Car/Scooter Parking.
v. Furniture of reputed make i.e. Godrej/ Rittal/Pyrotech :- control room table, tables for executives, chairs, lockers, almirah etc.

Any other work required for functional requirement of establishment of the substation.

C. Package-C

I. 66kV System :-

72.5kV SF_6 gas insulated switch gear shall have double bus bar arrangement with the following bays:-

S. No	Bay type	Number of bay(s)
01	Feeder bays.	06
02	Total	06

The SF_6 gas insulated switchgear rated for 66kV, 3-phase, 50 H_Z shall be of the indoor metal-enclosed type, comprising of following items:

(A) Double bus bar arrangement (3000A), Three -phase or single phase encapsulated SF_6 gas insulated, metal enclosed bus bars, each bus comprising of:

a. Bus bar enclosures running along the length of the switchgear to interconnect each of the circuit breaker bay modules in double main bus system as well as coupling arrangement for making compatibility to connect with existing GIS bus bar.
b. Three, 3-core, single phase voltage transformers/ PTs.
c. One 3-phase, single pole, group operated isolator/disconnector with two 3-phase, single pole, group operated earthing switches with manual and motor driven operating mechanisms.
d. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.
e. Interconnecting wiring/piping
f. Grounding, support structures and platforms
g. Local control cubicle.

(B) Outgoing 72.5kV Line Feeder Circuit Breaker bay modules, each comprising of :

a. One 2000A, 3-phase, SF6 circuit breaker, complete with operating mechanism for outgoing feeder.
b. Three 3-core , single phase current transformers.
c. One 2000 A, 3-phase, single pole, group operated isolator without earthing switch, complete

with manual and motor driven operating mechanisms.

d. One 2000A, 3-phase, single pole, group operated isolator with one 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
e. One 2000 A, 3-phase, single pole, group operated isolator with one normal and one high speed fault make 3-phase, single pole, group operated earthing switch, complete with manual and motor driven operating mechanisms.
f. Three, 3-core, single phase voltage transformers/ PTs with disconnector switch.
g. SF6 type Surge Arrester.
h. Suitable provision for testing of cable.
i. GIS Cable terminal connection with enclosures suitable for connecting 1x1000 sq.mm XLPE cable and accessories. However, actual size shall be finalized during detailed engineering.
j. Gas monitoring device, barriers, pressure switch, UHF based partial discharge measurement sensors etc. as required.
k. Local control cubicle.

II. Sub-station automation system for 66kV GIS bays including hardware and software for remote control station, relay and protection system complete in all respect along with associated equipments and kiosk for 06 Nos. 66kV bays (bay as defined in technical specification, section - sub-station automation) along with its integration with existing system.

III. Substation Automation equipment, optic fibre and other interface/converter equipments etc for integration of these six feeder bays with existing SAS system.

IV. Complete relay and protection system for 66 kV bays.

V. Fire Protection for extended 66 kV GIS bays and C&R panel Room etc. (Portable type fire extinguisher system)

VI. Air Conditioning System for the extended 66 kV GIS building as per specification in section substation automation system.

VII. Ventilation system for extended 66 kV GIS building.

VIII. 1.1kV grade Power & Control cables along with complete accessories.

IX. Extension of existing Earth mat and earthing of equipments (Measurement of resistivity is in the scope of contractor)

X. Complete lighting and illumination for extended GIS building etc with LED base/ Metal Halide Lamp. The specification for extended control room and GIS building illumination shall be as per Annexure-IV.

XI. Bidder shall arrange suitable provision for testing of 66kV cables after isolation from the main GIS. Provision for space for termination of cable/ Overhead line shall be dealt during detailed engineering stage.

XII. The work to be done under this specification comprises the provision of all labour, plant, equipment and material and the performance of all work necessary for the complete installation and commissioning of switchyard. It is hereby required that the contractor should provide all apparatus, appliances, material and labour etc. not specifically mentioned or included, but are necessary to complete the entire work or any portion of the work in compliance with the requirements implied in this specification is deemed to be included in the scope of contractor.

XIII. The scope of work shall cover in complete conformity with the specifications, the followings:-

A tentative layout plan for extension of 66kV SF6 gas insulated switchgear bays is enclosed. 66 kV GIS bays with complete civil work and automation shall be in complete conformity with the specification. In case any additional equipment is required, the same should be included in the scope of the supply and the offer should be complete and comprehensive. In addition all necessary platforms, supports, ladders and catwalks etc. for operation & maintenance work shall also be supplied. A tentative layout of the switchyard is enclosed with this specification. Bidder may adopt similar arrangement or optimize the same further without affecting any of the functional requirements specified.

XIV. Any other equipment/material required for completing the specified scope.

XV. All wiring related to LAN for computers and telephone wiring in respective rooms, if required.

XVI. Civil works - The work shall include but not limited to the following:-

i. **Design, Engineering and civil work for:**
   a. Extension of Buildings for GIS hall and associated work as per scope of work. Extended GIS hall shall have the provision of extension of supporting structure for EOT crane movement.
   b. All civil works associated with erection of SF6 Gas Insulated Metal Enclosed Switchgear bays including their foundation.
   c. Foundation for lighting poles, panels & control cubicles of equipments wherever required.
   d. Entry to extended Control room and GIS building as per site requirement
   e. Foundation for associated Lattice and pipe structures.
   f. RCC in foundation including earth work in excavating disposal of surplus earth PCC, RCC, reinforcement steel for structures and equipments.
   g. Drainage system for Control room and GIS building as per site requirement
   h. Provision for entrance/ termination of power cable connection with GIS bays.
   i. Extension of cable trench in GIS building, if required.
   j. Any other work required for functional requirement of establishment of the 66 kV GIS bays.
   k. Pile foundations as per requirement.

ii) The dimensions (LxB) proposed for building of 66 kV GIS cum control building for GIS bays is indicative/tentative only. The bidders shall design the building keeping appropriate space for unhindered access to 66 kV Cable Plugs/Housing for maintenance activities, C&R Panel and also for unhindered movement of personnel alongwith with testing and maintenance equipment. The dimensions of Building shall be finalized during detailed engineering.

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

The complete design **(unless specified otherwise in specification elsewhere)** and detailed engineering shall be done by the Contractor based on conceptual tender drawings.

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

3.3 Design of substation and its associated electrical & mechanical auxiliaries systems includes preparation of single line diagrams and electrical layouts for extension area, erection key diagrams, electrical and physical clearance diagrams, design calculations for Earth mat, control and protection schematics, wiring and termination schedules, civil designs (as applicable) and drawings, design of fire fighting system and air conditioning system, indoor/ outdoor lighting/illumination and other relevant drawings & documents required for engineering of all facilities under the scope of this contract.

3.4 The Bidder shall keep the provision of service bays for increasing the length of GIS room to meet the future requirement, keeping the width of the building same. GIS building size shall be frozen after considering the requirement of future bays.

3.5 Specific Exclusions

The following items of work are specifically excluded from the scope of the specifications for substation:

Package-A

1. Supply and ETC of 03 Nos. 160MVA Power Transformers.
2. Road outside Boundary Wall.

Package-B

1. Supply and ETC of 03 Nos. 160MVA Power Transformers.
2. Road outside Boundary Wall.

Package-C: NIL

3.6 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.

3.7 Purchaser has standardized its technical specification for various equipments and works for different voltage levels. Items, which are not applicable for the scope of this package as per schedule of quantities described in Bid Price Schedule, the technical specification for such

items should not be referred to.

3.8 Water based firefighting and reservoir are not envisaged.
Pump and pump house is required for evacuation of surface/rain water or water logging in substation premises, primarily for water accumulated in trenches/drains/Cellar. Moreover, Pump will also function for regulating water to water harvesting system.

4.0 PHYSICAL AND OTHER PARAMETERS

4.1 **Location of the Substation** - The location of substation is indicated below:

Name of Substation	Name of State	Nearest Railway station	Railway Head
Package-A:- BTPS	Delhi Region	Delhi	Northern Railways
Package-B:-Dwarka	Delhi Region	Delhi	Northern Railways
Package-C:-Harsh Vihar	Delhi Region	Delhi	Northern Railways

4.2 **Meteorological data**
The meteorological data of the substation shall be handed over to successful bidder However for design purposes, ambient temperature and altitude shall be considered as 50 degree centigrade and less than 1000 mtr above MSL, respectively.

4.3 **Soil Data**
The bidder shall be responsible for carrying out the required tests and should fully satisfy himself about the nature of soil expected to be encountered prior to the submission of bid. Any variation of soil data during detailed engineering or construction stage shall not constitute a valid reason in affecting the terms and conditions of the bid.

5.0 SCHEDULE OF QUANTITIES

The requirement of various items/equipments and civil works are indicated in Bid price Schedules.

All equipments/items and civil works for which quantities has been given in the price schedule shall be payable on unit rate basis. During actual execution, any variation in such quantities shall be paid based on the unit rate under each item incorporated in the letter of award.

Wherever the quantities of items/works are not indicated, the bidder is required to estimate the quantity required for entire execution and completion of works and incorporate their price in respective Bid price schedules.

The detailed bill of quantities of the mandatory spares with break up is given in the bid price Schedules (Volume-III).

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

6.0 BASIC REFERENCE DRAWINGS

6.1 Package-A: - The 66 kV GIS at BTPS is a new Gas Insulated Substation at existing 220 kV BTPS Sub-Station. For 66kV voltage level, Double bus switching scheme layout arrangement shall be used. Single line diagram and layout arrangements are enclosed with the bid documents, which shall be further engineered by the bidder.

Package-B: - The 66 kV GIS at Dwarka is a new Gas Insulated Substation at existing 400/220 kV GIS Sub-Station Dwarka Sec-5. For 66kV voltage level, Double bus switching scheme layout arrangement shall be used. Single line diagram and layout arrangements are enclosed with the bid documents, which shall be further engineered by the bidder.

Package-C: - The 66 kV GIS at Harsh Vihar is already existing Gas Insulated Substation at 400/220/66 kV Sub-Station Harsh Vihar. For 66 kV bays extension, existing layout arrangement shall be used. Tentative layout arrangements are enclosed with the bid documents, which shall be further engineered by the bidder according to the existing system.

The drawings enclosed in Annexure-II shall give the basic scheme, layout of substation, substation building, associated services etc. In case of any discrepancy between the drawings and text of specification, the requirements of text shall prevail in general. However, the Bidder is advised to get these clarified from Purchaser.

6.2 The auxiliary transformers of rating 400KVA & 630KVA shall be used to feed the substation auxiliaries:

Package-A: - The 630 KVA, 11/0.433 kV (170kVp - BIL) auxiliary transformer shall be connected through overhead conductor to the tertiary of any one of the 160 MVA power transformers and shall be located near the power transformer while another 630KVA (95kVp - BIL) auxiliary transformer shall be located in LT station area and HT side shall be connected with Discom supply through 11kV HT Cable. These auxiliary transformers should not be used for construction purpose.

Package-B: - The 400 KVA, 11/0.433 kV (170kVp - BIL) auxiliary transformer shall be connected through overhead conductor to the tertiary of any one of the 160 MVA power transformers and shall be located near the power transformer while another 400KVA (95kVp - BIL) auxiliary transformer shall be located in LT station area and HT side shall be connected with Discom supply through 11kV HT Cable. These auxiliary transformers should not be used for construction purpose.

Package-C:- No auxiliary transformer required.

7.0 ORDER OF PRECEDENCE OF DIFFERENT SECTIONS OF TECHNICAL SPECIFICATION

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

1) Section-1 : Project
2) Section-2 : GIS
3) Section-3 : General Technical Requirement (GTR)

4) Section-4 : Special Equipments
5) Section-5 : Fire Protection System
6) Section-6 : LT Switchgear
7) Section-7 : Battery and Battery Charger
8) Section-8 : Lighting System
9) Section-9 : LT transformer
10) Section-10 : DG Set
11) Section-11 : Switchyard Erection
12) Section-12 : Civil Works
13) Section-13 : Substation Automation System
14) Section-14 : Control and Relay Panels
15) Section-15 : Power and Control Cables
16) Section-16 : CCTV
17) Section-17 : Fiber Optic Terminal Equipment (FOTE)
18) Section-18 : Lightning Arrestor (LA)

In case of any discrepancy between Section-PROJECT, Section- GTR and other technical specifications on scope of works, Section-PROJECT shall prevail over all other sections.
In case of any discrepancy between Section-GTR and individual sections for various equipments, requirement of individual equipment section shall prevail.

8.0 MANDATORY SPARES

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

The bidder is clarified that no mandatory spares shall be used during commissioning of the equipment. Any spares required for commissioning purpose shall be arranged by the Contractor. The unutilized spares if any brought for commissioning purpose shall be taken back by the contractor.

9.0 SPECIAL TOOLS AND TACKLES

The bidder shall include in his proposal the deployment of all special tools and tackles required for erection, testing, commissioning and maintenance of equipment. However a list of all such devices should be indicated in the relevant price schedule. In addition to this the Contractor shall also furnish a list of special tools and tackles for the various equipment in a manner to be referred by the Purchaser during the operation of these equipment.

10.0 FACILITIES TO BE ARRANGED BY THE CONTRACTOR

10.1 For construction purpose, the Contractor shall arrange suitable electricity supply from the Distribution Utility at his own cost and in case of failure of power due to any unavoidable circumstances, the contractor shall make his own necessary arrangements like diesel generator sets etc., at his own cost so that progress of work is not affected and Employer shall in no case be responsible for any delay in works because of non-availability of power.

10.2 The contractor shall make his own arrangement for water supply at his own cost and the Employer shall in no case be responsible for any delay in works because of non-availability or inadequate availability of water.

11.0 TERTIARY WINDING (TRANSFORMER)

The tertiary winding shall be suitable for connection to LT transformer for auxiliary supply. The details of equipment associated with loading tertiary winding are enclosed as Annexure-III.

12.0 SPECIFIC REQUIREMENT

12.1 Training of Owner's Personnel:

The successful tenderer shall also arrange the training of owner's/purchaser's engineers at the manufacturer's works/facility from where the equipment is being supplied for 120 man days in Design, Manufacturing and Testing of equipment being supplied. To & fro air fare including boarding and lodging shall be borne by the owner/purchaser and no separate charges for training shall be paid.

12.2 Bidder shall conduct type tests on equipments other than GIS if required in their respective section.

12.3 The equipment to be supplied for 220kV system shall be suitable for system fault current of 50 KA for 1 second as specified elsewhere in the specification.

12.4 The contractor shall place their panels i.e. Bay level units, bay mimic, relay and protection panels etc in an enclosure for 66kV in respective GIS hall. The enclosure shall be air-conditioned and requirement of air-conditioning shall be as detailed in section Sub-station Automation System.

12.5 Control, monitoring and protections (over current and open delta protections) for Auxiliary transformer and associated equipments shall be from auxiliary BCU to be provided as per section sub-station automation.

12.6 The specification of 66kV XLPE cable required for interconnection between 66kV side of power transformer to 66kV GIS hall is enclosed as Annexure-V. The formation and the other details shall be finalized during detailed engineering.

12.7 As 66kV GIS are proposed to be extended in near future, the contractor shall make available all details such as cross section, gas pressure etc required to design adapter in future for extension of both GIS during detailed engineering.

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

12.9 In Section-GTR and other technical specifications, the word 'Employer' and/or 'Owner' may be read as 'Purchaser'.

Annexure-I

MANDATORY SPARES FOR GAS INSULATED SWITCHGEAR (GIS)

	66 KV SF6 CIRCUIT BREAKER	
1.	Three phase, Circuit Breaker interrupting chamber complete with all necessary apparatus.	1 no. of each rating
2.	Rubber gaskets, 'O' rings and seals	1 set
3.	Trip coils with resistor.	3 nos.
4.	Closing coils with resistor	3 nos.
5.	Relays, Power contactors, push buttons, timers & MCB etc.	1 set
6.	Closing valve assembly (3no. of each type)	1 no.
7.	Trip valve assembly (3no. of each type)	1 no.
8.	Auxiliary switch assembly	1 no.
9.	Operation Counter	1 no.
10.	Rupture disc/diapharm	1 no.
	66 KV GIS ISOLATORS & E/Switch	
11.	Three ph, Disconnecting Switch internal parts, complete with all necessary gaskets, mounting hardware, etc.	1 set.
12.	Three ph, Disconnecting Switch operating mechanism, complete with all necessary connecting apparatus.	1 set.
13.	Three ph., Grounding Switch internal parts, complete with all necessary gaskets, mounting hardware etc	1 set.
14.	Three ph., Grounding Switch operating mechanism, complete with all necessary connecting apparatus.	1 set.
	66KV GIS CURRENT TRANSFORMER	
15.	Single phase current transformers of each rating with packing.	no. of each rating
	66 kV GIS Voltage Transformer	
16.	Three phase VT complete with all Gaskets and mounting hardware.	1 no. of each rating
	220kV GIS SURGE ARRESTOR	
17.	Complete L.A. of each type and ratings with insulating base, terminal connector, , Surge counter & accessories	1 No.
	66kV GIS SURGE ARRESTOR	
18.	Complete L.A. including insulating Base with Surge counter & accessories.	1 no.
	DG Set	
19.	Set of Fuel filter (each type)	1 set
20.	Solenoid Coil Assembly	1 No.

21.	Self Starter assembly with clutch engaging and disengaging arrangements complete with motors	1 No.
22.	Lube Oil pressure safety control)	1 No.
23.	High water temp. safety control	1 No.
24.	Diode	1 No.
	BATTERIES	
25.	Spare Battery Cell	5 No.
26.	Terminal connectors with nuts & bolts	10 No.
	Relay & Protection Spare (for each voltage class)	
	Breaker Relay Panel	
27.	Breaker failure Relay	1 No
28.	Trip Circuit Supervision Relay	2 No
29.	Self Reset Trip Relay of each type (if applicable)	1 No
30.	Timer Relay of Each type (if applicable)	1 No
31.	DC Supervision Relays (if applicable)	1 No
	Line Protection Panel Equipments Spares	
32.	Main 1 Numerical Distance Relay (Excluding External Trip Relays)	1 Set
33.	Main 2 Numerical Distance Relay (Excluding External Trip Relays)	1 Set
	Transformer Protection Panel	
34.	Transformer Differential Protection Relay Including all AUX. CTs (if applicale)	1 No
35.	Restricted Earth Fault Protection Relay with Non Linear Resitor (if applicale)	1 No
36.	Backup Protection Relay with Three O/C and E/F Element	1 No
37.	Over Fluxing Relay (if Stand alone)	1 No
38.	CVT selection relay (if stand alone)	1 No
39.	Over Load Relay with Timer (if Stand Alone)	1 No
	Sub-station Automation System Spare	
40.	Bay Control Unit (of each type)	1 No
41.	Ethernet Switch of Each type	1 No
42.	optical cable with end terminations of each length/type	5 set

Annexure-II

List of Drawings for GIS:

Package-A

1. Tentative Single Line Diagram (Annexure-IIA).
2. Tentative Layout Plan and Location (Annexure-IIB).
3. Tentative SAS Architecture (In section: Substation Automation).
4. The list of vendors who have supplied various materials in DTL for reference to the bidder (Annexure-IIC).

Package-B

1. Tentative Single Line Diagram (Annexure-IID).
2. Tentative Layout Plan and Location (Annexure-IIE).
3. Tentative SAS Architecture (In section: Substation Automation).
4. The list of vendors who have supplied various materials in DTL for reference to the bidder (Annexure-IIC).

Package-C

1. Tentative Single Line Diagram (Annexure-IIF).
2. Tentative Layout Plan and Location (Annexure-IIG).
3. Tentative SAS Architecture (In section: Substation Automation).
4. The list of vendors who have supplied various materials in DTL for reference to the bidder (Annexure-IIC).

Annexure-III

TECHNICAL PARAMETERS FOR TERTIARY LOADING EQUIPMENTS FOR 160 MVA TRANSFORMER

A. **36kV, outdoor type, SF6 Circuit Breaker Technical Parameters**

a) Rated Current (A) – 630
b) Insulation level - BIL- 170kVpeak
c) Short time rating – 31.5KA for 1 sec.
d) The circuit breaker shall be provided with the provision of local and remote operation.

B) 33kV, outdoor type, Current Transformer Technical Parameters

a) Ratio: 400-200-100/1-1-1A
Core-I Metering
Core-II PS class
Core-III PS class
b) Insulation level - BIL- 170kVpeak
c) Short time rating – 31.5KA for 1 sec.
d) Class - 0.2S – metering
e) VA burden - 20 each

C) 11kV, outdoor type, Potential Transformer Technical Parameters

a) Ratio - 11kV/√3 / 110V/√3/110V/√3.
b) Insulation level - BIL- 170kVpeak
c) Class - 0.2 – metering
3P - open delta protection
d) VA burden - 20 each

D) 33kV, outdoor type, isolator with earth switch Technical Parameters

a) Isolator shall be horizontally mounted MOM type with local and remote operation.
b) Insulation level - BIL- 170kVpeak
c) Short time rating – 31.5KA for 1 sec.

E) 11 kV Surge Arrester

The rating of surge arrester shall be finalized during detailed engineering.

F) Control & Relay protection scheme

The control & relay panel for tertiary shall be mounted either in 33kV incomer panel or in separate panel. Tertiary control shall also be monitored through sub-station automation system, however, various items are required for control & relay panel is as follows:-

i) One Multifunction Meter.
ii) One Static Tri- vector meter 0.2 Class, ABT compliant.
iii) One Control switch for circuit breaker operation.
iv) LED for C.B/ Isolator closed/ open position in red and green colour.
v) Alarm and LED for DC failure.
vi) One painted mimic bus equipped with symbols and semaphore indicators to represent breaker position.
vii) LED for auto trip in amber colour.
viii) LED blue coloured for C.B. spring charged condition (if required).
ix) DC supervision scheme.
x) Push button and bulb for on demand checking of trip circuit healthy for ON/OFF position with relay.
xi) Static O/C and E/F relay.
xii) Inverse characteristic Neutral unbalance voltage relay.
xiii) Bell operation on DC.
xiv) Buzzer operating on 230V A.C.
xv) Push button for alarm cancellation.
xvi) Test terminal block for testing of meters.
xvii) Set of auxiliary relays and tripping relays required to complete the scheme.
xviii) A.C failure relay.

G) The sub-station auxiliary supply is normally met through a system having the following parameters. The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation system shall also conform the parameters as indicated in the following.

Normal Voltage	Variation in Voltage	Frequency in Hz	Phase/Wire	Neutral connection
415V	+/- 10%	50 +/- 5%	3/ 4 Wire	Solidly Earthed.
240V	+/- 10%	50 +/- 5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	2 wire	Isolated System

Combined variation of voltage and frequency shall be limited to +/- 10%.

Annexure-IV

LIGHTING SPECIFICATION

A. GENERAL

1. GIS BUILDING

The GIS Building main halls will be illuminated using enclosed type high bay, luminaries having 250 watt metal halide fixtures along with surface mounted 1x60W GLS down lighters for emergency areas. Use of LED based low power consumption luminaries to achieve desired lux level specified can also be used as finalized during detailed engineering.

2. CONTROL ROOM LIGHTING

i. Control room area will be illuminated using mirror optics luminaries, which have superb glare control, the luminaries will have Cat II mirrors. Philips TBS 088 / 236 C5 HF or equivalent.

ii. In addition to mirror optics luminaries CFL down lighter with turbo louvers will be used. The luminaries would be suitable for 2XPL 16 Watt Lamp.

iii. For non false ceiling areas, the illumination will be carried out using 2x28 Watt lamps with industrial reflector Philips TMS 122 / 228 HF or equivalent.

iv. DC Emergency Lighting in non false ceiling areas to be carried out with surface mounted down lighters.

v. For all areas necessary exit sign lights and minimum 4 nos portable emergency lights will be provided.

vi. Use of LED based low power consumption luminaries to achieve desired lux level specified can also be used as finalized during detailed engineering.

3. Following Average Lux Levels will be maintained :

S. No.	Description	Lux	Uniformity
i.	Control Room	350 Lux	0.8
ii.	GIS Building	200 Lux	0.7
iii.	Offices	300 Lux	0.8
iv.	Indoor areas other	150 Lux	0.7

4. Control :

Sufficient number of occupancy and light level sensors shall be provided subject to following minimum requirement:

Sl. No.	Area	No. of Occupancy Sensor	No. of Light Level Sensor
1	Control Room	1	1
2	Conference Room	1	1
3	Room For Engineers	4	---
4	Room for Non-executive	1	---
5	S/Stn. In-charge Room	1	---
6	Electronic Lab	1	1
8	220kV GIS Hall	---	4
9	66kV GIS Hall	---	4

No occupancy sensor and light level sensors are envisaged for ACDB room, DCDB room, Lobby, Corridor and DG set. Each light level sensor shall be provided to measure and regulate lighting. The light level sensor shall be used to achieve bank switching. Each occupancy sensor shall be used for indoor use with time delay programmable in the minimum range of 1 sec. to 2 Hour to control the illumination in the area.

B. Technical specifications for LED Luminaries for Control Room, GIS Building ETC. Illumination

1. SCOPE

This specification covers the general requirements of design, engineering, and manufacture, assembly, testing at manufacturer's works, packing and delivery at site of the energy efficient LED

outdoor lamps along with associated LED drivers, fixtures and other accessories for switchyard lighting in Substations.

2. APPLICABLE STANDARDS & CODES

LED Street Light shall be designed, manufactured and tested in accordance with the latest applicable Indian Standard and IEC standard as listed below –

Standard Code	Standard Description
IS 16101 : 2012	General Lighting -LEDs and LED modules – Terms and Definitions
IS16102(Part 1) 2012	Self-Ballasted LED Lamps for General Lighting Services, Part 1 Safety Requirements
IS16102(Part 2) 2012	Self-Ballasted LED Lamps for General Lighting Services, Part 2 Performance Requirements
IS16103(Part 1) 2012	Led Modules for General Lighting, Part 1Safety Requirements
IS16103(Part 2) 2012	Led Modules for General Lighting, Part 2 Performance Requirements
IS15885(Part2/Sec13)	Safety of Lamp Control Gear , Part 2 Particular Requirements , Section 13 dc. or ac. Supplied Electronic Control gear for LED Modules
IS16104 : 2012	d.c. or a.c. Supplied Electronic Control Gear for LED Modules -Performance Requirements
IS16105 : 2012	Method of Measurement of Lumen Maintenance of Solid State Light (LED) Sources
IS16106 : 2012	Method of Electrical and Photometric Measurements of Solid-State Lighting (LED) Products
IS 16107(Part 1)2012	Luminaries Performance ,Part 1 General Requirements
IS 16107(Part 2)2012	Luminaries Performance, Part 2 Particular Requirements, Section 1 LED Luminaries
IS 16108 : 2012	Photo biological Safety of Lamps and Lamp Systems
IS 10322 : 2012	Luminaries: Part 5 Particular requirements, Section 3 Luminaries for road and street lighting
IEC 62612	Self-ballasted LED lamps for general lighting services for voltage above 50 V — Performance requirements
IEC : 60598-2-3	Particular requirements - Luminaries for road and street Lighting
IEC 62471	Photo biological safety of lamps and lamp systems
IEC 62778	Application of IEC 62471 for the assessment of blue light hazard to light sources and luminaries
IEC 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test
IEC/PAS 62717	Performance requirements – LED modules for general lighting
IEC/PAS 62722	Performance requirements – LED luminaires for general lighting

Material conforming to other internationally accepted standards, which ensure equal or better quality than the standards mentioned above would also be acceptable. In case the bidder who wishes to offer material conforming to the other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English translations shall be furnished along with the offer.

3. CLIMATIC CONDITIONS:

The equipment covered under this specification is for outdoor installation and the climatic conditions that are prevailing at the sites in Delhi.

1.	Reference ambient temperature:	43.3 ° C as per IS 9676
2.	Maximum ambient air temperature	50°C
3.	Maximum daily average ambient temp	40°C
4.	Maximum Relative Humidity	100%
5.	Minimum Relative Humidity	10%
6.	Average annual rainfall	750 mm
7.	Average no. of rainy day	50
8.	Average no. of thunderstorm days per annum	40

9.	Altitude	Not exceeding 300 meters
10.	Rain months	June to Oct.
11.	Wind pressure as per IS 875	195 Kg/Sq. meters up to 30 meters

The atmosphere is generally laden with mild acid and dust in suspension during the dry months and is subjected to fog in cold months. Heavy lightening occurs in the area during rainy months (June to October).

All equipment shall be designed to withstand seismic forces, corresponding to an acceleration of 0.3 g horizontal.

4. Technical Design & construction Parameters:

S.No.	Technical Particulars	Required technical parameters	
A	**Fitting (Luninairs)**	**LED Switch Yard Lighting**	
1.	Distribution	Type-II	
	Usage hours	Dusk to dawn (12 hours)	
2.	Lens Type	Polycarbonate	
	Beam angle	120 Degree-min	
3.	Working Humidity	**10-100% RH 1**	
	Working temperature	**-10 to 50 ℃**	
4.	Wattage (System wattage)	100W ± 5%	150W ± 5%
5.	Luminary efficacy as per LM-79	>100 Lumen/watt	>100 Lumen/watt
6.	Minimum Lumens of Fitting	Minimum 12000Lumens	Minimum 15000 Lumens
7.	Pole entry dia	50-60 mm	50-60mm
8.	Luminaries protection	Class 1	
9.	Maximum variation allowed in luminary light output (lumen) throughout in the input operating voltage range	The voltage variations/fluctuations in the specified voltage range shall not impinge upon the lumen it produces. Maximum variation +/-2% is allowed in luminary light output (lumen) throughout in the input operating voltage range.	
10.	Input Voltage	240 Volts +/- 10%	
11.	Input Frequency	50Hz +/-3%	
12.	Operating voltage range	120-270V	
13.	Power Factor	≥0.95	
14.	Overall total harmonic distortion	<10% as per EN 55015 or EN 61000-3-2	
15.	Surge protection	≥10kv inbuilt or "5KV internal (inbuilt) and 5KV external" with NABL Lab test report	
16.	Index of protection level for optical & control gear	IP 66	
17.	Impact resistance	≥IK07	
18.	Housing	Single piece Corrosion free High Pressure aluminum die cast with manufacturer's embossed/engraved. The luminaries shall be built in such a way that it can withstand wind speed of150kmph. NABL accredited lab report supporting the same shall be furnished by the manufacturer.	
19.	Driver Housing	Integral	
20.	The luminaries should meet the standard	IEC 60598-1	
21.	Cover/Glass	UV stabilized poly carbonate/Toughened glass	
22.	Screw/faster & clamps	Stainless Steel	
23.	Type Tests report as per IS : 10322 Part 5 sec-3/IEC : 60598-2-3	From NABL accredited TPL (IP classification is IP 66, INSITU/Junction temp measurement shall be part of Thermal test)	
24.	Test report as per LM79/IS:16106	From ILAC/MRA/NVLAP/KOLAS/EPA/NABL accredited TPL (IP classification is IP 66)	

25.	Test report for IK07	As per IS 10322
26.	Test report with summary for compliance as per tender parameters (Operating voltage, Constant light output, Luminous flux per watt, CCT, CRI, Uniformity calculation, P.F, Wattage.	For LED parameters like lumen per watt, CCT, CRI, Beam Angle from LED Manufacturer or TPL.
27.	LM80/IS:16105 report	From ILAC/MRA/NVLAP/LOLAS/EPA/NABL accredited Manufacturer or TPL.
28.	Conformation standards of luminaire (Test reports of luminaire)	The luminaire should conform to IEC 60598/IS:10322 The luminarie should be tested as per IEC 60598-2-3:2002/IS:10322 Part 5 Sec-3 standards and following test reports should be submitted from NABL certified TPL TEST REPORT as per IS:10322 part 5 Sec-3/IEC:60598-2-3: Heat Resistance Test, Thermal Test, Ingress Protection Test, Drop Test. Electrical/Insulation Resistance Test, Endurance Test, Humidity Test, Photometry Test (LM79 report), Vibration Test.
B)	**LED**	
1)	Single LED chip for a single category/wattage of product.	Single LED chip is allowed for a single category/wattage of product, mixing of chip is not allowed for single product.
2)	LED Test Report	For LED parameters like Lumen per watt, CCT, CRI, Beam Angle from ILAC/MRA/NVLAP/KOLAS/EPA/NABL accredited Manufacturer or TPL
		LM 80/IS:16105 report from ILAC/MRA/NVLAP/KOLAS/EPA/NABL accredited Manufacturer or TPL
		IEC 62471 and assessment of blue light as per IEC/TR 62778-Ed.1.0
3)	Type of LED	Discrete high power LED with individual lens >1W and <3W
4)	Color Rendering Index (CRI)	>70
5)	CCT	≥ 5700K as per ANSI Bin
6)	Junction temperature	Tj≤85˚ provided Luminary housing temperature rise should not be more than 25̊ C over ambient temperature after 48 hours continuous operation.
7)	LED Efficacy	>135lm/W
8)	Life expectancy	≥ 60,000 hours at 70% lumen maintenance (LM70)
9)	LED should meet the standard	IEC 62471 2006-07 (photo biological safety of lamps and lamp systems)LM-80 and Assessment of blue light as per IEC/TR 62778.
10)	Light distribution	LED with secondary lens
C	**LED Driver**	
1)	Efficiency	≥85%
2)	Make of Driver	Similar to manufacturer make
3)	LED Driver Test Report	Type Tests report as per IS:15885-Part 5 Sec-13, IS: 16104
		Test Report as per tender specification (Driver Efficiency, >85% THD, < 10% Surge Protection > 10KV)
4)	Life of Driver	≥ 50000 hours
5)	Surge Voltage Protection	≥ 10kv inbuilt or “5KV internal (inbuilt) and 6KV

		external"
6)	Driver Current (Ampere)	≥ 350MA ≤1000mA
7)	Protection	Over voltage, short circuit, open circuit and Reverse polarity, Environmental. Potted with flame retardant thermal potting compound. CE Making, ENCE, RoHS Compliance, UT
8)	Construction	
9)	Driver Certification	
10)	Driver Approval	BIS approved driver with R Number certificate to submitted.
D	**Body & Other Parameters**	
1)	Type of housing (Material & Const.)	Single piece Corrosion free aluminum High Pressure die cast with manufacturer's Embo'ssed/engraved.
2)	Type of Cover/Glass	Toughened glass/UV stabilized Polycarbonate cover
3)	Type of heat Sink	Pressure die cast
4)	IP Protection Class	IP -66
5)	Finish	Polyester Power coated
6)	Screw/fastener & clamps	Stainless steel
7)	Product qualities	The luminaries shall be supplied with lable, giving indication of serial number, model and system lumen pack, nominal CCT, wattage of fitting, Date of Manufacturer, and other labeling details as per IS.
E	**Documents to be submitted**	
1)	5 year Guarantee Certificate	From Manufacturer/OEM.
2)	Test reports (LM 79, LM 80, Type Test Report, Technical Data Sheet, IP	From NABL accredited Third party lab covering NIT specifications.
3)	Copy of Technical Catalogues	
4)	Details of Service Centres	
5)	Photometric Report of fitting	LM 79 report from NABL Lab.
6)	Ref. of IS/IEC (if any) for type test	IS-10322 (Part 5/Sec 3)

5. NAME PLATE & MARKING:

Followings shall be clearly engraved/embossed on the die cast housing of LED Luminaries Housing:

a. Rated voltage or voltage range (marked 'V' or 'Volt');
b. Rated current (marked A' or 'Ampere');
c. Rated wattage (marked 'W' or 'Watts');
d. Rated frequency (marked in 'Hz')
e. Power factor
f. Rated lumen
g. Indian/International Standards to which it is
h. Manufactured
i. Month and year manufacture
j. Customer name as DTL
k. Fitting serial number
l. DTL PO no and date
m. Guarantee period

Following information shall be printed on the Control gear Driver Name plate:-

a. Operation Voltage range
b. Output voltage
c. Guaranteed period
d. DTL PO no. & date
e. Customer name as Delhi Transco Ltd.

6. TESTS:

The LED light must be of type tested from CPRI/ERDA/NABL/Equivalent accredited laboratory in accordance with IS 16102, IS 16103 and IS 16107 (PART-1,PART-2 2012) and reports shall be furnished along with the tender.

All Routine Tests, Acceptance tests shall be carried out in accordance with the relevant IS/IEC with latest in the presence of purchaser representative if so desired by the purchaser.

7. DRAWINGS, DATA & MANUALS TO BE SUBMITTED (FOR INFORMATION ONLY)

7.1	To be submitted along with bid	The bidder has to submit the following documents: a. Catalogues of the selected LED and Luminaire fittings. b. Guaranteed Technical Particulars c. General arrangement drawing of the LED light d. Calculation documents to substantiate choice of the LED and the Luminaire fittings. e. Verifiable Type Test Certificate of the LED and its luminaire carried out on identical Design and type of the unit of the same rating f. An illustrated literature on the LED giving technical information on the operational details and the current ratings, short circuit ratings, derating factors for different types of installation, packing date, weights and other relevant information.
7.2	After award of contract, seller has to submit mentioned drawings for buyer's Approval (A) /Reference (R)	The bidder has to be submit the following documents: a. Guaranteed Technical Particulars b. Calculations to substantiate choice of electrical, mechanical component size / ratings c. General arrangement drawing of the LED street light d. Programme for production & testing e. Detailed installation and commissioning instructions f. Quality Assurance plan
7.3	Submittals required prior to dispatch	a. Inspection and test reports, carried out in manufacturer's work b. Test certificates of all bought out items c. Operation and maintenance instruction as well as trouble shooting charts / manuals.

8. WARRANTY/GUARANTEE PERIOD

The full luminary shall be guaranteed against manufacturing defects, material, workmanship and design for the period of **05 years** from date of receipt of material. The guarantees for replacement of materials/accessories shall be provided free of charge at purchasers premises..The guarantee will be without prejudice to certificate of inspection or material receipt note issued by DTL.

Guarantee Technical particular of LED Luminaries:

S.No.	Technical Particulars	To be submitted by Bidder
A	**Fitting (Luminaries)**	
1)	Make	
2)	Manufacturing address	
3)	Model No.	
4)	Distribution	
5)	Usage hours	
6)	Lens Type	
7)	Beam angle	
8)	Working Humidity	
9)	Working temperature	
10)	Wattage (System wattage)	

11)	Luminary efficacy as per LM-79	
12)	Minimum Lumens of Fitting	
13)	Pole entry dia	
14)	Luminaries protection	
15)	Maximum variation allowed in luminary light output (lumen) throughout in the input operating voltage range	
16)	Input Voltage	
17)	Input Frequency	
18)	Operating voltage range	
19)	Power Factor	
20)	Overall total harmonic distortion	
21)	Surge protection	
22)	Index of protection level for optical & control gear	
23)	Impact resistance	
24)	Driver Housing	
25)	The luminaries standard	
26)	Type Tests report as per IS : 10322 Part 5 sec-3/IEC : 60598-2-3	
27	Test report as per LM79/IS:16106	
28	Test report for IK07	
29)	Test report with summary for compliance as per tender parameters (Operating voltage, Constant light output, Luminous flux per watt, CCT, CRI, Uniformity calculation, P.F, Wattage.)	
30	LM80/IS:16105 report	
31	Conformation standards of luminaire (Test reports of luminaire)	
B	**LED**	
1)	Make of LED	
2	Type of LED	
3	Model No. of LED	
4	Wattage of LED	
5	Number of LED used	
6	Color Rendering Index (CRI)	
7	CCT	
8	Junction temperature	
9	LED Efficacy	
10	Life expectancy	
11	LED Ref standard	
12	Light distribution	
13	Driving Current	
C	**LED Driver**	
1)	Efficiency	
2)	Make of Driver	
3)	LED Driver Test Report	
4)	Life of Driver	
5)	Model No. of Driver	
6)	Surge Voltage Protection	
7)	Driver Current (Ampere)	
8)	Protection	
9)	Construction	
10)	Driver Certification	
11)	Driver Approval	
D	**Body & Other Parameters**	
1)	Type of housing (Material & Const.)	
2)	Type of Cover/Glass	
3)	Type of heat Sink	
4)	IP Protection Class	
5)	Weight of fitting	

ANNEXURE-V

TECHNICAL SPECIFICATION FOR 66kV XLPE CABLE

1.0 TECHNICAL REQUIREMENTS

1.0.1 The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 1 (one) km of single core, 66kV or higher grade XLPE insulated cable which must be in satisfactory operation for at least 2 (two) years on the date of bid opening.

1.0.2 The XLPE insulated, HT cable shall be manufactured & tested in accordance with the IS 7098 Part-III and shall also conform to the requirements of internationally accepted applicable IEC standards for construction and testing. The terminating accessories shall conform to latest relevant IEC.

1.0.3 The cable shall be 66 kV grade, single core, un-armoured, stranded compacted Copper conductor, core screening by a layer of semiconducting tape followed by a layer of semiconducting compound, cross linked polyethylene (XLPE) dry cured insulation, insulation screening with semiconducting compound extruded directly over the insulation, longitudinal sealing by a layer of non woven tape with water swellable absorbent over insulation screen, metallic sheath of such metal/material (except lead/ lead alloy) designed to meet the requirement of the system short circuit rating of 31.5 KA for 1 sec and provide radial moisture barrier & outer jacket of extruded black colored PVC alternatively, PE with anti-termite protection and conforming to the technical particulars of specification.

1.0.4 The construction of cable shall generally conform to the description mentioned at sl no.1.0.2 of the specification. Bidder may offer necessary layers such as separation tape, binder tapes etc additionally as per their manufacturing practices for meeting required performance of the offered cable. The bidder shall enclose with the bid, drawing showing cross section of the cable. The conductors screen (non-metallic semi-conductive) shall be extruded in a single one-time process to ensure homogeneity and absence of voids.

1.0 Type Tests:

2.0.1 The cable shall conform to all type, routine and acceptance tests listed in the relevant IS/IEC.

2.0.2 The cable should have been type tested for all type tests as per latest relevant IEC /IS: 7098 (Part-3) – 1993 including amendments for XLPE insulated HT cable and its report shall be submitted to employer for its acceptance.

2.0.3 The bidder shall submit type test reports for all type test as per clause no. 11.3.2, latest relevant IEC including amendments for employer's acceptance for accessories for 66kV XLPE cable.

3.0 Rating

The cable size shall be suitable to carry the load current at 66 KV continuously followed by a 10% overloading capacity for two hours without exceeding the maximum conductor temperature of 90°C as per latest relevant IEC (The manufacturer shall specify such final temperature which shall ensure that there is no loss of life of the cable insulation). The cable rating size shall be based on loading of 2 Nos. three phase circuits at an ambient temperature of 50°C and soil temperature of 35°C. A complete set of experimentally verified data and calculations made; in arriving at the conductor rating shall be enclosed with the offer.

4.0 Cable Laying and Termination:

66kV, XLPE insulated cable shall be laid from 160MVA transformer to GIS in buried cable trench. The formation and other details shall be finalized during detailed engineering. Single point bonding system shall be employed along with sheath voltage limiters (SVL) if required, to limit the standing voltage to 65V. Laying route along with cable length shall be planned to keep provision of a future cable joint in all cables by providing S bend.

ANNEXURE-VI

TECHNICAL SPECIFICATION OF 33kV CURRENT TRANSFORMER OF RATIO 400-200-100/1-1-1 A for TERTIARY LOADING of 160MVA POWER TRANSFORMER

1.0 **GENERAL**

1.1. The 33 KV Current Transformer shall be out door, of Ratio 400-200-100/1-1-1A complete with terminal connectors.

1.2. The Technical features and construction details of each current transformer shall be in accordance with the requirement stated herein under.

1.3. The equipment quoted under this specification shall conform to the standards specified below unless otherwise specified, the equipment shall conform to the latest applicable IS/IEC.

2.0 STANDARDS

2.1. The design, manufacture and performance of the equipment provided under this specification shall comply with the standards given in the clause 2.2.

2.2

Indian Standard No.	Title
a) IS-2705 (part I to V)	: Specification for current Transformer
b) IS-4201	: Application guide for current Transformer.
c) IS-2099/ IS-5621	: High voltage porcelain Bushings/Hollow Column insulators.
d) IS-731	: Insulator for O/H Power line
e) IS-335	: New insulating oil for transformer and switchgear.
f) IS-9676	: Reference ambient temperature

3.0 SYSTEM PARAMETER

The 33 KV system parameters are as follows:

a) Nominal system voltage:	33 KV
b) Highest system voltage:	36 KV
c) Frequency:	50 Hz.
d) Earthing of the system:	solidly grounded
e) Insulation level:	
i) Impulse voltage withstand	170 KV (P)
ii) Power frequency withstand	70 KV (rms)
f) Short time current rating and its duration	31.5 KA for 1.0 Second

4.0 TECHNICAL PARTICULARS OF CURRENT TRANSFORMERS

4.1. 33 KV C.T. of ratio 400-200-100/1-1-1 A

CORE – I : METERING

a) Secondary Current	1 Amp.
b) Purpose	Metering
c) Rated output	20 VA
d) Class of Accuracy	0.2S
e) Instrument security factor	≤ 5

CORE – II: BACK UP PROTECTION (O/C & E/F)

a) Secondary Current	1 Amp.
b) Purpose	O/C & E/F Protection
c) Min. Knee point voltage VK	$40(R_{ct}+8)$ V (Rct.-Resistance of secondary winding)
d) Class of Accuracy	PS
e) Max. exciting current at VK/2	30 mA

CORE – III: TRANSFORMER DIFFERENTIAL PROTECTION

a) Secondary Current	1 Amp.
b) Purpose	Transformer differential
c) Class of Accuracy	PS
d) Min. Knee point voltage VK	$40(R_{ct}+8)$ V (Rct.-Resistance of secondary winding)
e) Max. exciting current at VK/2	30 mA

6.0 CONSTRUCTION DETAILS

6.1. The current transformers shall be oil immersed and self cooled outdoor type suitable for the specified services indicated, completed in all respects and in accordance with best engineering practice design and workmanship.

6.2. The core shall be of high grade non ageing, electrical silicon laminated steel of low hysteresis loss high permeability to ensure high accuracy at normal and over current conditions and shall produce undistorted secondary current under transient conditions at all ratios.

6.3. The oil immersed CT shall be hermetically sealed to eliminate breathing and to prevent air and moisture and shall be provided with a pressure relieving device capable to releasing abnormal internal pressure. C.T. shall be provided with oil level gauge, and necessary arrangement for replacing the oil shall be provided.

6.4. The current transformers shall be suitable for simultaneous 100% full load continuous rating of the winding.

6.5. The ratio changing taps shall be provided only on the secondary winding of the C.T.

6.6. The current transformer cores to be used for metering and instrumentation shall be of accuracy class specified and suitable for commercial and industrial metering. The Saturation factor of this core shall be low enough not to cause any damage to measuring instruments in the event of maximum short circuit current.

6.7. Current transformers cores to be used for protective relaying purposes shall be of accuracy class specified, suitable for distance protection, pilot wire protection, differential protection, restricted earth fault protection, over current and earth fault protection. Over current and earth fault for a maximum saturation factor as specified for the highest setting.

6.8. The secondary terminals shall be brought out in a weather proof terminal box (with degree of protection IP55) on the side of the current transformer and shall be accessible through a removable cover. The secondary tap shall be adequately reinforced to withstand normal handling without damage. Suitable cable glands shall be provided to accommodate purchaser's control cables.

6.9. The maximum permissible temperature rise of the windings over the ambient shall not exceed 50^0C.

6.10. The magnetising curve for each core shall be furnished with the tender.

6.11. The secondary terminals shall be provided with short circuiting and earthing arrangements at the terminal block.

6.12. The C.T.s shall be suitable for horizontal as well as vertical transportation.

6.13. The Instrument security factor at all ratios shall be less than 5 for metering cores.

6.14. The C.T. shall be suitable for high speed auto-reclosing.

7.0 INSULATION OIL:

The quality of insulating oil in each transformer shall be best available and the complete specification of the oil shall be furnished in the tender. The current transformers offered shall be hermetically sealed completely filled with insulating oil. The insulating oil shall conform to the latest Indian Standard specification No. 335.

8.0. BUSHINGS / INSULATORS:

i) a) Porcelain used in bushing/Insulator manufacture shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might effect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

b) Glazing of the porcelain shall be of uniform brown colour free from blisters, burrs and similar other defects. Bushings shall be designed to have ample insulation, mechanical strength and rigidity for the conditions, under which they will be used.

ii) When operating at normal rated voltage there will be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the bushings/ Insulator when operating at the normal rated voltage.

iii) All iron parts shall be hot dip galvanized and all joints shall air tight. Surfaces of the joints shall be trued up, porcelain parts by grinding and metal parts by machining. Bushing/ Insulator design shall be such as to ensure a uniform compressive pressure on the joints.

iv) The creepage distance of the bushing /Insulator shall in no case be less than 25mm/KV, suitable for heavily polluted atmosphere.

v) Bushing/ Insulator shall be tested for type tests and routine tests in accordance with stipulation of IS-2099/ IS-5621 Routine as well as type tests reports in conformity with IS-2099/ IS-5621 shall be furnished to the purchaser.

vi) Parameters of Bushings/Insulators:

a)	Rated Voltage	: 36 KV
b)	Impulse withstand voltage	: 170 KVp
c)	Power frequency withstand voltage (dry & wet)	: 70 KV (rms)
d)	Total creepage distance	: 900 mm
e)	Pollution level	: Suitable for Heavily Polluted Atmosphere

9.0 TERMINAL CONNECTORS

9.1. The current transformer offered shall be supplied with indigenous rigid type, Die casted, bimetallic (wherever applicable) terminal connectors suitable for single/double/quad ACSR Zebra conductor as per requirement conforming to IS-5561 for maximum current rating of CT.

9.2. The Neutral current transformer offered shall be supplied with one no. rigid type bimetallic (wherever applicable) terminal connector suitable for connecting to twin 75x12 mm flat of station earth. Also one no. terminal connector for connection to transformer neutral and suitable for ACSR Zebra shall be supplied.

9.3. Suitable terminal connectors for earthing connections shall also be supplied.

10.0 TESTS

10.1 The copies of certificates of all type tests as stipulated in IS: 2705 shall be furnished along with the tender.

10.2 Each current transformer shall be subjected to routine tests as specified in IS: 2705 in the presence of Purchaser's representative if so desired by the Purchaser. All test reports should be submitted and should be approved by the purchaser before dispatch of the equipment

11.0 MARKING

11.1. Rating plate : As per IS-2705 (Part-I)

11.2. Terminal marking: As per IS- 2705 (Part. I)

ANNEXURE-VII

Fire Detection and alarm System

This system shall be provided for control room building and Switchyard panel rooms of substations.

1. 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;
   a. A visual signal exhibited in the annunciation panels indicating the area where the fire is detected.
   b. An audible alarm sounded in the panel, and
   c. An external audible alarm sounded in the building, location of which shall be decided during detailed engineering.
   d. If the zone comprises of more than one room, a visual signal shall be exhibited on the outer wall of each room.
2. 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.
3. Coverage area of each smoke detector shall not be more than 80 m2 and that of heat detectors shall not be more than 40 m2. 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.
4. 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 IS 1554 (Part 1) shall be used.

SECTION-II

GAS INSULATED SWITCHGEAR

SECTION: 2

Technical Specification of 400kV, 220kV, 66kV, 33kV Gas Insulated Switchgear (GIS)

1. General

The GIS manufacturer shall design, manufacture, test, deliver and guarantee the GIS components and services as defined in this Technical Specification. The complete GIS based on the Single Line Diagram and as defined in Section Project, shall be provided for connection to Power Transformers/Reactors/Lines feeders with associated circuit breaker, disconnect switch and grounding switch (maintenance and high speed), instrument transformers, and surge arrestor (if applicable) etc.

2. GENERAL CHARACTERISTICS

2.1 The SF6 gas insulated metal enclosed switchgear shall be totally safe against inadvertent touch of any of its constituent parts. It should be designed for indoor application with meteorological conditions as specified.

2.2 All parts of the bus bar, switchgear and the bus ducts (for both indoor and outdoor applications) shall be as mentioned below:

400 kV GIS	Single phase enclosed
220 kV GIS	Single Phase/Three Phase enclosed
66 kV/33kV GIS	Three Phase enclosed

2.3 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 deemed to be included. The required overall system parameters of GIS are as per **Annexure -6**

3. REFERENCE STANDARDS

The GIS offered shall confirm to IEC 62271-203 and other relevant IEC standard except to the extent explicitly modified in the specification and shall be in accordance with requirement specified in GTR.

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 **5**2 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-gearStandards
IEC 62271-102	Alternating current Disconnect Switch (isolators) and earthing switches
IEC 61869	General Requirements Instrument 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 2013	IEEE Guide for Safety in AC Substation grounding.
CIGRE-44	Earthing of GIS- an a pplication g uide. (Electra no.151,Dec'93).
IEC 62271-211	Direct c onnection be tween P ower Transformers and g as insulated metal enclosed switchgear for rated voltage 72.5 k V and above.

The components and devices which are not covered by the above standards shall conform to, and c omply w ith, the l atest applicable standards, r ules, c odes a nd regulations of the internationally recognized standardizing bodies and professional societies as may be approved by t he E mployer. T he m anufacturer sh all l ist a ll su ch applicable s tandards, codes et c and provide copies thereof for necessary approval.

In c ase t he requirements laid down herein di ffer from t hose g iven i n above s tandard in any aspect, the switchgear shall comply with the requirements indicated herein in regard thereto.

4. DEFINITIONS

4.1. **Assembly:** Assembly refers to the entire completed GIS equipment furnished undercontract.

4.2. **Bay:** Bay refers to the area occupied by one Circuit Breaker and associated equipment used toprotect one feeder/line/bus coupler in double bus scheme.

4.3. **Compartment:** When used i n conjunction with GIS e quipment, compartment refers t o a gastight volume bounded by enclosure walls and gas tight isolating barriers.

4.4. **Enclosure:** When u sed i n c onjunction w ith G IS e quipment, enclosure r efers t o t he groundedmetal housing or shell which contains and protects internal Power system equipment (breaker, disconnecting sw itch, grounding sw itch, voltage t ransformer, current transformer, surge arresters, interconnecting bus etc.)

4.5. **Manual O peration:** Manual o peration m eans op eration by ha nd w ithout us ing a ny othersource of power.

4.6. **Module:** When us ed i n conjunction w ith G IS e quipment, m odule r efers to a por tion o f thatequipment. Each module includes its own enclosure. A module can contain more than one piece o f e quipment, f or example, a m odule c an contain a d isconnecting s witch a nd a grounding switch.

4.7. **Reservoir**: W hen us ed i n conjunction w ith G IS e quipment r eservoir r efers to a l arger g as-tight volume.

5. GENERAL DESIGN AND SAFETY REQUIREMENT

5.1. 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.

5.2. The GIS assembly shall consist of separate modular compartments e.g. Circuit Breaker compartment, Bus bar compartment filled (single phase design) 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.

5.3. 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.

5.4. All circuit breakers disconnect switches and other component of GIS having identical rating shall have identical and interchangeable parts and operating mechanism as far as possible.

5.5. Gas barrier insulators and support insulators shall have the same basis of design. The support insulators shall have holes on both sides for proper flow of gas.
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. Further, it is prohibited to work adjacent to a gas Compartment while it is fully pressurized on the other side. For such cases, the gas pressure in the adjacent compartments needs to be reduced.
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 GIS shall be such that in case a circuit breaker module of a feeder is removed for maintenance, both busbars 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.

5.6. 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. GIS should be suitably sub-divided into individual

arc and gas-proof compartments preferably for:

i. Bus bars
ii. Intermediate compartment
iii. Circuit breakers
iv. Feeder Disconnect Switch
v. Voltage Transformers
vi. Gas Insulated bus duct section between GIS and XLPE cable/Overhead Conductor.
vii. Gas Insulated bus section between GIS & Oil filled Transformer/ Reactor (if applicable)

5.7. **Service continuity requirement:**

The GIS equipment with the given bus switching arrangement is divided into different gas compartments. During the work such as a fault repair or major maintenance, requiring the dismantling of a gas compartment for which more than one compartments may need to be de-gassed.

Working conditions, method statements and procedures are to be furnished by the GIS manufacturer in order to ensure equipment and operating personnel's safety and to achieve following service continuity conditions to the extent possible:

5.7.1. For One & half breaker bus switching scheme during a fault in CB compartment, No bus bar and feeder is permitted out of service during maintenance and repair/replacement.

5.7.2. For Double Main bus switching scheme during a fault in CB compartment, No bus bar permitted out of service during maintenance and repair/replacement.

5.7.3. During a fault in GIS compartment other than CB compartment, maximum one bus bar and/or one feeder permitted out of service during maintenance and repair/replacement.

5.8. The material and thickness of the enclosures shall be such as to withstand an internal flash over without burns 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. This shall be validated with Type Test.

5.9. 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 (View Ports) shall be provided for Disconnect Switch and both type of earth switches i.e. Maintenance and fast operating.

5.10. 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.

5.11. 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.

5.12. 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.

5.13. Each gas-filled compartment shall be equipped with static filters, density switches, filling valve and safety diaphragm. The filters shall be capable of absorbing any water vapor which may penetrate into the enclosures as well as the by-products of SF6 during interruption. Each gas compartment shall be fitted with non-return valve connectors for evacuating & filling the gas and checking the gas pressure etc.

5.14. The switchgear 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/internal reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear.

5.15. The thermal rating of all current carrying parts shall be minimum for one sec. for the rated symmetrical short-circuits current.

5.16. 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.

5.17. 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, Repair and maintenance.

5.18. 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 and LCC panels.

5.19. It should not be possible 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.

5.20. In general the contours of energized metal parts of the GIS and any other accessory shall be such, so as to eliminate areas or points of high electrostatic flux concentrations. 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.

5.21. 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.

5.22. The enclosure shall be of continuous design and shall meet the requirement as specified in of IEEE 80 2013 (special considerations for GIS).

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.

5.23. 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.

5.24. 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.

5.25. 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.

5.26. The switchgear shall have provision for connection with ground mat risers through copper connections. This provision shall consist of grounding pads to be connected to the ground mat riser in the vicinity of the equipment.

5.27. Stairs, fixed ladder, platforms, and walkways for operation and maintenance access to the operating mechanism and monitoring devices should be provided to permit access. The structures shall be either aluminum or hot-dipped galvanized steel. All structures, stairs, platforms, and walkways shall conform to the relevant occupational health and safety regulations and designed in accordance with the latest industry standards and guidelines. The platforms and walkways shall have anti-skid surfaces that can be walked on. Handrails shall be provided where necessary. The GIS supplier shall provide 3-D arrangement drawing to show the location of equipment and access to it.

5.28. In addition to above suitable portable scissor lift shall be provided for access of distant portion of GIS installation.

5.29. New Gasket, sealant and desiccant shall be installed for permanent sealing of all site/field assembled joints. No gaskets are to be reused for any permanent seal broken or disturbed in the field/site.

5.30. The enclosure & support structure shall be designed such that person of 1780 mm in height and 80 Kg in weight is able to climb on the equipment for maintenance.

5.31. The sealing provided between flanges of two modules / enclosures shall be such that long term tightness is achieved.

5.32. 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) 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.

5.33. 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 meters

5.34 Temperature rise of all current carrying parts and enclosures shall be limited to the values stipulated in IEC-62271-1, under rated current and the climatic conditions as specified. The temperature rise for accessible enclosure shall not exceed 20 degree C above the ambient temperature of 50 degree C.

5.35. Wherever required, the heaters shall be provided for the equipment in order to ensure the proper functioning of the switchgear at specified ambient temperatures. All cabinet heaters shall be rated for 240V AC (1-phase) 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.

5.36. **Bellows or Compensating Units:-** Adequate provision shall be made to allow for thethermal expansion of the conductors & enclosures and for 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 busbars due to temperature variations.
3. Parallel compensators: These shall be provided to accommodate large linear expansions and angle tolerances.
4. Tolerance compensators: These shall be provided for taking up manufacturing, site assembly and foundation tolerances.
5. Vibration compensators: These bellow compensators shall be provided for absorbing vibrations caused by the transformers 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.

5.37. **Indication and verification of switch positions**: Indicators shall be provided on all circuitbreakers, 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.

5.38. **Pressure relief device**: Pressure relief devices shall be provided in the gas sections toprotect 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.

5.39. **Pressure vessel requirements**: The enclosure shall be designed for the mechanical andthermal 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.

5.40. **Grounding:**

5.40.1. The grounding system shall be designed and provided as per IEEE-80-2013 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences.

5.40.2 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 earthling conductors and associated hardware material for the following:

1. Connecting all GIS equipment, bus ducts, enclosures, control cabinets, supporting structure etc. to the ground bus of GIS.
2. Grounding of transformer, CVT/VT, SA and other outdoor switchyard equipments/structures etc.

5.40.3. 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 either internally or 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.

5.40.4. 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.

5.40.5. The grounding connectors 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.

5.40.6. 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.

5.40.7. The contractor shall provide suitable measure to mitigate transient enclosure voltage caused by high frequency currents due to 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. The contractor shall provide suitable barrier of non-linear resistor/ counter discontinued SF6/ Air termination, SF6/ Transformer or Reactor termination, SF6/ HV cable bushing etc. to mitigate transient enclosure voltage.

5.40.8 The bidders shall provide lightening mast/GS shield wire at suitable place for protection of

whole sub-station including transformers, GIS cum control room building etc. The bidder shall submit detailed proposal for grounding system of whole substation including indoor and outdoor equipments with Earthmat using 40mm. dia MS rod for approval of purchaser. The riser shall be GS flat of size 75X12mm for outdoor equipments and 50X6mm for indoor.

The bidder shall submit detailed proposal for grounding system for approval of purchaser. Any provision to be made in the building design to take care of earthing requirement shall also be clearly spelt-out.

5.41. **UHF sensors for PD detection**:

Adequate number of UHF sensors shall be provided in the offered GIS for detection of Partial discharge (of 5 pC and above) as per IEC 60270. The number and location of these sensors shall be based on laboratory test on typical design of GIS as per recommendations of CIGRE Document No. 654 (*APPLICATION GUIDE FOR SENSITIVITY VERIFICATIONfor UHF PARTIAL DISCHARGE DETECTION SYSTEM FOR GIS*). Offered numbers andlocation of UHF sensors shall be submitted based on above said criteria along with attenuation calculation for 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 as per recommendations of above CIGRE Document No. 654. In case during site testing, additional UHF sensors are required, the same shall also be supplied & installed to complete the technical requirement.

The calibration and frequency response of PD couplers shall be as per NGC Technical Guidance note TGN (T) 121, issue 1, 1997. Data sheet shall be submitted for the UHF couplers meeting this requirement.

5.42. **Gas Insulated Bus (GIB) layout :**

GIB shall be designed based on the following criteria

(1) Maximum weight of gas in a gas tight section of GIB shall not exceed 400 kg (for 400 kV)/ 250 kg (for 220 kV, 66 kV &33 kV).

(2) GIB shall be generally in horizontal layer. However in exceptional circumstance GIB in vertical layers can be provided with the approval of employer.

(3) The minimum vertical ground clearance of GIB at road crossing shall be 5.5 meters

(4) The horizontal clearance between GIB and GIS building /any other building wall shall be preferably three (3) meters.

(5) 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.

(6) The GIB clear height outside the GIS hall in switchyard area shall be minimum 3.5 meter, so as not to obstruct easy access to GIB, movement of crane for maintenance work.

(7) Optimization 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.

(8) For the maintenance of GIB of one circuit, only that circuit shall be isolated. Adequate clearance between bus ducts of two circuit shall be ensured by the contractor during layout finalization.

(9) GIS manufacturer as per their design shall preferably use maximum three standard straight horizontal outdoor bus duct lengths for entire GIS installation to optimize the spare requirement.

(10) The minimum outer to outer horizontal clearance between each GIS bus duct shall be 0.5 meter for 400kV, 220 kV, 66 kV & 33kV voltage level.

5.43. **Extension of GIS**

5.43.1. 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.

5.43.2. As the GIS is likely to be extended in future, during detailed engineering stage, the contractor shall make available the complete design detail of interface module such as cross section, enclosure material, enclosure dimensions (inner & outer), Flange diameter (inner & outer), conductor cross-section & connection arrangement, bolt spacing & dimension, rated gas pressure, Gasket detail 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.

5.43.3. 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 remained isolated. Interface Module drawing with necessary detail shall be submitted for approval.

5.43.4. Further the contractor who is extending the existing GIS installation, it shall be his responsibility to provide interface module matching with the existing GIS interface module. The drawing of existing GIS interface/end piece module shall be provided by the employer. However it shall be the responsibility of contractor to verify the existing details during site visit.

5.43.5. The Contractor 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 400/220/66/33kV.

5.44. **SF6 GAS**

The SF6 gas insulated metal-clad switchgear shall be designed for use with SF6 gas complying with the recommendations of IEC 60376, 60376A & 60376B, 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 & should be suitable in all respects for use in the switchgear under all operating conditions. Necessary statutory clearances from concerned authorities for import of the Gas and for storage of the Gas shall be obtained.

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 pressureliquefiable gases. The cylinders shall also meet latest Gas Cylinder Rules (PESO)

SF6 gas shall be tested for purity, dew point, air, hydrolysable fluorides and water contents as per IEC: 60376, 60376A & 60376B and test certificates shall be furnished to the Employer

indicating all test results as per IEC standards for each lot of SF6 gas. Further site tests for dew point and purity shall 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 of GIS during service. The method proposed shall have as a minimum check the moisture content & the percentage of purity of the gas on annual basis.

The contractor shall also submit 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.

5.44.1. **SF6 gas monitoring devices and alarm circuits:** Dial type temperature compensated gasdensity 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 tight compartment so that it can be monitored simultaneously as follows:-

Compartment/ Sl. No.	Compartments except CB	Circuit Breaker compartments
1	**"Gas Refill level:** This will be used to annunciate the need for the gasrefilling. The contractor shall provide a contact for remote indication.	**'Gas Refill' level :** This will be used toannunciate the need for gas refilling.The contractor shall provide a contactfor remote indication.
2	**"SF6 low level" :** This will be used to annunciate the need for urgent gasfilling . A contact shall be provided for remote indication	**"SF6 low level" :** This will be used toannunciate the need for urgent gasfilling . A contact shall be providedfor remote indication
3	**'Zone Trip' level:** This is the minimum level at which the Manufacturer will guarantee theinsulation rating of the assembly.	**Breaker Block' level :** This is the minimum gas density atwhich the manufacturer will guaranteethe rated fault interrupting capabilityof the breaker .At this level thebreaker block contact shall operateand the closing & tripping circuit shallbe blocked.
4	**Not Applicable**	**'Zone Trip' level:** This is theMinimum 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.

It shall be possible to test all gas monitoring relays/devices without de-energizing the primary equipment & without reducing pressure in the main section. 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.

5.44.2. **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.

5.45. **Documentation**

The contractor shall prepare and submit to the employer, drawings; details that show the GIS design in order for the employer to verify the equipment conform to the specifications. The Design Document to be submitted for review and approval are as follows:

i. Design Review Document as per clause no. **19** of this specification
ii. Single Line Diagram
iii. Gas Schematic Diagram
iv. GTP-Guaranteed Technical Particulars
v. GIS layout (Plan and Section) including 3D drawing
vi. GIS Component Drawings
vii. Interface modules drawing for GIS extension
viii. Rating and Name Plate Drawing
ix. GIS/LCC Schematics Drawing
x. Foundation loading plan and detail
xi. GIS Support Structure Drawing
xii. GIS platforms and Walkway Drawing
xiii. GIS grounding plan and details along with design calculation for GIS grounding
xiv. GIS key Diagram enlisting and marking each and every GIS Module clearly and separately identifiable (indoor and outdoor). This separately identified module shall be complete along with its enclosure, gasket and all active parts such as conductor, conductor joints, corona shield etc.
xv. Method Statement along with sequential instruction for dismantling and assembling of all major components of GIS exhibiting service continuity requirement
xvi. Type Test Reports
xvii. Seismic Analysis Report
xviii. Study report of VFTO generated for GIS installation for 400 kV
xix. The general arrangement drawing of interconnecting bus-duct from GIS bay module to XLPE cable termination end
xx. The general arrangement drawing of Terminal connection arrangement to connect GIS duct to SF6/Oil bushing and duct mounting arrangement details
xxi. Gas handling procedure
xxii. The design & construction proposal of the building along with necessary information, data, and drawings according to the complete requirements
xxiii. Capacity calculation of EOT crane for GIS hall considering a factor of safety of 5
xxiv. Method statement/ procedure of ON SITE high voltage testing with PD measurement and Switching Impulse test.

xxv. **Additional CB data to be furnished during detailed engineering :**
   a) Design 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.
   b) Curves supported by test data indicating the opening time under close open operation with combined variation of trip coil voltage and hydraulic pressure.
   c) Contact Travel: Operating mechanism operating shaft travel and contact overlap

of Circuit Breaker to be provided.

xxvi. PD Monitoring System

a) The technical proposal for PDM system along with detailed design documentation.
b) Data sheet for the UHF couplers.
c) The Sub-station GIS layout as a separate drawing indicating position of spacers, spread over of PD sensors with distance, sensor identification, the detector unit identification etc., total numbers of offered UHF Sensors along with attenuation calculation.
d) Guaranteed Technical Particulars & Data Sheet for various components used in the PDM system.
e) Electromagnetic compatibility Test Reports.
f) List of critical spares.

xxvii. Installation and Operation & Maintenance Manual

6. CIRCUIT BREAKERS

6.1. **General :** SF6 gas insulated metal enclosed circuit breakers and accessories shall conformto IEC: 62271 -100, IEC: 62 271-1 and other relevant IEC standards except to the extent explicitly modified in the specification and shall also be in accordance with requirements specified in Section-GTR.

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 (as applicable) with an operating sequence and timing as specified.

6.2. **Duty Requirements:** Circuit breaker shall be C2 - M2 class as per IEC 62271-100.

6.3 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.

6.4. The circuit breaker shall be capable of:

1. Interrupting the steady and transient magnetizing current shall be as follows:
Interrupting the steady and transient magnetizing current corresponding to 400 kV/220 kV, 220/66 kV and 220/33 kV class transformers of500 MVA, 315MVA, 160 MVA and 100 MVA ratings on 400 kV, 220 kV, and 66 kV & 33kV side.

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.)
400 kV	50 to 125	2.3
220 kV	25 to 50	2.3

6.5. **Total Break Time :** The total break times shall not be exceeded under any of the followingduties :

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%), 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.

6.6. **Constructional features :**

The features and constructional details of breakers shall be in accordance with requirements stated hereunder:

6.6.1. If multi-break interrupters are used, these shall be so designed and augmented that a uniform voltage distribution is developed across them. Calculations/ test reports in support of the same shall be furnished. The thermal and voltage withstand rating of the grading elements shall be adequate for the service conditions and duty specified.

6.6.2. **Contacts:** All making and breaking contacts shall be sealed and free from atmosphericeffects. 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.

6.6.3. 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.

6.6.4. 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.

6.6.5. 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)

6.6.6. 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.

6.6.7. 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.

6.6.8. 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 upto the local control cubicle.

6.6.9. The CO (Close-open) operation and its timings shall be such as to ensure complete travel/insertion of the contact during closing operation and then follow the opening operation.

6.7. Operating mechanism

6.7.1. General Requirements :

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.
b) The operating mechanism **box** shall be strong, rigid, rebound free and shall be readily accessible for maintenance.
c) The operating mechanism shall be suitable for high speed reclosing and other duties specified. During reclosing the breaker contacts shall close fully and then open. The mechanism shall be anti-pumping and trip free (as per IEC definition) under every method of closing.
d) The mechanism shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause unwanted trip or closing operation of the Circuit Breaker.

e) A mechanical indicator shall be provided to show open and close position of the breaker. It shall be located in a position where it will be visible to a man standing on the ground level with the mechanism housing closed. An operation counter shall also be provided in the central control cabinet.
f) Working parts of the mechanism shall be of corrosion resisting material, bearings which require grease shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker.
g) The contractor shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker.

6.7.2. Control

a) The close and trip circuits shall be designed to permit use of momentary-contact switches and push buttons.

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.

c) The breaker shall normally be operated by remote electrical control. Electrical tripping shall be perfromed 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.
d) The trip coil shall be suitable for trip circuit supervision during both open and close position of breaker.

e) Closing coil and associated circuits shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip and associated circuits shall operate correctly under all operating conditions of the circuit breaker upto the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage. If additional elements are introduced in the trip coil circuit their successful operation and reliability for similar applications on circuit breakers shall be clearly brought out in the additional information schedules. In the absence of adequate details the offer is likely to be rejected.

f) Density meter 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.

g) The auxiliary switch of the breaker shall be positively driven by the breaker operating rod.

6.7.3. **Spring operated Mechanism**

a) Spring operated mechanism shall be complete with motor as per manufacturer practice. Opening spring and closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided.
b) As long as power is available to the motor, a continuous sequence of the closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty.
c) After failure of power supply to the motor one close open operation shall be possible with the energy contained in the operating mechanism.
d) Breaker operation shall be independent of the motor which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided. The motor rating shall be such that it required preferably not more than 90 seconds for full charging of the closing spring.
e) Closing action of circuit breaker shall compress the opening spring ready for tripping.
f) When closing springs are discharged after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of this shall be provided in the local control cabinet & SAS.
g) Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition.
h) Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in the closed position.
i) The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.
j) The spring charging failure alarm shall be provided with a time delay relay having setting range from 0-3 minutes.
k) Separate MCBs shall be provided for each spring charging motor and the rating of MCBs shall be suitably selected to match the starting, running and stalling time.
l) An overload relay shall be provided for protection of the spring charging motor.

6.7.4. **Hydraulically Operated Mechanism :**

a) Hydraulically operated mechanism shall comprise of operating unit with power cylinder, control valves, high and low pressure reservoir, motor etc.

b) The hydraulic oil used shall be fully compatible for the temperature range to be encountered during operation.

c) The oil pressure switch controlling the oil pump and pressure in the high pressure reservoir shall have adequate no. of spare contacts, for continuous monitoring of low pressure, high pressure etc. at switchyard control room.

d) The mechanism shall be suitable for at-least two close open operations after failure of AC supply to the motor starting at pressure equal to the lowest pressure of auto reclose duty plus pressure drop for one close open operation.

e) The mechanism shall be capable of operating the circuit breaker correctly and performing the duty cycle specified under all conditions with the pressure of hydraulic operated fluid in the operating mechanism at the lowest permissible pressure before make up.
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.

f) All hydraulic joints shall have no oil leakage under the site conditions and joints shall be tested at factory against oil leakage.

6.8. **Controlled Switching Device(CSD):**

6.8.1. 400 kV Circuit Breaker shall be equipped with controlled switching device with consequent optimization of switching behavior, when used in:

1. Switching of transformer (400 kV side circuit breakers only)
2. Switching of shunt reactor

6.8.2. The CSD shall be provided in 400 kV Circuit breakers for controlling transformers and reactors (ie for breakers of switchable line reactor and in Main& Tie circuit breakers of Transformers, Transmission lines with non-switchable line reactors and Bus reactors). The requirement of CSD shall be explicitly specified in price schedule

6.8.3. Technical Requirement for Controlled switching device:

a) The CSD shall be designed to operate correctly and satisfactorily with the excursion of auxiliary A/C & DC voltages and frequency as specified in section - GTR.

b) The CSD shall meet the requirements of IEC-61000-4 16 class IV regarding HF disturbance test and fast transient test shall be as per IEC-61000 – 4-4 level IV and insulation test as per 60255 – 5.

c) The CSD shall have functions for switching ON & OFF the circuit breakers.

d) The CSD shall get command to operate the breakers manually or through auto re-close relay at random. The controller shall be able to analyze the current and voltage waves available through the signals from secondaries of CTs & CVTs for the purpose of calculation of optimum moment of the switching the circuit breaker and issue command to circuit breaker to operate.

e) The CSD shall have an adaptive control feature to consider the next operating time of the breaker in calculation of optimum time of issuing the switching command. In calculation of net operating time of the breaker the controller must consider all factors that may affect the operating time of the breaker such as, but not limited to, ambient temperature, control voltage variation, SF6 gas density variations etc. Schematic drawing for this purpose shall be provided by the contractor. The accuracy of the operating time estimation by the controller shall be better than + 0.5 ms.

f) The CSD shall have communication port to facilitate online communication of the control switching device with SCADA directly on 61850 or through gateway which shall be under present scope.

g) The CSD shall be PC compatible for the setting of various parameters and down loading of the settings and measured values date time of switching etc. Window based software for this purpose shall be supplied by the contractor to be used on the owner's

PC.

h) The CSD shall be suitable for current input of 1 amp from the secondary of the CTs. and 110 V (Ph to Ph) from the CVTs. The controller shall withstand transient and dynamic state values of the current from the secondary of the CTs and CVTs.

i) The CSD shall have time setting resolution of 0.1 ms or better.

j) The CSD shall have sufficient number of output/input potential free contacts for connecting the monitoring equipment and annunciation system available in the control room. Necessary details shall be worked out during engineering the scheme.

k) The CSD shall also record and monitor the switching operations and make adjustments to the switching instants to optimize the switching behavior as necessary. It shall provide self-diagnostic facilities, signaling of alarms and enable downloading of data captured from the switching events.

l) The provision for bypassing the Controlled switching device shall be provided through BCU and SCADA both so that whenever, the CSD is not healthy due to any reason (including auxiliary supply failure), uncontrolled trip/close command can be extended to the circuit Breaker. Alternatively, in case of any non-operation of the CSD after receiving a close/trip command after a pre-determined time delay, the CSD should automatically be by passed so as to ensure that the trip and close commands are extended to the Trip/Close coils through subsequent command.

m) The CSD shall be provided with a communication port to facilitate online communication of the CSD with Substation automation system directly on IEC 61850 protocols. If the CSD does not meet the protocols of IEC 61850, suitable gateway shall be provided to enable the communication of CSD as per IEC 61850.

6.9. The technical parameters of circuit breakers are as per **Annexure –1**

6.10. **Tests**

6.10.1. **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

iii. Circuit breakers meant for controlled switching shall conform to requirements of IEC/TR-62271–302. The contractor shall submit test reports to demonstrate that the offered CB conforms to the requirements of performance verification tests and parameter definition tests as per IEC/TR 62271-302. The contractor shall also furnish the report for the re-ignition free arcing window for switching 3-phase shunt reactor as demonstrated in the shunt reactor switching test.

6.10.2. **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 **control** voltage conditions. 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 **arranged by the contractor at his** own cost. After completion of site pre-

commissioning test, 03 nos. travel transducer shall be handed over to DTL.

ii. During testing of CB, dynamic contact resistance measurement (DCRM) shall be carried out for close-open (CO) operations with delay of 300ms between close and trip operations. Minimum 100A current shall be injected for DCRM test. Travel characteristics, injected current, trip/close coil current shall also be recorded along with DCRM test. This test shall also be performed at site for which the necessary operation analyzer along with necessary transducers, cables, console etc. shall be provided. The test for getting signature of the dynamic contact resistance measurement shall also be carried out at factory. The test result shall be treated as reference signature for condition monitoring in future.

iii. Routine tests on circuit breakers with controlled switching device as per IEC/TR 62271-302.

7. DISCONNECTORS (ISOLATORS)

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/ Project Section.

7.1. **Construction & Design**.

7.2.1. The disconnectors shall be operated by electric motor suitable for use on 220 Volt DC systems and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.

7.2.2. 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.

7.2.3. The disconnect 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.

7.2.4. It shall be possible to operate the disconnect switches manually by cranks or hand wheels.

7.2.5. For motor-operated disconnect switches, the control should be electrically and/or mechanically uncoupled from the drive shaft when the switch is operated manually to prevent coincident power operation of the switch and the drive mechanism(s).

7.2.6. 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.

7.2.7. 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).

7.2.8. Remote control of the disconnectors from the control room/SAS shall be made by means of remote/ local transfer switch.

7.2.9. 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.

7.2.10. Each disconnector 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 automation purposes. These spare NO and NC contacts shall be wired up to the local control cabinet.

7.2.11. 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.

7.2.12. 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.

7.2.13. The disconnectors and safety grounding switches shall have mechanical/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. Integrally mounted lock when provided shall be equipped with a unique key for such three phase group. Master key is not permitted.

7.2.14. 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.

7.2.15. All electrical sequence interlocks will apply in both remote and local control modes.

7.2.16. 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

7.2.17. 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.

7.2.18. The disconnecting switches shall be provided with rating plates and shall be easily accessible.

7.2.19. The mechanical endurance class shall be M2 as per IEC.

7.2.20. Mechanical position indication shall be provided locally at each disconnector and Electrical indication at each Local Control Cabinet (LCC) / SAS.

7.2.21. All auxiliary switches and auxiliary circuits shall be capable of carrying a current of at least 10 A DC continuously.

7.2.22. The auxiliary switches shall be capable of breaking at least 10 A in a 220 V DC circuit with a time constant of not less than 20 milliseconds.

7.2.23. The disconnecting switches shall be capable of being padlocked in both the open and closed positions with the operating motor automatically disengaged. The padlocking device shall be suitable for a standard size lock with a 10 mm shank. The padlock must be visible and directly lock the final output shaft of the operating mechanism. Integrally mounted lock when provided shall be equipped with a unique key for such three phase group. Master key is not permitted.

7.3. The technical parameters of disconnectors are as per **ANNEXURE-2**

8. SAFETY GROUNDING SWITCHES

8.1. 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.

8.2. 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.

8.3. 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.

8.4. The details of the inscription and coloring for the indicator are given as under :

	INSCRIPTION	**COLOUR**
Open Position	OPEN	GREEN
Closed Position	CLOSED	RED

8.5. Interlocks shall be provided so that manual operation of the switches or insertion of the manual operating device will disable the electrical control circuits.

8.6. Each ground switch shall be fitted with auxiliary switches having 6NO (Normally Open) and 6NC (Normally Closed) contacts for use by others over and above those required for local interlocking and position indication purposes.

8.7. Provision shall be made for padlocking / suitable locking arrangement for the ground switches in either the open or closed position.

8.8. 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.

8.9. 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.

8.10. The safety grounding switches shall conform to the requirements of IEC- 62271- 102 and shall have electrical endurance class: E0 & shall have mechanical endurance class M2 for 400 kV & M1 for 220/66/33 kV voltage level.

8.11. The grounding switch shall be provided with test provision (insulated link) to permit test voltage up to 10 kV and up to 200 A to be applied to the main conductor without removing SF6 gas from the enclosure and without disassembling the enclosure except for ground shunt leads.

8.12. Combined Disconnectors & Safety grounding switch arrangement shall also be acceptable.

8.13. Mechanical position indication shall be provided locally at each switch and Electrical indication at each Local Control Cabinet (LCC) / SAS.

9. HIGH SPEED MAKE PROOF GROUNDING SWITCHES:

9.1. 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

9.2. High Speed Grounding switches shall be provided with individual/three pole operating

mechanism suitable for operation from DC.

9.3. The switches shall be fitted with a stored energy closing system to provide fault making capacity.

9.4. The short circuit making current rating of each ground switch shall be at least equal to its peak withstand current rating as specified. The switches shall have inductive/ capacitive current switching capacity as per IEC-62271-102.

9.5. 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.

9.6. The details of the inscription and coloring for the indicator shall be as under:-

	INSCRIPTION	**COLOUR**
Open Position	OPEN	GREEN
Closed Position	CLOSED	RED

9.7. High speed ground switch operation should be possible locally from Local Control Cabinet (LCC)

9.8. 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.

9.9. Each high speed ground switch shall be fitted with auxiliary switches having 6NO (Normally Open) and 6 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.

9.10. 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.

9.11. 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.

9.12. The high speed make proof grounding switches shall confirm to the requirements of IEC-62271-102.

9.13. The grounding switch shall be provided with test provision (insulated link) to permit test voltage up to 10 kV and up to 200 A to be applied to the main conductor without removing SF6 gas from the enclosure and without disassembling the enclosure except for ground shunt leads.

10. INSTRUMENT TRANSFORMERS

10.1. CURRENT TRANSFORMERS

The current transformers and accessories shall conform to IEC:61869 and other relevant standards except to the extent explicitly modified in the specification.

The particulars of the various cores may change within reasonable limits as per the requirements of protection relay supplier. The manufacturer is required to have these values confirmed from the purchaser before proceeding with design of the cores. The other characteristics of CTs shall be as given in TECHNICAL PARAMETER of Current Transformer.

10.1.1. **Ratios and Characteristics:** The CT core distribution for various voltage levels shall be as per Table 3A, 3B, 3C 3D & 3E. Further the numbers of cores, rating, ratios, accuracy class, etc. for the individual current transformers secondary cores shall be in accordance with above table attached at **Annexure-3.**

Where multi-ratio current transformers are required the various ratios shall be obtained by changing the effective number of turns on the secondary winding.

10.1.2. **Rating and Diagram Plates:** Rating and diagram plates shall be as specified in the IECspecification incorporating the year of manufacture. The rated current & extended current rating in case of current transformers and rated voltage, voltage factor & intermediate voltage in case of voltage transformers shall be clearly indicated 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.

10.1.3. **Constructional Details**:

a) The current transformers incorporated into the GIS will be used for protective relaying and metering purposes and shall be of metal- enclosed type.

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.

c) Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

d) The rated extended currents for 420 kV class Current transformers shall be as given below:

I. The secondary winding shall be rated for 2A continuously.

II. For 400 kV systems CT, the rated extended primary current of the CT shall be 200% of rated primary on all except 2000/1A tap. At 2000/1A tap the rated extended primary current shall be 120%. At 2000/1A ratio, the CT shall be thermally rated for 200% for 15minutes and 120% continuous.

III. For 400 kV CT rated for 3000A, the rated extended primary current shall be 120% for 3000/1A tap and 180% for 2000 /1A tap and 200 % for lower tap ratios. The secondary windings shall be rated for 2A continuously.

e) For 245/72.5 /36 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.

f) For 420 /245/72.5/36 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.

For 0.2S accuracy shall be maintained between 1% to 120% of rated current.
CT burden shall not be less than 5VA to achieve required 0.2S accuracy class

g) For 420/245/72.5/36 kV CTs, 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 be inbuilt construction of the CTs. In case these are to be mounted separately these shall be mounted in the LCC panel suitably wired up to the terminal blocks.

h) The wiring diagram, for the interconnections of the three single phase CTs shall be provided inside the Secondary terminal box.

i) The current transformers shall be suitable for high speed auto-reclosing.

j) Provisions shall be made for primary injection testing either within CT or outside.

k) 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.

l) The bidder will take care for the compatibility of the CT vis-à-vis burden of relay and connecting leads, however for calculation purpose fault current may be taken as 63kA for 400kV, 50kA for 220kV & 31.5 kA for 66kV/33kV and secondary current may be calculated accordingly.

m) The output burden of cores shall be as **Annexure 3A, 3B, 3C, 3D**. However burden of each core shall be finalized during detailed engineering.

10.2. VOLTAGE TRANSFORMERS

The voltage transformers shall conform to IEC- 61869 and other relevantstandards 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.

10.2.1. **Ratios and Characteristics**: The rating, ratio, accuracy class, connection etc. for thevoltage transformers shall be in accordance with **Annexure-4 & Table 4A,4B,4C,4D**

10.2.2. **Rating and diagram plates** :Rating and diagram plate shall be provided complying withthe requirements of the IEC specification incorporating the year of manufacture and including turns ratio, voltage ratio, burden, connection diagram etc.

10.2.3. **Secondary Terminals, Earthing and Fuses**

The beginning and end of each secondary winding shall be wired to suitable terminals accommodated in a terminal box mounted directly on the voltage transformer section of the SF6 switchgear.

All terminals shall be stamped or otherwise marked to correspond with the marking on the diagram plate. Provision shall be made for earthing of the secondary windings inside the terminal box.

10.2.4. The transformer shall be able to sustain full line to line voltage without saturation of transformer. The accuracy class will be at maximum tap.

10.2.5. **Constructional Details of Voltage Transformers:**

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.

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.

c) The voltage transformers shall have three secondary windings.

d) Voltage transformers secondary shall be protected by Miniature Circuit breakers (MCBs) with monitoring con tacts for al l t he w indings. The secondary t erminals of the VT's sh all b e terminated to preferably stud type non-disconnecting terminal blocks in the secondary boxes via the fuse.

e) The v oltage transformer s hould be thermally and dielectrically sa fe w hen the se condary terminals are loaded with the guaranteed thermal burdens.

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.

g) The diagram for the interconnection of the VTs shall be provided inside secondary terminal box.

h) It should be ensured that access to secondary terminals is without any danger of access to high voltage circuit.

10.3. **Tests:**

10.3.1. Current Transformer a nd Voltage Transformer s hould ha ve be en t ype t ested and s hall be subjected to routine tests in accordance with relevant IEC.

10.3.2. The test reports of type tests, as applicable, as per IEC-61869-2 for CT, and IEC-61869-3 for IVT and following additional tests shall be submitted for the Employer's review.

a) Current Transformers (CT): Transmitted ov er v oltage t est f or 66kV a nd above v oltage rating

b) Inductive Voltage Transformers (IVT): Transmitted over voltage test for 66kV and above voltage rating

11. SURGE ARRESTORS

11.1. The surge arrestors shall confirm in general to latest IEC –60099-4.

11.2. **Insulation c o-ordination an d sel ection o f su rge arrestor**: T he c ontractor s hall be fullyresponsible for complete insulation co-ordination of switchyard including GIS. Contractor s hall carry out de tailed studies and design calculations t o evolve the required parameters locations, en ergy capa bility et c. of surge ar restors s uch t hat adequate p rotective margin is available between peak impulse, surge and power frequency discharge voltages and BIL of t he protected r equirement. The l ocations o f surg e arrestors shown in si ngle line diagram is indicative on ly. If the con tractor f eels t hat at some m ore l ocations t he s urge arrestors are required to be provided the same should also be deemed included in the offer.

If distance between Surge Arrestor and transformer bushing terminal inclusive of head length is more than 60 m or 170 ft then one surge arrestor shall be with GIS System and another shall be with transformer.

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 c ontractor s hall a lso consider i n the s tudies the ope n c ircuit breaker cond ition, fast transients generated by s low ope ration o f di sconnecting s witches. The s tudy r eport a nd de sign calculations shall be submitted for Owner's approval.

11.3. **Duty requirements of GIS Surge Arrestor**

11.3.1. The surge arrestor shall be SF6 gas insulated metal oxide and gapless type. The metal housing

of the arrestor shall be connected to the metal enclosure of the GIS with flange, bolted and gasketed joint so that the arrestor housing is grounded through GIS enclosure.

11.3.2. Surge arrestor shall be disconnect-link type and be attached to the gas-insulated system in such a manner that they can be readily disconnected from the system while the system is being dielectrically tested.

11.3.3. The surge arrester shall be of heavy duty station class and gapless (Metal oxide) type without any series or shunt gaps.

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

11.3.5. Surge arresters for the 400 kV class arrester shall be capable of discharging energy equivalent to class 4 of IEC for a 400 kV system on two successive operation followed immediately by 50 HZ energisation with a sequential voltage profile as specified below:

705 kVp for 3 peaks
580 kVp for 0.1 Sec.
565 kVp for 1 Sec.
550 kVp for 10 Secs.

11.3.6. 245 kV, 72.5kV & 33kV class arrester shall be capable of discharging energy equivalent to class 3 of IEC for 245 kV, 72.5 kV & 36 kV systems respectively on two successive operations.

11.3.7. The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.
The surge arresters are being provided to protect the followings whose insulation levels are indicated in the table given below:-

Equipment	**Lightning impulse(kVp) for 420 kVsystem**	**Swicthing surge(kVp) for 420 kV system**	**Lightning impulse(kVp) for 245 kVsystem**	**Lightning impulse(kVp) for 72.5 kVsystem**	**Lightning impulse(kVp) for 36 kVsystem**
Pr.Transformer	+/-1300	+/-1050	+/-950	+/-325	170
InstrInstrument Transformer	+/-1425	+/- 1050	+/- 1050	+/-325	170
Reactor	+/-1300	+/- 1050	+/- 1050		
CB/ Isolator Phase to Ground	+/-1425	+/- 1050	+/- 1050	+/-325	170
Across Open Contract	+/-1425 (+ 240)	+/- 900 (+345)	+/- 1200	+/-375	195

11.3.10. **Constructional Features**

The nonlinear blocks shall be of sintered/inferred 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 along discharge counter. 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.

11.4. **TESTS**

11.4.1. 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.

11.4.2. Each metal oxide block shall be tested for the guaranteed specific energy capability in addition to the routine/acceptance test as per IEC-60099.

11.4.3. Test on Surge Monitors: The Surge monitors shall also be connected in series with the test specimens during residual voltage and current impulse withstands tests to verify efficacy of the same. Additional routine/functional tests with one 100A and 10 kA current impulse, (8/20 micro sec.) shall also be performed on the surge monitor.

11.5. **Technical Parameters**: Technical parameters f surge arrestor is as per **ANNEXURE-5**.

12. OUTDOOR SF6/Air 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.

12.1 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 than 31mm/kV.

12.2 **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.

12.3 **Mechanical forces on bushing terminals:** Outdoor bushings must be capable ofwithstanding cantilever forces due to weight of bus duct (GIB) on one side & AIS conductor/Al tube on the other side and short circuit forces.

12.4 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. Design calculations in support of the cantilever strength chosen shall be submitted for owners review and approval.

12.5 The technical parameters of Bushing are as per **ANNEXURE-6**.

13. GIS TO CABLE TERMINATION (If applicable)

13.1. This scope covers the supply, erection, commissioning of connection assembly of fluid-filled or extruded cables to gas-insulated metal enclosed switchgear (GIS) as per IEC 62271-209

13.2. The XLPE cables shall be connected to GIS by the interfacing of XLPE cable sealing end

to GIS Cable termination enclosure.

13.3. The GIS to XLPE cable termination shall conform to IEC-62271-209.

13.4. The rating of XLPE cables for different voltages is specified in the Section project.

13.5. The limits of supply of gas-insulated metal-enclosed switchgear and the cable termination shall be in accordance with IEC 62271-209.

13.6 Cable termination and cable connection enclosure 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.

13.7 The SF6 cable end unit and connection support structure should be equipped with provisions for isolating the cable sheath or pipe to permit cathodic protection of cable system.(see IEC62271-209)

13.8 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.

13.9 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 Employer.

13.10 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.

13.11 Type test reports of radio interference voltage (RIV) level shall be submitted for approval.

14. TRANSFORMER / REACTOR TERMINATION

14.1. TRANSFORMER / REACTOR Direct Connection with GIS (if applicable)

14.1.1. The limits of supply of gas-insulated metal-enclosed switchgear and the direct connection to oil filled transformer shall be in accordance with IEC 62271-211.

14.1.2. 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.

14.1.3. 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 transformer and reactor supplier shall have to be carried out by the GIS supplier to facilitate proper connection with the bushings of the transformer and reactors.

14.2. TRANSFORMER / REACTOR Connection with SF6/Air Bushing

14.2.1. 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 Transformer/Reactor supplier and the same shall be connected to the SF6 ducts thru air to SF6 bushings to be provided under present scope.

14.2.2. In case of single phase Transformers/Reactors are being installed in the substation, HV&IV auxiliary bus for the Transformer/Reactor bank for connecting spare unit shall be formed inside the GIS hall as per the SLD furnished and as specified in Section project.

15. LOCAL CONTROL CUBICLE (LCC)

15.1. Functions

15.1.1. 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/indicating lamp 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.

15.1.2. Status indications in the LCC shall be semaphore type or LED type.

15.1.3. 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.

15.1.4. 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.

15.1.5. 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 .

15.1.6. Where plugs and sockets connect control cabling between the local control cubicle and the switchgear these shall not be interchanged. In plug in connector type cable arrangement, min 2 cores of the cable with connected condition on both side up to the TB to be left unused as spare.

15.1.7. 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.

15.1.8. 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.

15.2. **Constructional features**

15.2.1. 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. Alternatively folded sheet panels of adequate thickness and strength is also acceptable.

15.2.2. 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(if required) having anti insect screen. All doors shall be gasketed all around with suitably profiled Neoprene/EPDM/PU gaskets conforming to the provision of IS 11149. However, XLPE gaskets can also be used for fixing protective glass doors.

15.2.3. For LCC panel of each feeder bay (i.e. line, transformer, and reactor etc.), Bus Coupler bay and Bus Sectionalizer bay, separate AC/DC supply for power circuit of GIS switchgear shall be provided, fed directly from ACDB/DCDB. The control DC supply (for control, interlocking, signaling) shall be tapped from respective relay & protection panel. For LCC panel illumination and heating purpose Loop in Loop out AC Supply can be provided.

15.2.4. 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/MCBs. 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'.

15.2.5. Each LCC Panel shall be provided with the following

1. **Plug Point**: 240V, Single phase 50Hz, AC socket with switch suitable to accept 5/15Amps pin round standard Indian plug, shall be provided in the interior of each cubicle with ON-OFF switch.
2. **Interior Lighting**: Each panel shall be provided with a door-operated LED lightingfixture rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch.

3. **Space H eater**: E ach panel sh all be p rovided with a thermostatically conne cted spaceheater rated for 240V, single phase, 50 Hz AC supply for the internal heating of the panel t o p revent condensation o f m oisture. The f ittings s hall b e c omplete w ith switch unit.

15.2.6 O perating m echanisms, a uxiliary s witches a nd a ssociated r elays, c ontrol s witches, c ontrol cable t erminations, and other anc illary equi pment s hall be accom modated in she et s teel vermin proof cubicles.

15.2.7 L ocal 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.

15.2.8 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.

15.2.9 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, that allows a c omplete v iew of t he a nnunciator a nd m imic di agram w hen t he L CC door i s c losed. Necessary protection shall be provided to avoid inadvertent operation of control switches.

15.2.10 An interlocking scheme shall be provided that takes into account the following basic requirements.

I. To safeguard maintenance personnel who may be working on one section of the equipment with other sections live.

II. prevent incorrect switching sequences that could lead to a hazardous situation to plant, equipment and personnel.

15.2.11 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 i s locked or f ree. Me ans, no rmally pa dlocked/handle lock, shall be p rovided whereby the bolt can be operated in the emergency of a failure of interlock supplies.

15..2.12 Where k ey i nterlocking i s e mployed t ripping of t he c ircuit br eaker shall no t oc cur i f a ny attempt i s m ade t o r emove t he trapped k ey f rom t he m echanism. Any l ocal em ergency-tripping device shall be kept separate and distinct from the key interlocking.

15.2.13 D isconnecting s witches s hall be s o i nterlocked t hat t hey c annot be ope rated un less t he associated circuit-breaker i s ope n except t hat w here doub le bus ba r ar rangements ar e specified, on -load transfer of f eeder circuits f rom o ne bus ba r t o another shall be m ade possible by interlocks which ensure that the associated bus coupler and its isolators are closed.

15.2.14 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.-

15.2.15 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.

15.3. **Cabling between LCC Panel and GIS equipment**

15.3.1. The unarmored screen cable shall be of 1.1kV grade, multi core, annealed copper conductor, Tinned copper braided screen (approx. 85% coverage).

15.3.2. The core insulation and outer sheath of cable shall be of halogen-free special polymer.

15.3.3. The cable shall be flame-retardant, flexible, abrasion-and wear-resistant.

15.3.4. The size of core shall not be less than 2.5 sq. mm for instrument transformers and 1.5 sq. mm for other control cable.

15.3.5. Prefabricated cables with heavy duty multi-point plug-in connections on GIS end shall be provided.

15.3.6. All instrument transformer connections shall be hard wired to terminal block via ring type connection.

16. GIS BUILDING

16.1. The bu ildings s hall h ouse ea ch voltage c lass G as Insulated Switchgear (GIS) and o ther

associated equipment inside each of the GIS buildings. GIS building(s) shall be constructed for the specified number of bays/diameters as per section project.

16.2. For finalizing the dimensions of GIS building the requirement of Turning radius to rotate the largest removable component for assembly/disassembly shall be taken in to consideration.

16.3. Wherever GIS Building of already exists, then the existing GIS Building(s) for respective voltage class shall be suitably extended keeping the width of the building same to accommodate the number of bays/diameters as specified in the Section Project/BPS.

16.4. 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.

16.5. The area for GIS Building(s) is indicated in the BPS. The area given is for reference only and may vary according to the 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.

16.6. The contractor shall place their panels i.e. Bay level units, bay mimic, relay and protection panels, RTCC panels, Communication panels etc. in a separate Relay Panel Room in the GIS building. The size of the room shall be such that all the panels for the bays/ diameters as per clause 16.1 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.

17. ELECTRIC OVERHEAD CRANE :

17.1. Two EOT Cranes of suitable capacity shall be provided for erection & maintenance of largest/heaviest GIS component/assembly for each of 400kV, 220kV, 66kV GIS hall/building. The crane shall consist of all special requirements for erection & maintenance of GIS equipment.

17.2. The capacity of the crane shall be sized to lift the heaviest GIS switchgear component.

17.3. The Crane shall be used for the erection and maintenance of the GIS switchgear components 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.

17.4. Crane hook approaches shall be of the minimum possible dimensions to ensure maximum coverage of the GIS building area.

17.5. 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.

17.6. Crane shall be designed for operation under following variable speeds through VVVF drives at full load :

Hoisting: 0.3 – 3 Meters per Minute
Cross Travel: 1.6 – 16 Meters per Minute
Long Travel: 2.0 – 20 Meters per Minute

17.7. The electric overhead cranes shall be provided with walkways, platforms. 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.

17.8. The platform and walkways shall be designed to support any weight to be imposed upon them during crane overhaul.

17.9. An access platform shall be provided together with a guarded ladder to allow access to the bridge rails.

17.10. The crane shall be provided with pendant control and RF control.

17.11. Contractor shall submit the capacity calculation of crane for GIS hall considering a factor of safety of rope as at least 5.

17.12. The Capacity of Cranes to be provided for GIS Hall shall confirm following.

a) The crane for 400kV GIS hall shall have capacity of minimum 6T safe working load & minimum hook height of crane have shall be 9.0 meters or as per actual requirement whichever is higher.

b) The crane for 220kV GIS/66kV/33kV GIS shall have capacity of minimum 5T /3T safe

working load & minimum hook height of crane have shall be 8.0/6.0 meters respectively or as per actual requirement whichever is higher.

17.13. In case the GIS hall is to be extended, the scope of work also involves extension of EOT crane girders and all necessary Electrical & Mechanical accessories to facilitate movement of existing EOT crane in the extended portion of GIS hall. Cost of the same shall be deemed to be covered in the building cost.

17.14. The following tests shall be carried out on 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 all the accessories for proper function
b. No load test
c. Load test as per site conditions

18. SEISMIC DESIGN CRITERIA:

The equipment shall be designed for operation in seismic zone for earthquake resistance. The seismic loads are due to the horizontal and vertical acceleration which may be assumed to act non concurrently. Seismic Qualification requirements shall be as per IEC 62271-207 for the design of equipment. The equipments along with its parts shall be strong enough and sufficiently well connected to resist total operating stresses resulting from the forces in normal operation but in case of abnormal condition shall also resist with forces superimposed due to earthquakes. The copies of type test reports for similar rated equipment, if tested earlier, should be furnished. If the equipment has not been type tested earlier Test Report/Analysis Report should be furnished during detailed engineering.

To prevent the movement of GIS sub assemblies i.e. various bay modules during the earthquake, suitable devices shall be provided for fixing the sub assemblies to the foundation. The contractor shall supply necessary bolts for embedding in the concrete foundation. The fixing of GIS sub assemblies to the foundation shall be designed to withstand the seismic events. It will also be ensured that the special devices as well as bolts shall not be over stressed. The details of the devices used and the calculations for establishing the adequacy shall be furnished by the supplier and shall be subject to the approval.

19. DESIGN REVIEW

19.1. Design reviews shall be conducted by Employer; 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 finalized 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. Dielectric Stress of Solid Insulation Like Gas barrier, Support insulator etrc.
2. 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. Thermal stress and resulting increase in gas pressure during short circuit condition.
8. 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. 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 during detailed engineering:

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) Calculations 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 ratedpeak 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 For Reactive Current switching capability as per Clause 6.4.1.
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

The test reports of the above type tests for GIS (including type test report on Circuit breaker, Disconnect Switch, 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. MISCELLEANOUS

21.1. **Painting of enclosure**: All enclosures shall be painted externally as per manufacturer'spainting procedure.

21.2. **Heaters:** Wherever required, heaters shall be provided to prevent moisture condensationinside various Marshaling boxes.

21.3. **Identification & rating plate**

Each bay shall have a nameplate showing

a) Each module will have its own Identification & rating plate. The rating plate marking for each individual equipment like Circuit breaker, Disconnect Switch Grounding switches, Current transformer, Voltage transformers, Surge arrester etc shall be as per their relevant IEC.
b) A schematic diagram indicating their relative locations.
c) DTL Contract no.

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 impact recorders (on returnable basis) during transportation to measure

the magnitude and duration of the impact in all three directions. In case of electronic impact recorder, 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 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.

23.6. Blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site which may on later stage necessarily be used during repair and maintenance shall remain the property of DTL. Balance blanking plates, caps, seals, etc shall be returnable to the contractor. 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 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 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 on raised platform, as required etc. is included in

the works to be performed by the contractor. Cost of the raised platform for temporary storage is deemed to be included in overall cost. The raised platform needs to be made ready before arrival of GIS equipment at site. The contractor may use the available storage areas at site with permission of site in charge.

23.10. The equipment shall be unpacked immediately before Installation. 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 or SF6 gas until required.

23.11. For the purpose of release of payment linked to receipt and physical verification in case of GIS equipment it shall mean random opening and physical verification of one number of packing unit of each type of main equipment (i.e. GIS CB/ISO/ES/PT/LA etc.) for each voltage level. Thereafter proper re-packing of the GIS units shall be ensured as per manufacturer recommendation.

24. INSTALLATION OF GIS

24.1. Civil works of GIS Hall shall be completed in all respects before taking up the installation and it shall be ensured that Ventilation System is operational and all dust and dirt in the hall are removed. The GIS hall needs to be in positive pressure before starting Installation.

24.2. The installation area shall be secured against entry of unauthorized personnel. Only certified manufacturer's engineer and supervisor shall undertake the erection works. Engineers and supervisors of the manufacturer shall submit authorization and competency certificate to DTL.

24.3. Un-packaging of GIS modules shall be done outside the GIS hall and in no case module to be taken inside GIS hall with packing.

24.4. All assembly work shall be done by qualified personnel only who are to be identified and list submitted to DTL site before starting of erection work.

24.5. Assembly drawing for GIS erection for the section under progress shall be available and displayed in GIS hall at the time of erection work.

24.6. 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.

24.7. 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.

24.8. 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 on regular basis.

24.9. Only T&P and consumables required for GIS erection shall be kept in GIS during erection.

24.10. 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/protective enclosure/chamber etc)

24.11. Bus duct exits in the GIS hall's wall shall be kept covered by suitable means until permanent cover is provided after installation of bus ducts.

24.12. Maintenance room (as a part of LCR room) shall be constructed for carrying out repair works/ small part assembly. All excess material (not required for immediate installation works) test equipment and tools and tackles to be stored separately from GIS hall in this room for rework.

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 DTL site before start of erection. Shock recorder down loaded data and analysis shall be submitted preferably before commencement of erection work. In case of violation of shock limits, expert form manufacturer shall visit and do the joint internal inspection and shall submit analysis report before giving clearance for erection. If required the module shall be taken back to factory for further analysis and testing.

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 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 of gas compartment, the same shall be thoroughly cleaned externally. The vacuum cleaning of the installation area shall also be done specially the immediate vicinity of the flanges to be connected.

24.15. All Civil Work inside building including internal cable trench shall be completed before GIS installation.

24.16. Installation of flanges shall be done immediately after removal of transport covers. Transport covers, O-rings and other packing material of GIS shall be taken out immediately after removal.

24.17. 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.

24.18. At all points of time during installation authorized personnel shall use suitable gloves to avoid contamination.

24.19. Cable termination work shall commence only after completion of GIS equipment erection, as during GIS installation period laying and termination of cables interferes with the GIS erection work and affects cleanliness.

24.20. Approved Field Quality Plan shall be followed during site work.

24.21. 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.

25. ON SITE TESTING

After the GIS Switchgear has been fully installed at site and SF6 gas filled at rated filling density, the complete assembly shall be subjected to the site tests as per IEC-62271-203 and with the test voltages specified below:-

25.1. Application of Power Frequency voltage test for duration of 1 minute with the value as per IEC 62271-203.

25.2. Directly after the above test at 25.1, Switching impulse test with three impulses of each polarity and with the value (80 % of the rated switching Impulse withstand level) as per IEC 62271-203.

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 during the AC voltage test and a repeat test is performed due to this failure, then the repeat test shall be carried out at Specified voltage.

25.4. 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 during Oscillating Switching Impulse Test and a repeat test is performed due to this failure then the repeat test shall be carried out at a value equal to 90 % of the rated switching Impulse withstand level.

25.5. Method statement/ procedure of ON SITE high voltage testing, PD measurement and Switching Impulse test shall be submitted by contractor in advance. 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 dischargedetection 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.

25.6. 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.

25.7. 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 .

25.8. The analysis of PD measured during High voltage test shall be 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.

25.9. Method statement/ procedure of on site high voltage testing and PD measurement shall be submitted by contractor in advance.

26. VENTILATION SYSTEM FOR GIS HALL

26.1. 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.

26.2. 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:

i. Pre Filters: To remove dust particles down to 10 micron in size with at least 95% efficiency.

ii. 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.

26.3. 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.

26.4. 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.

27. MANDATORY SPARE

Design, engineering, manufacture, testing, supply on FOR destination site basis including transportation & insurance, storage at site of Mandatory spares for the GIS(As specified in BPS).

28. TESTING & MAINTENACE EQUIPMENT

Testing & Maintenance equipment shall be offered, as per relevant schedule of BPS.

28.1. SF6 Gas leakage detector.

28.2. The technical specification of SF6 Gas leakage detector shall be as per **Annexure-8**

28.3. Gas filling and evacuating plant : (Gas Processing unit)

I. 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).

II. 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.

III. The minimum capacity parameters of evacuation plant will be as under :

Oil Free Suction (Recovery) Pump:	30 M^3/Hour
Compressor (Two Stage):	15 M^3/Hour
Oil Free Vacuum Pump:	100 M^3/Hour

IV. 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.

V. 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

28.3. SF6 gas analyzer: The technical specification of SF6 gas analyzer shall be as per(As per Annexure-9)

28.4. Portable Partial Discharge(PD) monitoring system (Shall generally applicable for 220kV,66kV& 33 kV)

I. 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.

II. 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.

III. 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.

IV. The equipment shall meet the following requirements

1. Measurement shall be possible in noisy environment.
2. Stable reading shall be possible in presence of vibrations within complex GIS assemblies, which can produce signals similar to PD.
3. Equipment should have necessary synchronizing circuits to obtain PD correlation with power cycle and power frequency.
4. The equipment shall be battery operated with built-in-battery charger. It shall also be suitable for 230V AC/50 Hz input.
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.
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.
7. The function of software shall be covering the following:
   a) Data recording, storage and retrieval in computer
   b) Data base analysis
   c) Template analysis for easy location of fault inside the GIS
   d) Evaluation of PD measurement i.e, Amplitude, Phase Synchronization etc.
   e) Evaluation of bouncing/loose particles with flight time and estimation on size of particle.
   f) Expert software system for accurate interpretation of cause of PD.
   g) Report generation.

8. To prove the suitability in charged switchyard condition, practical demonstration shall be conducted before acceptance.
9. Supplier shall have "Adequate after sales service" facility in India and shall provide the document in support of this.
10. Necessary training may be accorded to personnel to make use of the kit for locating PD sources inside the GIS
11. Instrument shall be robust and conform to relevant standard.

IV. **Calibration/Sensitivity verification:** The UHF Couplers have to be first calibrated as per CIGRE Document No.654 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.

V. Pulse generator, same type as that of used during factory testing for UHF sensor sensitivity test shall be supplied as a standard accessory.

28.5. Online Partial Discharge Monitoring System (Applicable 400 kV GIS)

a) GIS equipment shall be designed so as to minimize partial discharge or other electrical discharge. A state-of-the art Partial Discharge Monitoring system shall be provided to monitor the entire GIS installation.

b) An on-line continuous Partial Discharge Monitoring (PDM) system shall be designed to provide an automatic facility for the simultaneous collection of PD data at multiple points on the GIS & its associated GIB ducts and Voltage Transformers adopting UHF technique. The data stored shall provide a historical record of the progress of PD sources and shall identify the areas of maximum activity.

c) On-line continuous Partial Discharge Monitoring (PDM) system 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.

d) The scope shall cover Engineering, supply, installation, testing and commissioning of partial discharge continuous monitoring system, with all necessary auxiliaries and accessories to make a complete system as per technical specification, including site demonstration of successful operation. Any items/accessories necessary to make the system fully functional for the trouble free online PD monitoring of complete GIS installation shall be considered as included in the scope.
The PDM system shall be provided with all its hardware and software, with readily interfacing to the UHF PD couplers installed in the GIS of present bays and future bays as shown in SLD plus 20% additional as extra. Details of this shall be submitted during engineering stage for approval.
The integration of UHF PD coupler in future GIS bays shall be done in respective package.
The number of UHF PD coupler for future bays shall be decided based on GIS layout finalized under present scope (considering present GIS equipment with future provision).
The PD Monitoring PC Work Station shall be housed in a lockable cabinet with duplicate keys and shall be located in the control room of the GIS substation. Workstation PCs shall be pre-loaded with all necessary Hardware & Software. The PCs shall have each Combo drive & Retrievable disk drive (1 TB), Ethernet port 100Mbps, printer. The workstation PC shall be powered by suitable dedicated UPS and same is included in the present scope.

e) Design of on-line PDM System

1. The technical proposal for PDM system along with detailed design documentation

shall be submitted for EMPLOYER'S approval during engineering stage.

2. To guarantee that sufficient coverage is available for complete GIS installation to monitor PD activity all design details shall be submitted as part of the above for review.
3. The sensitivity of the offered system shall be in accordance with CIGRE Document No. 654 that will be verified as part of site sensitivity tests.
4. UHF attenuation data of GIS shall be submitted for the switching devices, spacers, bends etc.
5. The signal attenuation level of co-axial cable per meter length and justification for the length of cable connection between the couplers and detector units shall be furnished.
6. The overall sensitivity of PD detection system shall take into account the spacing between couplers and the associated cabling, filters, amplifiers, etc.
7. The Sub-station GIS layout as a separate drawing indicating position of spacers, spread over of PD sensors with distance, sensor identification, the detector unit identification etc. shall be submitted during engineering stage for approval.
8. The PD sensors shall be identified / coordinated with the corresponding detector unit etc. with proper identification labeling and indicated in the substation PDM SLD.
9. Internal arrangement/wiring diagram is to be submitted for detector units/control cabinet etc. All internal items are to be identified / labeled to facilitate troubleshooting.
10. Supply requirement (AC & DC) to be specified for the complete monitoring system.
11. Power supply to PDM PC shall have protection against surges, overload and short circuit. A dedicated on-line UPS system shall also be provided as a backup during supply interruption, to ensure trouble-free & reliable running of the PDM System for a minimum of 15 minutes duration. Ratings of UPS shall be proposed for the approval of EMPLOYER'S. The UPS shall have enough capacity to initiate a 'safe' shut down of the PDM PC and the peripherals after this 15-minute period if normal supply fails to resume. The PDM PCs shall restart automatically on resumption of normal supply. The UPS shall not generate spikes during changeover of supply. UPS shall automatically give indication / alarm when it requires battery replacement. Potential Free Contacts shall be generated to signal these events. These contacts shall be wired out to Annunciation / Monitoring systems. Alternately, inverter of suitable capacity is also acceptable. Critical Process and Status alarms of the PDM system shall be displayed.
12. PDM System shall be provided with a user security for accessing the system with a log-on and password entry procedure. The user levels shall be defined as a Master User and other users for the modification of system, update, and entry of parameters or manual operation. System shall be able to generate 3D point on wave pattern whenever any PD activity detected by the system. System shall be able to give online 3D point on wave pattern, on line PRPD (phase resolved PD) and on line short time trende tc. System shall be able to generate the all the logs related to system fault, system access, PD event, and any changes in system setting etc.
13. Method of electrical isolation/protection provided between PD sensor and detector circuitry in case of flashover/high potential stress inside GIS should be furnished.
14. The selected mode of propagation of PD signal (electromagnetic wave) inside GIS for the design of sensors shall be furnished.
15. The protection available for electronics against transient over voltages caused by switching operations shall be furnished.
16. The capacity of each detector unit to be specified to accommodate as many numbers of PD sensors signal.
17. The applicable standards to meet IEC & IEEE requirements for electromagnetic compatibility shall be specified. The offered system should have been tested for the

same for working in a 400kV & above substation environment. The necessary documentation has to be submitted in this regard.

18. Guaranteed technical particulars & data sheet for various components used in the system shall be submitted.

f) **Calibration:** The UHF Couplers have to be first calibrated as per CIGRE procedure TF15/330305 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.

g) **Every Day Use & Maintenance** : The system shall be designed suitable for anunmanned s/s and operate automatically. The system shall generate alarms if suspected partial discharge activity is noticed or the system itself is in failure, thereby eliminating the necessity of periodic system access by the user and one such alarm shall be connected to Substation automation system (SAS). The alarms shall be configured coupler wise.

h) **Computers and Peripherals:** The PC operating system shall be the latest version of MSWindows. It should be suitable for continuous process application and should have been tested for the same. The hardware configuration of PC should be the latest available in the market of industrial type subject to EMPLOYER'S / Engineer approval. For storing the historical PD database, sufficient storage facility in the form of hard disc and retrievable hard disk drive of 1TB as specified shall be available in the substation. The PC monitor shall be 21" LCD type of reputed make.

i) **Filtering Facility:** The filtering facility has to be provided in order to distinguish real PDfrom internal/external noise such as switching operations, self-test signal, radio, communication signal etc. The PDM system itself shall be able to discriminate the noise from real PD. The exposed gas barriers of the GIS shall be shielded effectively against noise interference & tested. The gas barrier shields/belts shall be suitable for outdoor use also & able to withstand high ambient temperature. Site measurements have to be performed after installation of the PDM system in order to identify the various sources of external noise to incorporate the same in the filtering facility. This filtering will preferably be through software by band pass, which can be manually activated (as an option) to filter out noise signals in the trend plot display. If hardware filtering is employed then adequate measures have to be taken to avoid masking of other signals, which may lie in the same frequency range. The method adopted for the above shall be specified taking into account the sensitivity requirement of PDM system as per CIGRE document. The noise filters shall be selectable individually coupler-wise.

j) **Self-Test (Diagnostic) Facility**: Built-in self-checking facility shall be incorporated inthe control system which will continuously verify the correct operation of the whole monitoring system with the simulated PD signal viz. checking of the sensitivity of individual detector units, response of PD sensors in addition to the checking of the system functioning. The periodicity of such self-check operation shall be specified. In case of system failure this shall trigger an alarm for communication to SAS. External check facility: Propose the arrangement/device available for externally checking the healthiness of PD sensors by pulse injection in addition to built-in monitoring facility.

k) **Detector Units**: The sensitivity of each detector unit shall be furnished. The sensitivity levelof individual detector units shall be selectable depending on the site background noise level.

l) **Trend Plot**: The trend plot facility shall be available with the update period ofhourly/daily/weekly/monthly/yearly. It shall be possible to view the historical trends for the complete archived data accumulated over several years.

m) **PD Monitoring modes**: There shall be two different modes of system operation viz. adedicated Continuous PD Monitoring mode for the normal day today operation of the system & a dedicated HV commissioning test mode which is exclusively for PD monitoring during HV commissioning test. The HV commissioning mode shall also operate as an independent

feature.

In the HV Commissioning mode the real time display shall be possible for a minimum of two complete bays with associated bus bars and at with one second update period. The HV test software shall automatically record the HV voltage information along with PD so as to check PD inception & extinction voltages precisely. The complete HV & PD data recorded during HV test shall be possible to be reviewed in replay mode after the HV test.

n) **Alarm Facility:** The PDM system shall generate alarm when action is required; viz. a) PDalarm (abnormal PD activity indicating a risk of failure) & b) PD system fail alarm to be connected to SAS.

o) **Real Time Display:** The PDM system should have the facility of Real Time display, whichwill give an instant indication of PD activity coupler wise, with one-second-update period. The PDM system shall be able to capture the PD data triggered by associated switching operations of CBs & isolators.

p) **Schematics: The** PDM system should have GIS schemes bay-wise incorporating PD sensoridentification and location along with spacer location. The sectional view of typical bay arrangement of GIS showing active parts shall also be included as part of the PDM software.

q) **Print Option/Facility:** PDM system should have the option/facility of printing all trendplots/reports/POW patterns/displays, etc. Laser Colour printer shall be provided for this purpose at substation.

r) **Data Archives:** This is to provide access to historical data and file storage with date andtime stamp. Sufficient storage facility shall be available to review historical data updated for the lifetime of switchgear. The substation & headquarters PCs shall have a backup device in the form of a retrievable disk drive of 1TB capacity for this purpose.

s) **PD Fault Identification & Location/Pattern Recognition/Predictive Maintenance**

Diagnostic Software: In order to interpret various types of PD defects, intelligent diagnostics software (expert system) shall be built- in as part of the PDM software capability. This is mainly to reduce the dependence on PD specialist. The bidder shall also make available typical point-on-wave patters as library pictures to train the user.

Software Updates: It shall be possible to upgrade / update the system software throughout the lifetime of the system with the ongoing development / refinement in PD technology.

t) Fault investigation : In case of any indication of suspected PD activity by the on line system, further investigation has to be carried out by the contractor for the PD defect identification and location during the warranty period

u) Special Tools / equipment, Spare Parts, software packages

   i. Special Tools: Special tools for cutting and crimping of coaxial cable with 'N Connectors' shall be supplied.
   ii. Spare parts: The contractor has to supply critical spares with replacement procedure for the trouble free operation of the system during its expected lifetime as part of the contract. A detailed list shall be included in the tender and also submitted for EMPLOYER'S approval during the detailed engineering stage.
   iii. Software Packages: The complete software package shall be supplied as part of a back-up facility in the form of DVD/CDs viz. Windows operating system with end user license, PDM Software including HV Test, Drivers for modems etc., software for remote access, printer etc. The list shall be submitted for reference.
   iv. Pulse generator for UHF sensor sensitivity test shall also be supplied as a standard accessory.

v) Operation & Maintenance Manual :A complete O&M manual covering all aspects of trouble shooting of PDM system in six sets in original shall be provided & also in CD's. For diagram references colour pictures shall be provided. A step-by-step procedure for spare parts replacement shall also be included.

w) **Factory / Site Test Formats**: Thefactory & site tests format to be submitted for approval. Theformat shall cover all possible tests to confirm healthiness of the system and to record the test values.

x) List of References: The bidder shall provide a reference list of PD monitoring system, which is supplied by them and in successful operation worldwide in a power utility.

29.0 Training

The successful bi dder shall a rrange f ree of cost training t o engineers o f t he purchaser/purchaser's representative in design, manufacture and testing of GIS being supplied for 120 man days.

• Four weeks on site and on-job training during erection.
• Two weeks training on GIS at principle manufacturer's works as per

curriculum specified below :

Curriculum for GIS Training

The curriculum of GIS training should at least cover the following aspects. Any other specificarea may be brought to notice and included.

1. General Explanation for GIS
2. Layout and Architecture of GIS
3. Gas Sectionalisation of GIS
4. Construction of CB
5. Operating Mechanism of CB
6. Maintenance of CB
7. Overhaul of CB (Interrupting chamber)
8. Overhaul of CB (Operating Unit)
9. Construction of DS/ES
10. Maintenance of DS/ES
11. Overhaul of DS/ ES
12. Construction of Bus/ Cable head/ SF6 – air bushing
13. Maintenance of Bus/ Cable head/ SF6 – air bushing
14. Overhaul of Bus/ Cable head
15. Overhaul of various transformer connections
16. Operation of GIS with SCADA
17. Construction & Maintenance of Lightning Arrester
18. Construction & Maintenance of VT/CT
19. Construction & Maintenance of Local control panel
20. Erection of GIS at site.
21. Installation & Testing of GIS at site
22. Type tests of GIS
23. Routine tests of GIS.
24. Faults simulation of GIS
25. Localization of GIS fault.

30. Service conditions

The equipment and the accessories to be supplied against this technical specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

1. Temperature: The reference ambient temperature be taken as 43.3 º C as per IS 9676.		
a.	Maximum ambient air temperature	50ºC
b.	Maximum daily average ambient temp	40^{o}C
c.	Maximum indoor ambient temp	35º C
2. Relative Humidity:		
a.	Maximum Relative Humidity	100%

b.	Minimum Relative Humidity	10%
3.	Average annual rainfall	750 mm
4.	Average no. of rainy day	50
5.	Average no. of thunderstorm days per annum	40
6.	Altitude	Not exceeding 300 meters
7.	Rain months	June to Oct.
8.	Wind pressure as per IS 875	195 Kg/Sq. meters upto 30 meters
9	Seismic Level	Zone-IV, as per IS-1893,Year-2002
10	Pollution class/creepage distance	31 mm/kV

The atmosphere is generally laden with mild acid and dust in suspension during the dry months and is subjected to fog in cold months. Heavy lightening occurs in the area during rainy months (June to October).

All equipment shall be designed to withstand seismic forces, corresponding to an acceleration of 0.3 g horizontal.

ANNEXURE-1

Technical parameters of Circuit Breaker shall be as follows:

S.No.	Details	Unit	400kV	220kV	66kV	33kV
1.	Rated current	A	3000/2000 A (3000 for bus-coupler breaker& I/C bay)/ As per scheme	1600/2500 (2500 for bus-coupler breaker& I/C bay)/ As per scheme	2000/2500 (2500 for bus-coupler breaker& I/C bay)/As per scheme	1250/2500 (2500 for bus-coupler breaker & I/C bay)/As per scheme
2.	Operating mechanism		Spring/ hydraulic	Spring/ hydraulic	Spring/ hydraulic	Spring
3.	Rated fault current & its duration	kA	63 (1 sec.)	50 (1 sec.)	31.5 (1 sec.)	31.5 (1 sec.)
4.	Rated short circuit making current	kA	158	125	80	80
5.	Rated operating duty cycle:					
5a)	For auto-reclosing type		O-0.3 sec-CO-3 min-CO	O-0.3 sec-CO-3 min-CO	O-0.3 sec-CO-3 min-CO	NA
5b)	For non-auto reclosing type		------	------	------	CO-15sec-CO
6)	Lightning (Full wave)impulse withstand voltage (1.2/50 μ s)					
6a)	Between line terminals and ground	kVp	±1425	±1050	±325	±170
6b)	Between terminals with circuit breaker contacts open:	kVp	±1425 kVp impulse on one terminal & 240 kVp of opposite polarity on the other terminal	±1200	±375	±195
6c	-Lightning impulse voltage applied to one terminal	kVp	1425	---	---	---
6d	-Power frequency voltage applied to	kVp	240	---	----	----

S.No.	Details	Unit	400kV	220kV	66kV	33kV
	opposite terminal					
7.	Switching impulse withstand voltage (250/2500 s) dry & wet					
7a)	Between line terminals and ground	kVp	1050	---	---	---
7b)	Between terminals with circuit breaker contacts open:		900	--	---	---
7c	-Switching impulse voltage applied to one terminal	kVp	900	---	---	---
7d	-Power frequency voltage applied to opposite terminal	kVp	345			
8	One minute power frequency withstand voltage					
8a)	Between line terminals and ground	kV rms	As per IEC			
8b)	Between terminals with circuit breaker contacts open	kV rms	As per IEC			
9)	Minimum corona extinction voltage in open and close position	kV rms	320	156	105	---
10.	Maximum radio interference voltge for frequency between 0.5 to 2MHz in open and close position	Micro-volt	1000 (at 320 kVrms)	1000 (at 156 kVrms)	500 (at 92 kVrms)	---
11.	First pole to clear factor		1.3	1.3	1.3	---
12.	Maximum line charging current (rms)(5)	A	600	125	50	10
13.	Rated cable charging breaking current capacity (rms)	A	400	250	160	50
14.	Break time: -Total break time up to rated breaking current -Rated break time	ms	 45 40	 65 60	 65 60	 105 100
15.	Making time (closing time)	ms	<150	<200	<200	<200
16.	Difference in instants of closing/opening of contacts(6)					
	-within a pole	ms	2.5	2.5	--	--

S.No.	Details	Unit	400kV	220kV	66kV	33kV
	-Between poles (for opening)	ms	3.3	3.3	--	--
	-Between poles (for closing)	ms	5	5	---	--
17.	Maximum noise level (7)	dB	140	140	140	140
18.	Maximum over –voltae on switching of transformer on no load	p.u.	<2.3	---	---	---
19.	Closing time	msec	100	100	100	100
20.	DC control voltage	V	220	220	220	220
21.	Auxiliary contacts continuous current rating	A	10	10	10	10
22.	Auxiliary contacts breaking capacity (for circuit time constant >20 ms)	A	2	2	2	2

Annexure-2

The major technical parameters of Disconnector and Earthing Switches for various voltage levels shall be as follows:

S.No.	Details	Unit	400kV System	220kV System	66kV System	33kV System
1.	Nominal/Rated voltage	kV	400	220	66	33
2.	Highest system voltage	kV	420	245	72.5	36
3.	Rated current	A	3150/2000 A (3000 for bus-coupler breaker& I/C bay)/ As per scheme	1600/2500 (2500 for bus-coupler breaker& I/C bay)/ As per scheme	2000/2500 (2500 for bus-coupler breaker& I/C bay)/As per scheme	1250/2500 (2500 for bus-coupler breaker & I/C bay)/As per scheme
4.	Rated fault current and its duration	kA	63 (1 sec)	50 (1 sec)	31.5 (1 sec)	31.5 (1 sec)
5.	Rated dynamic short circuit current	kAp	158	125	80	62.5
6.	Operating mechanism		AC motor operated & manual	AC motor operated & manual	AC motor operated & manual	Manual
7.	Lightning (Full wave) Impulse withstand voltage (1.2/50µs)					
7a)	Rated insulation Between line terminals and ground(+ve or –ve polarity	kVp	1425	1050	325	170
7b)	Between terminals with disconnector contacts open:	kVp	1425	1200	375	195
	-Lightning impulse voltage applied to one terminal	kVp	1425	--	--	--
	-Power frequency coltage of opposite polarity applied to other terminal	kVp	240	--	--	--
8.	Switching impulse withstand voltage (250/2500µs) dry & wet					
8a)	Between line terminals	kVp	1050	--	--	--

	and ground					
8b)	Between terminals with circuit breaker contacts open:	kVp	900	--	--	--
	-Switching impulse voltage applied to one terminal	kVp	900			
	-Power frequency voltage of opposite polarity applied to other terminal	kVp	345			
9.	One minute power frequency withstand voltage:					
9a)	Between line terminals and ground	kVrms	650	460	275	70
9b)	Between terminals with disconnector contacts open	kVrms	815	530	315	80
10.	Operating time	Sec	<12	<12	<12	<12
12.	Maximum radio interference voltage for frequency between 0.5 to 2 MHz in open and close position	µ-volt	1000 (at 320 kVrms)	1000 (at 156 kV rms)	500 (at 92 kV rms)	--
13.	Total operating time	Sec	<12	<12	<12	<12
15.	DC control voltage	V	220	220	220	220
16.	Auxiliary contacts continuous current rating	A	10	10	10	10
17.	Auxiliary contacts breaking capacity (for circuit time constant >20ms	A	2	2	2	2

ANNEXURE-3

The major technical parameters of Current Transformer

S.No.	Details	Unit	400kV System	220kV System	66kV System	33kV System
1.	Nominal /Rated system voltage	kV	400	220	66	33
2.	Highest system voltage	kV	420	245	72.5	36
3	Rated fault current and duration	kA	63(1 sec)	50(1 sec)	31.5(1 sec)	31.5(1 sec)
4	Rated dynamic short circuit current	kA0	157.5	125	78.75	62.5
5	Lightning (Full wave)impulse withstand voltage (1.2/50µs) -between l ine terminals and ground	kVp	1425	1050	650	170
6	Switching im pulse withstand voltage (250/2500µs) -between l ine terminals ground (dry& wet)	kVp	1050	--	--	--
7	One m inute pow er frequency withstand voltage -between l ine terminals and ground	kVrms	630 (dry only)	460	275	75
8	One m inute pow er frequency withstand voltage of s econdary winding	kV	5	5	5	5
9	Minimum corona extinction voltage	kVrms	320	156	105	--
10	Maximum radio interference voltage for frequency between 0.5 to 2 MHz	µ-volt	1000 (at 320 kVrms)	1000 (at 156 kVrms)	500 (at 92 kVrms)	--
11	Maximum partial discharge level	pC	10	10	10	10

S.No.	Details	Unit	400kV System	220kV System	66kV System	33kV System
12	Cantilever	kg.	500	350	350	350

TABLE-3A

REQUIREMENTS FOR 420 kV CURRENT TRANSFORMER

No. of cores	Core No.	Applc ation	Current ratio	Output Burden (VA)	Accurcey Class as Per IEC: 61869	Min. Knee pt Voltage Vk	Max CT Sec. Wdg. Resista nce (ohm)	Max Excitation current a t V k in mA)
5	1	BUS DIFF CHEC K	3000-2000-1000/1	-	-	Vk>K.Is .(Rct +Rb)V	15/10/5	20 on3000/1tap. 30 on2000/1tap. 60 on1000/1tap.
	2	BUS DIFF MAIN	3000-2000-1000/1	-	-	Vk>K.Is .(Rct +Rb)V	15/10/5	20 on3000/1tap. 30 on2000/1tap. 60 on1000/1tap.
	3	MET E-RING	3000-2000-1000/1	20 20 20	0.2s 0.2s 0.2s	-	-	-
	4	TRA NS.B ACK UP/ LINE PRTN .	3000-2000-1000/1			Vk>K.Is .(Rct +Rb)V	15/10/5	20 on3000/1tap. 30 on2000/1tap. 60 on1000/1tap. .
	5	TRA NS. DIFF/ LINE PRTN .	3000-2000-1000/1			Vk>K.Is .(Rct +Rb)V	15/10/5	20 on3000/1tap. 30 on2000/1tap. 60 on1000/1tap. .

Note:

- The Bidder will ensure compatibility of CT and numerical relay in respect of knee-point vol tage a s well a s ope rating time of r elay to avoid mal-functioning or damage to the numerical relay.
- Protection cores shall be of accuracy class PX as per IEC 61869.
- Metering Core shall be of accuracy class 0.2S as per IEC: 61869

TABLE-3B
REQUIREMENTS FOR 245 kV CURRENT TRANSFORMER

No. of cores	Core No.	Application	Current ratio	Output Burden (VA)	Accuracy Class as Per IEC: 44-1	Min. Knee pt Voltage Vk	Max CT Sec. Wdg.Resistance (ohm)	Max Excitation current at Vk in mA)
5	1	BUS DIFF CHECK	1600-800/1	-	-	1600/800	8/4	25on1600/1tap 50 on800/1 tap.
	2	BUS DIFF MAIN	1600-800/1	-	-	1600-800/1	8/4	25on1600/1ta 50 on800/1 tap.
	3	METE-RING	1600-800/1	20	0.2S	-	-	-
	4	TRANS. BACK UP/ LINE PRTN.	1600-800/1	-	-	1600-800/1	8/4	25on1600/1tap 50 on800/1 tap.
	5	TRANS. DIFF/ LINE PRTN.	1600-800/1	-	-	1600-800/1	8/4	25on1600/1tap 50 on800/1 tap.

NOTE:-

- 220kV C.T ratio of 1600-800/1-1-1-1-1 A for all bays
- The Bidder will ensure compatibility of CT and numerical relay in respect of knee-point vol tage a s well a s ope rating time of r elay to avoid mal-functioning or damage to the numerical relay.
- Protection cores shall be of accuracy class PX as per IEC 61869.
- Metering Core shall be of accuracy class 0.2S as per IEC: 61869

TABLE-3C
REQUIREMENTS FOR 72.5 kV CURRENT TRANSFORMER

No. of Cores	Core no.	Application	Current ratio	Output Burden (VA)	Accuracy Class as Per IEC: 44-1	Min.Knee pt. Voltage Vk	Instrument security factor
4	1	METERING	*	20	0.2S	-	Less than 5
	2	Differential Protection	*	-	*	Vk>K.I.(Rc +R)V	
	3	Back-up Protection(O/C and E/F)	*	-	*	Vk>K.I.(Rc +R)V	
	4	REF Protection	*	-	*	Vk>K.I.(Rc +R)V	

*** NOTE:-**

i) Protection cores shall be of accuracy class PX as per IEC 61869.
Metering Core shall be of accuracy class 0.2S as per IEC: 61869

ii) 66kV C.T. of ratio 2000/1-1-1-1 A for incoming from 160 MVA Trf and 2000/1-1-1 for bus coupler (with core one for metering and core 2 for back-up protection)

iii) 66kV C.T. ratio 1000 /1-1-1 A for Feeder Protection with core 1 for metering, core 2 for Line protection and core 3 for back-up protection with above accuracy class.

TABLE-3D
REQUIREMENTS FOR 36kV CURRENT TRANSFORMER

No. of cores	Core no.	Application	Current ratio	Output Burden (VA)	Accuracy Class as Per IEC: 44-1	Min.Knee pt. Voltage Vk	Instrument security factor
3	1	METERING	*	10	0.2S	-	Less than 5
	2	PROTECTION/ O/C & E/F	*	-	*	Vk>K.I.(Rc+R)V	
	3	Back-up Protection	*	-	*	Vk>K.I.(Rc+R)V	

*** NOTE:-**

i) Protection cores shall be of accuracy class PX as per IEC 61869.

Metering Core shall be of accuracy class 0.2S as per IEC: 61869

ii) 33kV C.T. of ratio 2000/1-1-1 A for incoming from 100 MVA Trf. and for bus coupler.

iii) 33kV C.T. ratio 800-4001-1-1 A for feeder protection.

Annexure -4

The major technical parameters of voltage Transformer

S.No.	Details	Unit	400kV System	220kV System	66kV System	33kV System
1.	Nominal /Rated voltage	kV	400	220	66	33
2.	Highest system voltage	kV	420	245	72.5	36
3.	Fault current and duration	kA	63 (1 sec)	50 (1 sec)	31.5 (1 sec)	31.5 1 sec
4.	Rated primary voltage	kV	420/ √3	245/ √3	145/ √3	36/ √3
5.	Rated secondary voltage(1)	V	110/√3	110/√3	110/√3	110/√3
6.	Accuracy class					
	-protection		3P	3P	3P	3P
	-metering(2)		0.2	0.2	0.2	0.2
7,	Lightning (Full wave) impulse withstand voltage (1.2/50μs) -between line terminals and ground	kVp	1425	1050	650	170
8.	Switching impulse withstand voltage (250/2500 μs) - between line terminals and ground(dry & wet)	kVp	1050	--	--	--
9.	One minute power frequency withstand voltage -between line terminals and ground	kVrms	630 (dry only)	460	275	75
10.	Minimum corona extinction voltage	kVrms	320	156	105	--
11.	Maximum Radio interference voltage for frequency between 0.5 to 2 MHz	Micro-volt	1000 (at 320 kV rms)	1000 (at 156kV rms)	500 At 92 kVrms)	--
12.	Standard reference range of frequencies for which the					

S.No.	Details	Unit	400kV System	220kV System	66kV System	33kV System
	accuracies are valid					
	-protection	%	96 to 102	96 to 102	96 to 102	NA
	-measurement	%	99 to 101	99 to 101	99 to 101	NA
13.	High frequency capacitance for entire carrier frequency range	%	80 to 150% of rated capacitance	80 to 150% of rated capacitance	80 to 150% of rated capacitance	NA
14.	Equivalent resistance over entire carrier frequency range	Ω	<40	<40	<40	--
15.	Stray capacitance and stray conductance of LV terminal over entire carrier frequency range		As per IEC 60358	As per IEC 60358	As per IEC 60358	--
16.	One minute power frequency withstand voltage (LV side)					
16a)	Between LV (HF) terminal and earth					
	-for exposed terminals	kVrms	10	10	10	10
	-for terminals enclosed in weather proof enclosure	kVrms	4	4	4	4
16b)	For secondary winding	kVrms	3	3	3	3
17.	Rated voltage factor					
	-continuous		1.2	1.2	1.2	1.2
	-for 30 seconds		1.5	1.5	1.5	1.5
18.	Maximum partial discharge level	pC	10	10	10	10
19.	Rated capacitance	pF	4400 (+10,-5%)	4400 (+10,-5%)	4400 (+10,-5%)	--
20.	Cantiliver strength	Kg	500	350	350	350

TABLE-4A
REQUIREMENT OF 400kV VOLTAGE TRANSFORMERS

Sl. No.	PARTICULARS	400kV		
1	Rated primary voltage	420/√3 kV		
2	Type	Electromagnetic, or Single phase capacitor VT		
3	No. of secondaries	3		
4	Rated voltage factor	1.2 continuous		
		1.5-30 seconds		
5	Phase angle error	±20 minutes		
		Sec.1	Sec II	Sec III
6	Rated voltage (V)	110/√3	110/√3	110/√3
7	Application	Protection	Protection	Metering
8	Accuracy	3P	3P	0.2
9	Output burden (VA) (minimum)	50	50	50

TABLE-4B
REQUIREMENT OF 220kV VOLTAGE TRANSFORMERS

S. N	PARTICULARS	220kV		
1	Rated primary voltage	245/√3 kV		
2	Type	Electromagnetic		
3	No. of secondaries	3		
4	Rated voltage factor	1.2 continuous		
		1.5-30 seconds		
5	Phase angle error	±20 minutes		
		Sec.1	Sec II	Sec III
6	Rated voltage (V)	110/√3	110/√3	110/√3
7	Application	Protection	Protection	Metering
8	Accuracy	3P	3P	0.2
9	Output burden (VA) (minimum)	50	50	50

TABLE-4C
REQUIREMENT OF 72.5kV VOLTAGE TRANSFORMERS

S. N.	**PARTICULARS**	**66 kV**		
1.	Rated primary voltage	72.5/√3 kV		
2.	Type	Electromagnetic		
3.	No. of secondary	3		
4.	Rated voltage factor	1.2 continuous		
		1.5-30 seconds		
5.	Phase angle error	±20 minutes		
		Sec I	Sec II	Sec III
6.	Rated voltage (V)	110/√3	110/√3	110/√3
7.	Application	Metering	Protection	Protection
8.	Accuracy	0.2	3P	3P
9.	Output burden (VA) (minimum)	50	50	50

TABLE-4D

REQUIREMENT OF 33kVVOLTAGE TRANSFORMERS

Sl. No.	PARTICULARS	33 kV		
1.	Rated primary voltage	36/√3 kV		
2.	Type	Electromagnetic		
3.	No. of secondaries	3		
4.	Rated voltage factor	1.2 continuous		
		1.5-30 seconds		
5.	Phase angle error	±20 minutes		
		Sec I	Sec II	Sec III
6.	Rated voltage (V)	110/√3	110/√3	110/√3
7.	Application	Metering	Protection	Protection
8.	Accuracy	0.2	3P	3P
9.	Output burden (VA) (minimum)	20	20	20

Annexure-5

The major technical parameters of Surge Arresters

S.No.	Details	Unit	400kV System	220kV System	66kV System	33kV System
1.	Rated SYSTEM voltage	kV	400	220	66	33
2.	Highest system voltage	kV	420	245	72.5	36
3.	Rated arrester voltage	kV	336	216	120	30
4.	Continuous operating voltage (COV) at 50˚C	kVrms	267	168	102	25
5.	Discharge current (8/20µs *wave*					
5a)	Nominal discharge current	kAp	20	10	10	10
5b)	Discharge current at which insulation c0ordination will be done	kAP	20	10	10	10
6.	Minimum discharge capability (1)	kJ/kV	12	5	5	5
7,	Maximum residual voltage for					
7a)	Lightning impulse current					
	-20kA	kVp	850	--	--	--
	-10kA	kVp	800	600	330	90
	-5kA	Micro-volt	--	560	310	85
7b)	Switching impulse current					
	-at 2kA	kVp	670	--	--	NA
	-at 1kA	kVp		500	280	NA
	-at 500A		650	--	--	NA
7c)	Steep current impulse at nominal discharge current		925	650	380	110
8.	Long duration discharge class (as per IEC)		Class 4	Class 3	Class 3	Class 3
9.	Perspective symmetrical fault current for pressure relief test (for 0.2 Sec)	kA(rms)	63	50	31.5	25
10.	Low current long duration test value		As per IEC (2400µs)	As per IEC (2400µs)	As per IEC (2400µs)	As per IEC (2400µs)

11.	High current impulse test value (4/10 micro sec.)	kAp	100	100	100	100
12.	Minimum corona extinction voltage	kVrms	320	156	105	NA
13.	Maximum radio interference voltage for frequency between 0.5 to 2 MHz	Micro-Volt	500 At 320 kV rms)	500 (at 156 kVrms)	500 (at 92 kVrms)	---
14.	Full wave impulse withstand voltage (1.2/50µs)-between line terminals and ground	kVp	1425	1050	650	170
15.	Switching impulse withstand voltage (250/250µs)-between line terminals and ground (Dry & wet)	kVp	1050	NA	NA	NA
16.	One minute power frequency withstand voltage between line terminals and	kV(rms)	630	460	275	70
17.	Maximum Partial Discharge for arrester at (1.05 x COV)	pC	50	50	50	50
18.	Cantilever strength	Kg	500	350	350	350

(Annexure -6)

SYSTEM PARAMETERS

S.No.	Details	Unit	400kV system	220kV System	66kV system	33kV system
1.	Nominal/rated voltage	kVrms	400	220	66	33
2.	Highest system voltage	kVrms	420	245	72.5	36
3.	Phase	nos.	3	3	3	3
4.	Rated frequency	Hz	50	50	50	50
5.	Ambient temperature	^{o}C	50	50	50	50
6.	Specific creepage distance	mm/kV	31	31	31	31
7.	Rated fault current and its duration	kA	63 1 sec.	50 1 sec.	31.5 1 sec.	31.5 1 sec.
8.	Minimum corona extinction voltage	kVrms	320	156	105	NA
9.	Maximum radio interference voltage (RIV) for frequency between 0.5 & 2.0 MHz	-volt	1000 (at 320kV rms)`	1000 (at 156 kV rms)	500 (at 92 kV rms)	NA
10.	Seismic acceleration Zone-IV, as per IS-1893,Year-2002	G	0.3	0.3	0.3	0.3
11.	System neutral earthing		Effectively earthed	Effectively earthed	Effectively earthed	Effectively Earthed
12.	Auxiliary AC supply (3Ph,2wire,50 Hz)	V	415 ±10%			
13.	Auxiliary DC supply (2 wire ungrounded)	V	220 ±10%			

Annexure -7

TECHNICAL PARAMETERS FOR SF6/AIR BUSHING

Sl. No.	Particular	400 kV	220 kV	66kV	33kV
1	Rated Voltage (kV) (rms)	420 kV (rms)	245 kV (rms)	72.5 kV (rms)	36
2	Rated Current (Amp)	As per scheme	As per scheme	As per scheme	As per scheme
3	1.2/50 micro second impulse voltage (Lightning impulse withstand voltage)	1425 kVp	±1050 kVp	±325 kVp	±170 kVp
4	250/2500 micro second switching impulse voltage	1050 kVp	NA	NA	NA
5	One minute power frequency withstand voltage(kV R.M.S)	±650	±460	±140	±70
6	Minimum total Creepage distance in mm	31 mm/kV			
7	Minimum Cantilever strength (kN)	10	8	5	

Annexure-8

Technical Specifications for SF6 Gas Leak Detector Equipment along with Standard Accessories:

1. General Requirements

1.1 The testing equipment shall be type tested and shall be subjected to acceptance and routine tests in accordance with the requirements of relevant national/international standards with latest version.

1.2 The instrument should have been proven for repeatability of test result in charged switchyard of EHV substations. Documentary evidence for this should be furnished along with the bid.

1.3 The acceptance of the equipment is subject to the successful demonstration to the satisfaction of DTL at prescribed site of DTL including 400KV switchyard/site during technical evaluation.

1.4 Under very high/low ambient temperatures, high humidity, equipment shall be able to carry out measurement under these conditions.

2. Functional Requirement:

2.1. The meter shall be capable of detecting leakage of SF6 from 400/220kV Circuit Breakers/GIS equipments. Instrument shall work in induced condition of charged switchyard up to 400kV level. The equipment shall not be sensitive to moisture or other gases in atmosphere and water vapour.

2.2. It shall be Microprocessor controlled, with advanced digital signal processing, visual LED display Audible signal for progressive leak-size indication having following features:

a. easy and tactile keypad control, battery test function, battery low voltage indication etc;
b. Cordless and portable, Battery operated,
c. Immediate response time for quick leak detection and quick return to zero - position even after detection of large leaks.
d. The sensing probe shall be such that it can reach all the points on the switchgear where leakage is to be sensed.

2.3. The equipment 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 equipment shall be such that the transportation from one station to other will not affect the performance, repeatability and accuracy of measurement of equipment.

2.4. The test results should have repeatability consistency & immunity to electromagnetic, electrostatic interference in live switch yard up to 400kV.

2.5. Safety, EMC/EMI, Environment, Enclosure, and Interference limits shall be as per national/international standards with latest revision.

2.6. Accessories:

Set of batteries, Battery Charger, Manual, Hard Carrying case, Spare sensor tip etc, Software CD and other mandatory accessory.

SPARES: Filter Tips 5 nos, Infra red cell or any other consumable as required/Mandatory for operations of kit during guarantee period, Optional spares shall be quoted separately.

3. Technical Parameters:-

S.No.	Parameter	Specification
1.	Method of operation and principle	Continuous leak detection and leak measurement operation during leak check without limitation with audible and visual indication.(Infrared technology)
2.	Range of SF6 leak measurement during leak detection	0-1000 and more PPMv by volume with accuracy of ±5% or better
3.	Sensitivity	3.5 gm SF6/year or less. No cross sensitive to other gases
4.	Response Time	Immediately
5.	Alarm	Visual as well as Audio
6.	Power supply	Li-Ion batteries powered / equivalent power supply with charger.
7.	Batteries voltage indication/test function	To be displayed
8.	Spares	Mandatory for operation of equipment during guarantee period
9.	Operating Temperature & Relative Humidity	0 to 50°C& RH 95%

4. Calibration certificate:-

The instrument shall be supplied with proper Calibration certificate from NABL or internationally accredited lab. It is the responsibility of the supplier to provide the Calibration services of the instrument after the calibration interval is over. Date of Calibration Certificate shall not be older than three month from the date of supply of kit.

5. Demonstration:-

The bidder will have to demonstrate the equipment for accuracy and repeatability under stringent field conditions at prescribed site of DTL including 400kV switchyard/site up to the satisfaction of DTL at their own cost and ***this will be the part of technical evaluation***. Successful demonstration of equipment shall be the pass / fail criteria for further evaluation / rejection of bid. The instrument failed during demonstration shall be rejected.

6. Warranty/Guarantee Period:

Min 05 years from the date of successful & complete commissioning at DTL sub-station.

The warranty shall include:

a) Calibration of instrument (annually),

b) As much as visit for repairs to site, along with all the materials, including accessories etc. are to be covered under warranty/guaranty period. If the equipment needs to be shifted to supplier's works for repairs within warranty/guaranty period, suppliers will have to bear the cost of spares, software, and transportation of equipment for repair at test lab / works.

7. Services after sale:

Bidder will have to submit the documentary evidences of having established mechanism for prompt services as and when required by DTL. Bidder need to submit their organization service chart along with bid.

8. Commissioning, Training and Handling Over of the Instrument

Successful bidder will have to commission the instrument to the satisfaction of DTL. The instrument failed during the demo shall be rejected and no repairs are allowed.

Bidder will have to provide training to DTL engineers for safe operation and maintenance of the instrument before handing over the same at DTL site in batches."

9. Guaranteed technical particulars SF6 Gas Leak Detector Test Equipment along with Standard Accessories

Sr.No	Item	Description (To be filled in and signed by the Bidder)
1.	Mfg.Name/Model No.	
2.	Method of Operation and principle	
3.	Range of Sf6 leak measurement during leak detection	
4.	Sensitivity	
5.	Response Time	
6.	Alarm	
7.	Power Supply	
8.	Spares	
9.	Operating temperature	
10.	Accessories	
11.	Warranty	
12.	Calibration certificate	
13.	Services after Sale	
14.	Safety,EMC/EMI,Environment, Enclosure, and Interference applicable standards	

Annexure-9

Technical specifications of SF6 gas analyzer

1. General Requirements

1.1 The testing equipment shall be type tested and shall be subjected to acceptance and routine tests in accordance with the requirements of relevant national/international standards with latest version.

1.2 The instrument should have been proven for repeatability of test result in charged switchyard of EHV substations. Documentary evidence for this should be furnished along with the bid.

1.3 The kit and accessories shall be robust and rugged enough, so that it can be transported safely to different locations. The transportation and packing cases 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. Further, the instrument shall be robust enough to sustain the jerks during the transportation in local condition.

1.4 Bidder will have to submit the documentary evidences of having established mechanism for prompt services in India as and when required by DTL. Bidder need to submit their organization service chart along with bid.

2. Functional Requirement

2.1. The instrument should be suitable for online measurement of Moisture (Dew point & ppm), Purity, SO2 content of SF6 Gas in gas insulated EHV equipments and GIS (Gas insulated switchgear), in live switchyard upto 400 kV level.

2.2. The measurement principle shall be based upon zero gas loss i.e. the gas will be returned back to original compartment of the GIS after performing the measurement without being exposed to the atmosphere.

2.3. The instrument shall be able to measure the pressure of the compartment under Test in bar, kPa, MPa.

2.4. The measurement should be possible at standard pressure/system pressure.

2.5. The test results should have repeatability consistency & immunity to electromagnetic, electrostatic interference in live switch yard up to 400kV.

2.6. It should have facility for Data Storing in the kit & down loading to PC. It should have USB / Ethernet Interface.

3. Technical Parameters:-

Item	Specification
Measurement Parameters	1. SF6 purity – Range: 0-100 % , Accuracy: +/- 0.5 % 2. Dew point - Range : -60 to +20 deg C, Accuracy: +/-4 deg C 3. SO2 - Range : 0-100 ppm, Accuracy : +/- 3 ppm 4. HF-Range :-10ppm & Accuracy : +/- 10 %
Input Pressure	0.5 to 9 Bar
Re-circulation/ Pumping B ack of SF6 gas	The kit shall have the inbuilt facility of pumping back the measured SF6 gas to the equipment being tested.
Test L eads and accessories	Complete se t o f H oses, pipes, coup ling, valves et c. f or m easurement (min 10 m length) with suitable adaptors for connection with Equipment (Areva, CGL,ABB,Hyosung, BHEL, Siemens make GIS/CBs etc).
Design/Engg.	The complete e quipment a long w ith c omplete a ccessories m ust be designed/engineered by Original Equipment Manufacturer.
Power Supply	150 – 240 V AC at 50 Hz and Inbuilt battery with charger/adapter etc.
Operating Temperature	-10 to +50 °C
Relative humidity	Max. 90 % non-condensing
IP Class	It should be housed in a robust IP67 case with wheels
Display/Control	LCD/Keypads.
Environment	The t est k it sh all be co mpatible for E MI/EMC/safety env ironment requirement as per IEC.

4. Calibration certificate:-

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.

Calibration certificate f rom NABL accr edited lab or i nternationally r eputed lab, shall be submitted. Date of calibration shall not be older than two month from the date of supply of kit.

5. Demonstration:-

The bidder will have to demonstrate the kit for accuracy and repeatability under stringent field conditions at prescribed site of DTL including 400kV switchyard/site upto the satisfaction of DTL at t heir ow n cost and ***this will be the part of technical evaluation***. Successful demonstration of equipment shall be the pass / fail criteria for further evaluation / rejection of bid. The instrument failed during demonstration shall be rejected.

6. Warranty/Guarantee Period:

Min 03 years from the date of successful & complete commissioning at DTL sub-station. All the materials, including accessories etc. are to be covered under warranty/guaranty period. If the k it ne eds t o be sh ifted t o supplier's w orks for r epairs w ithin warranty/guaranty pe riod, suppliers will have to bear the cost of spares, software, and transportation of kit for repair at test lab / works.

7. Commissioning, Training and Handling Over of the Instrument

Successful bidder will have to commission the instrument to the satisfaction of DTL. The instrument failed during the demo shall be rejected and no repairs are allowed.

Bidder will have to provide training to DTL engineers for safe operation and maintenance of the instrument before handing over the same at DTL site in batches."

8. <u>Guaranteed technical particulars SF6 Gas Quality Analyzer Test Kit along with Standard Accessories</u>

Sr. No.	Particulars	Filled by bidder
1.	Name & Country of Manufacturer	
2.	Type / Model No.	
3.	SF6 Purity Measurement method	
4.	Pump back of SF6 gas back in to breaker after measurement	
5.	Measurement parameter as per IEC60480 & CIGRE B3.02.01	
6.	SF6 Purity range with accuracy	
7.	Dew Point measurement range with accuracy	
8.	SO2 measurement range with accuracy	
9.	User selectable Inbuilt standards a) IEC60480 b) IEC60376	
10.	Measurement Cycle Selection	
11.	Direct Input Gas pressure	
12.	Vacuum purging for hose pipes	
13.	Quantum of SF6 gas used for measurement	
14.	Data storage	
15.	Display	
16.	Power input	
17.	Battery operation	
18.	Casing Protection class	
19.	Weight	
20.	Accessories	
21.	Service life	

SECTION-III

GENERAL TECHNICAL REQUIREMENTS

SECTION : 3

GENERAL TECHNICAL REQUIREMENTS (GTR)

1.0 FOREWORD

1.1 The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other sections of tender documents and is not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

2.0 GENERAL REQUIREMENT

2.1 The bidders shall submit the technical requirements, data and information as per the technical data sheets provided in the Volume III of bid documents.

2.2 The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification.

2.3 It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different from those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser's. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the specific requisite schedule, will not be considered as valid deviation.

2.4 Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures, makes shall be as defined in Section- Lighting System

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

2.6 The contractor shall design the system maintaining all the statutory clearances for both indoor and outdoor equipments as per relevant standards and norms. Contractor shall also design the building with sufficient working space for ease of operation and maintenance activities.

3.0 **STANDARDS**

3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

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

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

3.4 The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

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

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

3.7 The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

4.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

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

4.2 All equipments shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

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

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

4.5 The equipment shall also comply to the following:
a) All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing.
b) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
c) All piping, if any between equipment control cabinet/ operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

4.6 Operating times of circuit breakers and protective relays have been specified in respective sections. However, the bidder is allowed to have minor variations on the individual equipment timings subject to the condition that overall fault clearing time remains within 160 milli seconds at 220 kV level under comparable conditions.

4.7 EHV equipments and system shall be designed to meet the following major technical parameters as brought out hereunder.

4.7.1 System Parameter

S. No	Description of parameters	220 kV System	66kV System	33 kV System
1.	System operating voltage	220kV	66kV	33kV
2.	Rated frequency	50Hz	50Hz	50Hz
3.	No. of phase	3	3	3
4.	Rated Insulation levels			
	i) Full wave impulse withstand voltage (1.2/50µs)	1050 kVp	325kVp	170 kVp
	ii) One minute power frequency dry and wet withstand voltage (rms)	460kV	140kV	70kV
5.	Corona extinction voltage	156kV	-	-
6.	Max. radio Interference voltage for frequency b/w 0.5MHz and 2 MHz at 156kV rms for 220kV system	1000 µV	-	-
7.	Minimum creepage distance	25 mm/kV (6125 mm)	25 mm/kV (1812.5 mm)	25 mm/kV (900 mm)
8.	Min. clearances			
i)	Phase to phase	2100mm	630mm	320mm
ii)	Phase to earth	2100mm	630mm	320mm
iii)	Sectional clearances (These clearances are mentioned for air clearance)	5000 mm	3000mm	3000mm
9.	Rated short circuit current for 1 sec. duration	40 kA	31.5kA	31.5 kA
10.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed

Note : The insulation and RIV levels of the equipments shall be as per values given in the respective chapter of the equipments.
Bidder is required to maintain the clearances as per relevant IEC/IS and shall adhere to safety guidelines.

4.7.2 Major Technical Parameters

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

(A)-I For 220/66/11 kV Power Transformer

Voltage ratio (kV)	**220/66/11**
Rated frequency (Hz)	50
Max. Design Ambient Temp. (°C)	50

Windings		HV	IV	LV
(i)	System Fault level (kA)	40	31.5	18.35
(ii)	1.2/50 micro sec. impulse withstand voltage kVp	±1050	±325	±170
(iii)	One minute power frequency voltage kV(rms)	±460	±140	±70
(iv)	Winding connection	Star	Star	delta
(v)	Neutral	- Solidly grounded -		
(vi)	Insulation	- Solidly grounded -		
(vii)	Vector Group	- YN yn0 d11 –		

(A)-II For 220/33/11 kV Power Transformer

Voltage ratio (kV)	**220/33/11**
Rated frequency (Hz)	50
Max. Design Ambient Temp. (°C)	50

Windings		220kV	33kV	11kV
(i) System Fault level (kA)		40	31.5	18.35
(ii) 1.2/50 µsec. impulse withstand voltage kVp		±1050	±170	±170
(iii) One minute power frequency voltage kV rms		±460	±70	±70
(iv)	Winding connection	Star	Star	delta
(v)	Neutral	- Solidly grounded -		
(vi)	Insulation	- Solidly grounded -		
(vii)	Vector Group	- YN yn0 d11 -		

(B) For 245 kV, 72.5kV & 36kV Circuit Breaker and Isolator

Rated voltage kV (rms)	**245**	**66**	**36**
Rated frequency (Hz)	50	50	50
No. of Poles	3	3	3
Design ambient temperature (°C)	50	50	50

Rated insulation levels :

1) Full wave impulse withstand voltage (1.2/50 µsec.)

- between line terminals and ground	± 1050 kVp	±325 kVp	±170 kVp
- between terminals with circuit breaker open	± 1200 kVp	±375 kVp	±195 kVp
- between terminals with isolator open	± 1200 kVp	±375 kVp	±195 kVp

2) One minute power frequency dry and wet withstand voltage

- between line terminals and ground	460 kV (rms)	±140 kVp	±70kV (rms)
- between terminals with circuit breaker open	530 kV (rms)	As per IEC	As per IEC
- between terminals with Isolator open	530 kV (rms)	As per IEC	As per IEC

3) Max. radio interference voltage (µV) for frequency between 0.5 MHz and 2 MHz in all positions of the equipments.	1000 (at 156 kV rms)	-	-

4) Minimum creepage distance :-

Phase to ground (mm)	6125	1812.5	900
Between CB Terminals (mm)	6125	1812.5	900

5) System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed

6) Seismic acceleration - 0.3g horizontal -

7) Rating of Auxiliary Contacts	- 10 A at 220 V DC -
8) Breaking capacity of Auxiliary contacts	2 A DC with circuit time constant of not less than 20 ms.

Auxiliary Switch shall also comply with other clauses of this chapter.

(C) FOR 245 kV, 72.5kV & 36kV CT/CVT/SA

Rated voltage kV (rms)	**245**	**72.5**	**36**
Rated frequency (Hz)	50	50	50
No. of poles	1	1	1
Design ambient temperature (°C)	50	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	±325 kVp	±170 kVp
- for arrester housing	± 1050 kV peak	±325 kVp	±170 kVp
2) One minute power frequency dry and wet withstand voltage			
- between line terminals and ground for CT and CVT	±460 kV rms	±140 kVp	±70 kV rms
- for arrester housing	±460 kV rms	±140 kVp	± 70kV rms
3) Max. radio interference voltage (µV) 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)		
4) Minimum creepage distance :-			
- Phase to ground (mm)	6125	1812.5	900
5) System neutral earthing	- Effectively earthed -		
6) Seismic acceleration	- 0.3g horizontal -		
7) Partial discharge for :-			
- Surge arrester at 1.05 COV	- Not exceeding 50 pc. -		
- for CT/CVT	- Not exceeding 10 pc. -		

(D) Technical Parameters of Bushings/Hollow Column insulators/support insulators:

	220 kV	**66kV**	**33 kV**
(a) Rated Voltage (kV)	245	72.5	36
(b) Impulse withstand voltage (Dry & Wet) (kVp)	±1050	±325	±170
(c) Power frequency withstand voltage (dry and wet) (kV rms)	±460	±140	±70
(d) Total creepage distance (mm)	6125	1812.5	900

(e) Pollution Class-III Heavy (as per IEC 71) and as specified Section-2 for all class of equipment

(f) Insulator shall also meet requirement of and IEC-815 for 220 kV system, as applicable having alternate long & short sheds.

5.0 ENGINEERING DATA AND DRAWINGS

5.1 The engineering data shall be furnished by the Contractor in accordance with the Schedule for each set of equipment as specified in the Technical Specifications.

5.2 The list of drawings/documents which are to be submitted to the Purchaser shall be discussed and finalised by the Purchaser at the time of award. The Contractor shall necessarily submit all the drawings/ documents unless anything is waived. The Contractor shall submit 4 (four) sets of drawings/ design documents /data/ test reports as may be required for the approval of the Purchaser.

5.3 Drawings

5.3.1 All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

5.3.2 Each drawing submitted by the Contractor shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

5.3.3 Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

5.4 The review of these data by the Purchaser will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Purchaser may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the purchaser shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.5 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

5.6 All engineering data submitted by the Contractor after final process including review and approval by the Purchaser shall form part of the Contract Document and the entire works performed under these specifications shall be performed I strict conformity, unless otherwise expressly requested by the Purchaser in Writing.

5.7 Approval Procedure

The scheduled dates for the submission of the drawings as well as for, any data/information to be furnished by the Purchaser would be discussed and finalised at the time of award. The following schedule shall be followed generally for approval and for providing final documentation.

i)	Approval/comments by Purchaser on initial submission	As per agreed schedule
ii)	Resubmission (whenever from date of Comments required including both ways postal time).	Within3 (three) weeks
iii)	Approval or comments	Within 3 weeks of receipt of resubmission.
iv)	Furnishing of distribution copies in bound volume (5 copies per substation and one copy for Corporate Centre)	2 weeks from the date of final approval
v)	Furnishing of distribution copies of test reports	
(a)	Type test reports (one copy per substation plus one copy for corporate centre)	2 weeks from the date of final approval
(b)	Routine Test Reports	-do

	(one copy for each substation)	
vi)	Furnishing of instruction/ operation manuals (4 copies per substation and two copies for corporate centre)	As per agreed schedule
vii)	RTFs of drawings (one set substation and one set for corporate centre)	-do
(viii)	Video Cassette (VHS-PAL) - highlighting installation and maintenance techniques/ requirements of circuit breaker & isolators (one per substation plus one for corporate centre)	-do
(ix)	As built drawings & RTFs (Two sets per substation plus one set for corporate centre)	On completion of entire works
(x)	ROM optical disks for all As built drawings (one per substation plus one for corporate	-do

NOTE:

(1) The contractor may please note that all resubmissions must incorporate all comments given in the earlier submission by the Purchaser or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

(2) The drawings which are required to be referred frequently during execution should be submitted on cloth lined paper. The list of such drawings shall be finalised with the Contractor at the time of Award.

(3) All major drawings should be submitted in Auto Cad Version 12 or better.

(4) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

(5) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Purchaser.

(6) The Contractor shall furnish to the Purchaser catalogues of spare parts.

5.8 The list of major drawings and General Technical Parameters shall be as per Annexure – D.

6.0 MATERIAL/ WORKMANSHIP

6.1 General Requirement

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

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

6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual

agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads.

The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

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

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

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

6.1.7 All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

6.1.8 A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of design with pads for anchoring the units, shall have a raised up all around and shall have threaded in air connections, if so required.

6.1.9 Corona and radio interference voltage test and seismic withstand test procedures for equipments shall be in line with the procedure given at Annexure-A and B respectively.

6.2 Provisions For Exposure to Hot and Humid climate

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

6.2.1 Space Heaters

6.2.1.1 The heaters shall be suitable for continuous operation at 240 V as supply voltage. On-off switch and fuse shall be provided.

6.2.1.2 One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

6.2.1.3 Suitable anti condensation heaters with the provision of thermostat shall be provided.

6.2.2 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

6.2.3 Ventilation opening

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air / dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

6.2.4 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

a) Installed out door: IP- 55
b) Installed indoor in air conditioned area: IP-31
c) Installed in covered area: IP-52
d) Installed indoor in non air conditioned area where possibility of entry of water is limited: IP-41.
e) For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS:13947 (Part-I)/ IEC-947 (Part-I)/ IS 12063 / IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS

6.3.1 Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

6.3.2 All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators and C & R panels shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

6.4 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into successful Operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

7.0 DESIGN IMPROVEMENTS / COORDINATION

7.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the Purchaser or the Contractor may propose changes in the specification of the equipment or quality thereof and if the Purchaser & contractor agree upon any such changes, the specification shall be modified accordingly.

7.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

7.3 The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, subassemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

7.4 The Contractor has to coordinate designs and terminations with the agencies (if any) who are Consultants/Contractor for the Purchaser. The names of agencies shall be intimated to the successful bidders.

7.5 The Contractor will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Purchaser (if any) during the period of Contract. The Contractor shall attend such meetings at his own cost at New Delhi or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

8.0 QUALITY ASSURANCE PROGRAMME

8.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's Works or at his Sub-contractor's premises or at the Purchaser's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be broadly outlined by the contractor and finalised after discussions before the award of contract. The detailed programme shall be submitted by the contractor after the award of contract and finally accepted by DTL after discussion. However, in case detailed valid programme approved by DTL for the equipment already exist, same would be followed till its validity. A quality assurance programme of the contractor shall generally cover the following:

(a) His organization structure for the management and implementation of the proposed quality assurance program:

(b) Documentation control system;

(c) Qualification data for bidder's key personnel;

(d) The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

(e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;

(f) Control of non-conforming items and system for corrective actions;

(g) Inspection and test procedure both for manufacture and field activities.

(h) Control of calibration and testing of measuring instruments and field activities;

(i) System for indication and appraisal of inspection status;

(j) System for quality audits;

(k) System for 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 Purchaser or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his vendor's quality management and control activities.

8.2 Quality Assurance Documents

The contractor would be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of purchaser's inspection of equipment/material

9.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

9.1 All equipment being supplied shall conform to type tests including additional type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Purchaser reserves the right to witness any or all the type tests. The Contractor shall intimate the Purchaser the detailed program about the tests at least three (3) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

9.2 The reports for all type tests and additional type tests as per technical specification shall be furnished by the Contractor alongwith equipment / material drawings as per relevant IEC with latest amendments. The type tests conducted should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by the representative(s) of DTL or Utility. The test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening.
In case the test reports are of the test conducted earlier than 10 (ten) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to the purchaser.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design / manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

9.3 Bidder shall conduct type tests on equipments other than GIS if required in their respective section.

9.4 The Purchaser, his duly authorised representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractor'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 Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

9.5 The Contractor shall give the Purchaser /Inspector thirty (30) days written notice of any material being ready for joint testing including contractor and DTL. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Purchaser / inspector, unless witnessing of the tests is virtually waived, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed alone with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.

9.6 The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser /Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

9.7 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Purchaser/inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser /Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Engineer/Inspector. Failure of the Purchaser /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of CIP by the Purchaser.

9.8 In all cases where the Contract provides for tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and

instruments as may be reasonably demanded by the Purchaser / Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser / Inspector or to his authorised representative to accomplish testing.

9.9 The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.

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

9.11 The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipments for these tests shall be provided by the Purchaser.

10. TESTS

10.1 Pre-commissioning Tests

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

10.2 Commissioning Tests

10.2.1 The testing equipments required for testing and commissioning shall be arranged by the Contractor.

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

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

11.0 PACKAGING & PROTECTION

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

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

12.0 FINISHING OF METAL SURFACES

12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & bolts and spring washers shall be electro galvanized to service condition 4. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

12.2 HOT DIP GALVANISING

12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq. m and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

12.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

12.2.3 After galvanizing. no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

12.2.4 The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immmersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

12.3 PAINTING

12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

12.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

12.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

12.3.4 The exterior colour of the paint shall be as per shade no: 697 (for outdoor) & 692 (for indoor) of IS-5 and inside shall be glossy white for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

12.3.5 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted alongwith the Bids for Purchaser's review & approval.

12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

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	FIRE RED	Sky Blue

	–Air		
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

13.0 HANDLING, STORING AND INSTALLATION

13.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

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

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

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

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

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

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

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

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

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

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

13.12 Equipment Bases

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have
threaded drain connections.

14.0 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

15.0 AUXILIARY SUPPLY

15.1 The sub-station auxiliary supply is normally met through a system indicated under section "Electrical & Mechanical Auxiliaries" having the following parameters. The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation shall also conform the parameters as indicated in the following.

Normal Voltage connection	Variation in Voltage	Frequency in HZ	Phase /Wire	Neutral
415V	+/- 10%	50 +/- 5%	3/ 4 Wire	Solidly Earthed
240V	+/- 10%	50 +/- 5%	1/ 2 Wire	Solidly Earthed
220V System	190V to240V	DC	-	Isolated 2 wire
50V (+) earthed	_	DC	_	2 wire system

Combined variation of voltage and frequency shall be limited to +/-10%.

16.0 SUPPORT STRUCTURE

The Contractor is required to supply standard structures of various equipments. Bidder may also refer relevant Clauses of Section (Civil) in this regard.

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

17.1 All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below :

a) For connecting ACSR conductors	Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617
b) For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS 617 with 2mm thick bimetallic liner and all test shall conform to IS:617
c) For connecting G.I wire	Galvanised mild steel shield

i) Bolts, nuts & Plain, washers	i) Electrogalvanised for sizes below M12, for others hot dip galvanised.
ii) Spring washers for items 'a' to 'c'	ii) Electro-galvanised mild steel suitable for atleast service condition-3 as per IS:1573

17.2 Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor terminations of equipment shall be either expansion, sliding or rigid type suitable for 4" IPS (OD : 114.2 mm, ID: 97.18 mm) aluminum tube or suitable for Quad/Twin ACSR / AAAC Conductor (250 mm Sub- Conductor spacing for 220 kV). The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

17.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Purchaser by the Contractor.

17.4 Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.

17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body for Bi-metallic clamps.

17.6 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be 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.

17.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

17.10 Clamps and connectors shall be designed to be corona controlled. Corona extinction voltage for 220 kV class clamps shall not be less than 156 kV and R.I.V. level shall not be more than 1000 micro volts at the test voltage specified in respective sections.

17.11 Tests

17.11.1 Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports on three samples of similar type shall be submitted for approval as per clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last five years shall not be applicable).

i) Temperature rise test (maximum temperature rise allowed is 35° C over 50°C ambient)
ii) Short time current test
iii) Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)
iv) Resistance test and tensile test

18.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

18.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-439, as applicable, and the clauses given below:

18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be atleast 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

18.3 Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.

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

18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged/cracked during the ten years of operation of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

18.6 All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connnections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

18.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

18.8 For illumination of a 20 Watts flourscent tube or 15 watts CFL shall be provided. The switching of the fittings shall be controlled by the door switch.

18.9 All control switches shall be of rotary switch type and Toggle/piano switches shall not be accepted. However, Spring return type actuator switch for ON/Off control are acceptable.

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

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

18.12 a) The following routine tests alongwith the routine tests as per IS:5039 shall also be conducted:
i) Check for wiring
ii) Visual and dimension check

b) The enclosure of bay marshalling kiosk, junction box, terminal box shall conform to IP-55 as per IS:13947 including application of, 2.5 KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.

19.0 Auxiliary Switches (Applicable for isolators and circuit breakers)

The following type test reports on auxiliary switches shall be submitted for approval:

(a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of m V drop/visual defects/temperature rise test.

(b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.

(c) Heat run test on contacts.

(d) IR/HV test etc.

20.0 TERMINAL BLOCKS AND WIRING

20.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.

20.2 Terminal blocks shall be 650 V grade and have continuous rating to carry the maximum expected current on the terminals. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be nondisconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wago or equivalent.

20.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

20.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.

20.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.

20.6 The terminal blocks shall be of extensible design.

20.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

20.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

20.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

a) All circuits except Minimum of two of 2.5 sq mm CT circuits copper flexible.
b) All CT circuits Minimum of 4 nos. of 2.5 sq mm copper flexible.

20.10 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.

20.11 Atleast 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

20.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

20.13 The Contractor shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.

20.14 All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The

Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment

21.0 LAMPS AND SOCKETS

21.1 Lamps

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

21.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

21.3 Hand Lamp:

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

21.4 Switches and Fuses:

21.4.1 Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

21.4.2 All fuses shall be of HRC cartridge type conforming to IS: 9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

22.0 Bushings, Hollow Column Insulators, Support Insulators:

22.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5621. The support insulators shall be manufactured and tested as per IS 2544/IEC 168 and IEC 273. The insulators shall also conform to IEC 815 as applicable. The bidder may also offer composite silicon insulator, conforming to IEC-61109.

22.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

22.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

22.4 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

22.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

22.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

22.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

22.8 Tests

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS: 2544 & IS : 5621. The type test reports shall be submitted for approval.

23.0 Motors

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

23.1 Enclosures

a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP 55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP 44 as per IS: 4691.
b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs other means to facilitate lifting.

23.2 Operational Features

a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

23.3 Starting Requirements:

a) All induction motors shall be suitable for full voltage direct-online starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
c) The locked rotor current shall not exceed six (6) times the rate full load current for all motors, subject to tolerance as given in IS: 325.
d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding at least two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.
e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

23.4 Running Requirements:

a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS: 325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

23.5 TESTING AND COMMISSIONING

An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field Q.P./Instructions of the equipment Contractor or Purchaser

without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

(a) Insulation resistance.
(b) Phase sequence and proper direction of rotation.
(c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

24.0 TECHNICAL REQUIREMENT OF EQUIPMENTS

24.1 Circuit Breakers

a. The manufacturer(s) whose Circuit Breaker are offered should have designed, manufactured tested as per IEC/IS or equivalent standard supplied the same for the specified system voltage and which are in satisfactory operation for at least 2 (two) years as on the date of bid opening.

Or

b. The manufacturer(s) whose Circuit Breaker are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 24.1.a given above.

And

Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

24.2 Isolators

The manufacturer whose isolators are offered, should have designed, manufactured, tested as per IEC/IS or equivalent standard and supplied the isolator for the specified system voltage and fault level and should be in satisfactory operation for at least 2 (two) years as on the date of bid opening.

24.3 Instrument Transformers

The manufacturer whose instrument transformers are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the same for the specified system voltage for CT & CVT and fault level in case of CT. These equipment should be in satisfactory operation for at least 2 (two) years as on the date of bid opening.

24.4 Surge Arresters

The manufacturer whose Surge Arresters are offered should have designed, manufactured and tested as per IEC/IS or equivalent standard and supplied the Surge Arrester for the specified energy capability with rated system voltage and which are in satisfactory operation for at least 2 (two) years as on the date of bid opening.

24.5 1.1 kV Grade Power & Control Cables

24.5.1 Applicable for PVC Control Cable

The manufacturers, whose PVC control cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 Kms of 1.1 kV grade PVC insulated control cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 27C x 2.5 Sq.mm or higher size as on the date of bid opening.

24.5.2 Applicable for PVC Power Cable

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

24.5.3 Applicable for XLPE Power Cables

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

24.6 LT Switchgear

24.6.1 The Manufacturer whose LT Switchgear are offered, should be a manufacturer of LT Switchboards of the type and rating being offered. He should have designed, manufactured, tested and supplied at least 50 nos. draw out circuit breaker panels, out of which at least 5 nos. should have been with relay and protection schemes with current transformer. He should have also manufactured at least 50 nos . m otor control c enter pane ls of t he t ype an d r ating b eing of fered w hich should b e i n successful operation as on date of bid opening.

24.6.2 The Switchgear items (such as circuit breakers, fuse switch units, contactors etc.), may be of his own m ake or s hall be pr ocured f rom reputed m anufacturers and of pr oven de sign. At l east o ne hundred circuit breakers of the make and type being offered shall be operating satisfactory as on date of bid opening.

24.7 Battery and Battery Charger

24.7.1 Requirements for Battery Manufacturers

The manufacturer whose Batteries are offered should have designed, manufactured and supplied DC B atteries of t he t ype s pecified a nd being of fered, hav ing a c apacity of at l east 600 A H a nd these shall be operating satisfactorily for two years in power sector and/or industrial installations as on date of bid opening.

24.7.2 Requirements for Battery Charger Manufacturers

The manufacturer, whose Battery Chargers are offered, should have designed, manufactured and supplied Battery C hargers generally of the t ype of fered, with s tatic aut omatic v oltage r egulators and having a continuous output of atleast ten (10) KW and these should be in successful as on the date of bid opening.

24.8 LT Transformers

The manufacturer, w hose t ransformers ar e of fered s hould ha ve d esigned, m anufactured, t ype tested including short circuit test as per IEC/IS or equivalent standards and supplied transformers of at l east 33 k V c lass of 800 k VA or hi gher. T he t ransformer should h ave be en i n s uccessful operation for at least 2 years as on the date of bid opening.

24.9 Fire Fighting System

Nitrogen I njection F ire Prevention a nd Extinguishing System s hall be used f or f ire pr otection of Transformer. In addition fire protection wall shall be erected between the two transformers which have adjacent base. Portable Fire Extinguishers shall also be provided.

24.10 Control and Relay Panels

24.10.1 The m anufacturer w hose C&R panels a nd protective r elay are of fered should have des igned, manufactured, tested, installed and commissioned C&R panels including protection relays which must be in satisfactory operation on 220 kV system for atleast 2 (two) years on the date of bid opening.

24.10.2 The C&R P anel f rom a manufacturer w hose have designed, manufactured, tested, installed a nd commissioned C &R pan els w hich are i n s atisfactory oper ation on 2 20 k V s ystem for at least 2 (two) years on the date of bid opening can also be offered, provided the protective relay schemes should be of fered f rom a Contractor who fully m eets t he r equirements s tipulated under c lause 24.10.1 abo ve. Further, i n s uch an event t he m anufacturer s hall f urnish an undertaking jointly executed by him and his protective relay schemes Supplier, as per the format enclosed in the bid documents for successful performance of the protection system offered.

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ANNEXURE-A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

Unless otherwise stipulated, all equipment (except Auto Transformer) together with its associated connectors, where applicable, shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV).

2. Test Levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3. Test Methods for RIV:

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 Mhz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 220 kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4.0 Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130% of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 130 %, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, 115% and 130%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall been such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

4.1 The test shall be recorded on each photograph. Additonal photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.

4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5. Test Records:

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

a) Background noise before and after test.
b) Detailed procedure of application of test voltage.
c) Measurements of RIV levels expressed in micro volts at each level.
d) Results and observations with regard to location and type interference sources detected at each step.
e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE – B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (except Auto Transformer) shall be carried out alongwith supporting structure. The Bidder shall arrange to transport the structure from his Contractor's premises/DTL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Purchaser.

ANNEXURE - C

LIST OF SPECIFICATIONS

GENERAL STANDARDS AND CODES

India Electricity Rules
Indian Electricity Act
Indian Electricity (Supply) Act
Indian Factories Act

IS-5,	-	Colors for Ready Mixed Paints and Enamels.
IS-335,	-	New Insulating Oils.
IS-617,	-	Aluminium and Aluminium Alloy Ingots and
	-	Castings for General Engineering Purposes
IS-1448 (P1 to P 145)	-	Methods of Test for Petroleum and its Products.
IS-2071 (P1 to P3)	-	Methods of High Voltage Testing.
IS-12063	-	Classification of degrees of protection provided by enclosures of electrical equipment.
IS-2165 P1:1997 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 for Radio Interference Test on High voltage Insulators.
IS-9224 (Part 1,2&4)	-	Low Voltage Fuses
IEC-60060 (Part 1 to P4)	-	High Voltage Test Techniques
IEC 60068	-	Environmental Test
IEC-60117	-	Graphical Symbols
IEC-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-60694	-	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 & 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 atmospheres.
IS-3639	-	Fittings and Accessories for Power Transformers
IS-6600	-	Guide for Loading of Oil immersed Transformers.
IEC-60076 (Part 1 to Part 5)	-	Power Transformers
IEC-60214	-	On-Load Tap-Changers.
IEC-60289	-	Reactors.
IEC- 60354	-	Loading Guide for Oil - Immersed power transformers
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 Alternating Current Breakers
IEC-60427	-	Synthetic Testing of High Voltage alternating current circuit Breakers.
IEC-61264	-	Pressurised Hollow Column Insulators

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 the Contents of Industrial Gas Cylinders
IEC-60044-1	-	Current transformers.
IEC-60044-2	-	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		
IS-2099	-	Bushings for Alternating Voltages above1000V
IEC-60137	-	Insulated Bushings for Alternating Voltages above1000V

SURGE ARRESTERS

IS-3070 (PART2)	-	Lightning arresters 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, 3231 (P-3)	-	Electrical relays for power system 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 Swtichgear 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
IS: 8623: (Part I to 3)	-	Specification for Switchgear & Control Assemblies.
NEMA-AB	-	Moulded Case Circuit and Systems
NEMA-CS	-	Industrial Controls and Systems
NEMA-PB-1	-	Panel Boards
NEMA-SG-5	-	Low voltage Power Circuit breakers
NEMA-SG-3	-	Power Switchgear Assemblies
NEMA-SG-6	-	Power switching Equipment
NEMA-5E-3	-	Motor Control Centers
1248 (P1 to P9)	-	Direct acting indicating analogue electrical measuring instruments & their accessories.

Disconnecting switches

IEC-60129	-	Alternating Current Disconnectors (Isolators) and Earthing switches
IEC-1129	-	Alternating Current Earthing Switches Induced Current switching
IEC-60265 (Part 1 & Part 2)	-	High Voltage switches
ANSI-C37.32	-	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories
ANSI-C37.34	-	Test Code for high voltage air switches
NEMA-SG6	-	Power switching equipment

PLCC and line traps

IS-8792	-	Line traps for AC power system.
IS-8793	-	Methods of tests for line traps.
IS-8997	-	Coupling devices for PLC systems.
IS-8998	-	Methods of test for coupling devices for PLC systems.
IEC-60353	-	Line traps for A.C. power systems.
IEC-60481	-	Coupling Devices for power line carrier systems.
IEC-60495	-	Single sideboard power line carrier terminals
IEC-60683	-	Planning of (single Side-Band) power line carrier systems.
CIGRE	-	Teleprotection report by Committee 34 & 35.
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 part 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	-	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 headbolts, screws and nuts of product grade C.
IS-1364 (P1 to P5)	-	Hexagon head bolts, screws and nuts of products grades A and B.
IS-3138	-	Hexagonal Bolts and Nuts (M42 to M150)
ISO-898	-	Fasteners: Bolts, screws and studs
ASTM	-	Specification and tests for materials

Clamps & connectors

IS-5561	-	Electric power connectors.
NEMA-CC1	-	Electric Power connectors for sub station
NEMA-CC 3	-	Connectors for Use between aluminium or aluminum- Copper Overhead Conductors

Bus hardware and insulators

IS: 2121	-	Fittings for Aluminum and steel cored Al conductors for overhead power lines.
IS-731	-	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V.
IS-2486 (P1 to P4)	-	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V.
IEC-60120	-	Dimensions of Ball and Socket Couplings of string insulator units.
IEC-60137	-	Insulated bushings for alternating voltages above 1000 V.
IEC-60168	-	Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V.
IEC-60233	-	Tests on Hollow Insulators for use in electrical equipment.
IEC-60273	-	Characteristices of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
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 porcelain insulators
ANSI-C29.1	-	Test methods for electrical power insulators
ANSI-C92.2	-	For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8	-	For wet-process porcelain insulators apparatus, post-type
ANSI-G.8	-	Iron and steel hardware
CISPR-7B	-	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153	-	Zinc Coating (Hot-Dip) on iron and steel hardware

Strain and rigid bus-conductor

IS-2678	-	Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube.
IS-5082	-	Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical purposes.
ASTM-B 230-82	-	Aluminum 1350 H19 Wire for electrical purposes
ASTM-B 231-81	-	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	-	Aluminum - Alloy extruded bar, road, wire, shape
ASTM-B 236-83	-	Aluminum bars for electrical purpose (Busbars)
ASTM-B 317-83	-	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes(Bus Conductors)

Batteries and batteries charger Battery

IS:1651	-	Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652	-	Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146	-	Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071	-	Synthetic Separators for Lead-Acid Batteries
IS:266	-	Specification for Sulphuric Acid
IS:1069	-	Specification for Water for Storage Batteries
IS:3116	-	Specification for Sealing Compound for Lead-Acid Batteries
IS:1248	-	Indicating Instruments

Battery Charger

IS:3895	-	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS:4540	-	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment.
IS:6619	-	Safety Code for Semiconductor Rectifier Equipment
IS:2026	-	Power Transformers
IS:2959	-	AC Contactors for Voltages not Exceeding 1000 Volts
IS:1248	-	Indicating Instruments
IS:2208	-	HRC Fuses
IS:13947 (Part-3)	-	Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC
IS:2147	-	Degree of protection provided by enclosures for low voltage switchgear and controlgear.
IS:6005	-	Code of practice for phosphating of Iron and Steel
IS:3231	-	Electrical relays for power system protection
IS:3842	-	Electrical relay for AC Systems
IS:5	-	Colours for ready mix paint
IEEE-484	-	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations.
IEEE-485	-	Sizing large lead storage batteries for generating stations and substations

Wires and cables

ASTMD-2863	-	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	-	PVC insulated cables for working voltages upto and including 1100 Volts.
IS-1255	-	Code of practice for installation and maintenance of power cables, upto and including 33 kV rating
IS-1554 (P1 and P2)	-	PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V.
	-	Part (2) for working voltage from 3.3 kV upto and including 11kV.
IS:1753	-	Aluminium conductor for insulated cables
IS:2982	-	Copper Conductor in insulated cables.
IS-3961 (P1 to P5)	-	Recommended current ratings for cables.
IS-3975	-	Mild steel wires, formed wires and tapes for armouring of cables.
IS-5831	-	PVC insulating and sheath of electric cables.
IS-6380	-	Elastometric insulating and sheath of electric cables.
IS-7098	-	Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts.
IS-7098	-	Cross-linked polyethyle insulated PVC sheathed cables for working voltage from 3.3kV upto and including 33 kV.
IS-8130	-	Conductors for insulated electrical cables and flexible cords.
IS-1753	-	Aluminum Conductors for insulated cables.
IS-10418	-	Specification for drums for electric cables.
IEC-60096 (part 0 to p4)	-	Radio Frequency cables.
IEC-60183	-	Guide to the Selection of High Voltage Cables.
IEC-60189 (P1 to P7)	-	Low frequency cables and wires with PVC insulation and PVC sheath.
IEC-60227 (P1 to P7)	-	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V.
IEC-60228	-	Conductors of insulated cables
IEC-60230	-	Impulse tests on cables and their accessories.
IEC-60287 (P1 to P3)	-	alculation of the continuous current rating of cables (100% load factor).
IEC-60304	-	Standard colours for insulation for low frequency cables and wires.
IEC-60331	-	Fire resisting characteristics of Electric cables.
IEC-60332 (P1 to P3)	-	Tests on electric cables under fire conditions.
IEC-60502	-	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV
IEC-754 (P1 and P2)	-	Tests on gases evolved during combustion of electric cables.

AIR conditioning and ventilation

IS-659	-	Safety code for air conditioning
IS-660	-	Safety code for Mechanical Refrigeration
ARI:520	-	Standard for Positive Displacement Refrigeration Compressor and Condensing Units
IS:4503	-	Shell and tube type heat exchanger
ASHRAE-24	-	Method of testing for rating of liquid coolers
ANSI-B-31.5	-	Refrigeration Piping
IS:2062	-	Steel for general structural purposes
IS:655	-	Specification for Metal Air Dust
IS:277	-	Specification for Galvanised Steel Sheets
IS-737	-	Specification for Wrought Aluminium and Aluminium Sheet & Strip
IS-1079	-	Hot rolled cast steel sheet & strip
IS-3588	-	Specification for Electrical Axial Flow Fans
IS-2312	-	Propeller Type AC Ventilation Fans
BS-848	-	Methods of Performance Test for Fans
BS-6540 Part-I	-	Air Filters used in Air Conditioning and General Ventilation
BS-3928	-	Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors)
US-PED-2098	-	Method of cold DOP & hot DOP test
MIL-STD-282	-	DOP smoke penetration method
ASHRAE-52	-	Air cleaning device used in general ventilation for removing particle matter
IS:3069	-	Glossary of Terms, Symbols and Units Relating to Thermal Insulation Materials.

IS:4671	-	Expanded Polystyrene for Thermal Insulation Purposes
IS:8183	-	Bonded Mineral Wool
IS:3346	-	Evaluation of Thermal Conductivity properties by means of guarded hot plate method
ASTM-C-591-69	-	Standard specification for rigid preformed cellular urethane thermal insulation
IS:4894	-	Centrifugal Fans
BS:848	-	Method of Performance Test for Centrifugal Fans
IS:325	-	Induction motors, three-phase
IS:4722	-	Rotating electrical machines
IS:1231	-	Three phase foot mounted Induction motors, dimensions of
IS:2233	-	Designations of types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Vertical shaft motors for pumps, dimensions of
IS:7816	-	Guide for testing insulation resistance of rotating machines
IS:4029	-	Guide for testing three phase induction motors
IS:4729	-	Rotating electrical machines, vibration of, Measurement and evaluation of
IS:469	-	Degree of protection provided by enclosures for rotating electrical machinery
IS:7572	-	Guide for testing single-phase a.c. motors
IS:2148	-	Flame proof enclosure for electrical apparatus
BS:4999 (Part-51)	-	Noise levels

Galvanizing

IS-209	-	Zinc Ingot
IS-2629	-	Recommended Practice for Hot-Dip galvanizing on iron and steel.
IS-2633	-	Methods for testing uniformity of coating of zinc coated articles.
ASTM-A123	-	Specification for zinc (Hot Galavanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.
ASTM-A-121-77	-	Zinc-coated (Galvanized) steel barbed wire

Painting

IS-6005	-	Code of practice for phosphating of iron and steel.
ANSI-Z551	-	Gray finishes for industrial apparatus and equipment
SSPEC	-	Steel structure painting council

Fire protection system

Fire protection manul issued by tariff advisory committee (TAC) of India

HORIZONTAL CENTRIFUGAL PUMPS

IS:1520	-	Horizontal centrifugal pumps for clear, cold and fresh water
IS:9137	-	Code for acceptance test for centrifugal & axial pumps
IS:5120	-	Technical requirement – Roto dynamic special purpose pumps
API-610	-	Centrifugal pumps for general services
	-	Hydraulic Institutes Standards
BS:599	-	Methods of testing pumps
PTC-8.2	-	Power Test Codes - Centrifugal pumps

DIESEL ENGINES

IS:10000	-	Methods of tests for internal combustion engines
IS:10002	-	Specification for performance requirements for onstant speed mpression ignition engines for general purposes (above 20 kW)
BS:5514	-	The performance of reciprocating compression ignition (Diesel) engines, utilising liquid fuel only, for general purposes
ISO:3046	-	Reciprocating internal combustion engines performance
IS:554	-	Dimensions for pipe threads where pressure tight joints are required on threads
ASME Power Test Code	-	Internal combustion engine PTC-17
	-	Codes of Diesel Engine Manufacturer's Association, USA

PIPING VALVES & SPECIALITIES

IS:636	-	Non percolating flexible fire fighting delivery hose
IS:638	-	Sheet rubber jointing and rubber inserting jointing
IS:778	-	Gun metal gate, globe and check valves for general purpose
IS:78	-	Sluice valves for water works purposes (50 to300 mm)
IS:901	-	Couplings, double male and double female instantaneous pattern for fire fighting
IS:902	-	Suction hose couplings for fire fighting purposes
IS:903	-	Fire hose delivery couplings branch pipe nozzles and nozzle spanner
IS:1538	-	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903	-	Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062	-	SP for weldable structural steel
IS:2379	-	Colour Code for the identification of pipelines
IS:2643	-	Dimensions of pipe threads for fastening purposes
IS:2685	-	Code of Practice for selection, installation and maintenance of sluice valves
IS:2906	-	Sluice valves for water-works purposes (350to 1200 mm size)
IS:3582	-	Basket strainers for fire fighting purposes (cylindrical type)
IS:3589	-	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038	-	Foot valves for water works purposes
IS:4927	-	Unlined flax canvas hose for fire fighting
IS:5290	-	Landing valves (internal hydrant)
IS:5312	-	Swing check type reflex (non-return) valves(Part-I)
IS:5306	-	Code of practice for fire extinguishing installations and equipment on premises
Part-I	-	Hydrant systems, hose reels and foam inlets
Part-II	-	Sprinkler systems
BS:5150	-	Specification for cast iron gate valves

MOTORS & ANNUNCIATION PANELS

IS:325	-	Three phase induction motors
IS:900	-	Code of practice for installation and maintenance of induction motors
IS:996	-	Single phase small AC and universal electric motors
IS:1231	-	Dimensions of three phase foot mounted induction motors
IS:2148	-	Flame proof enclosure of electrical apparatus
IS:2223	-	Dimensions of flange mounted AC induction motors
IS:2253	-	Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Dimensions of vertical shaft motors for pumps
IS:3202	-	Code of practice for climate proofing of electrical equipment
IS:4029	-	Guide for testing three phase induction motors
IS:4691	-	Degree of protection provided by enclosure for rotating electrical machinery
IS:472	-	Rotating electrical machines
IS:4729	-	Measurement and evaluation of vibration of rotating electrical machines
IS:5572	-	Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362	-	Designation of methods of cooling for rotating electrical machines
IS:6381	-	Construction and testing of electrical apparatus with type of protection‘e’
IS:7816	-	Guide for testing insulation for rotating machine
IS:4064	-	Air break switches
IEC DOCUMENT 2 (Control Office) 432	-	Three Phase Induction Motor
VDE 0530 Part I/66	-	Three Phase Induction Motor
IS:9224 (Part-II)	-	HRC Fuses
IS:6875	-	Push Button and Control Switches
IS:694	-	PVC Insulated cables
IS:1248	-	Indicating instruments

IS:375	-	Auxiliary wiring & busbar markings
IS:2147	-	Degree of protection
IS:5	-	Colour Relay and timers
IS:2959	-	Contactors

PG Test Procedures

NFPA-13	-	Standard for the installation of sprinkler system.
NFPA-15	-	Standard for water spray fixed system for the fire protection
NFPA-12A	-	Standard for Halong 1301 Fire Extinguishing System.
NFPA-72E (Latest Edition)	-	Standard on Antomatic Fire Detectors Fire Protection Manual by TAC
NFPA-12	-	Standard on Carbon dioxide extinguisher systems.
IS:3034	-	Fire of industrial building: Electrical generating and distributing stations code of practice
IS:2878	-	CO2 (Carbon dioxide) Type Extinguisher
IS:2171	-	DC (Dry Chemical Powder) type
IS:940	-	Pressurised Water Type

D.G. SET

IS:10002	-	Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes
IS:10000	-	Method of tests for internal combustion engines
IS:4722	-	Rotating electrical machines-specification
IS:12063	-	Degree of protection provided by enclosures
IS:12065	-	Permissible limit of noise levels for rotating electrical machines.
	-	Indian Explosive Act 1932

Steel structures

IS-228 (1992)	-	Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P1 to 3:)	-	Code of practice for use of structural steel in overhead transmission line towers.
IS-806	-	Code of practice for use of steel tubes in general building construction
IS-808	-	Dimensions for hot rolled steel beam, column channel and angle sections.
IS-814	-	Covered electrodes for manual arc welding of carbon 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 & nuts of products grade C.
IS-1364	-	Hexagon headbolts, screws and nuts of product grades A and B.
IS-1367 (P1 to P18)	-	Technical supply condition for threaded steel fasteners.
IS-1599	-	Methods for bend test.
IS-1608	-	Method for tensile testing of steel products.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-1978	-	Line Pipe.
IS-2062	-	Steel for general structural purposes.
IS-2595	-	Code of practice for Radiographic testing.
IS-3063	-	Single coil rectagular section spring washers for bolts, nuts and screws.
IS-3664	-	Code of practice for ultrasonic pulse echo testing by contact and immersion methods.
IS-7205	-	Safety code for erection of structural steel work.
IS-9595	-	Recommendations for metal arc welding of carbon and carbon

		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 and 2)	-	Mild steel tubes, tubulars 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 hotdipped, zinc coated welded and seamless
ASTM-A106	-	Seamless carbon steel pipe for high temperature service
ASTM-A284	-	Low and intermediate tensile strength carbonsilicon 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 piple threads
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

Other civil works standards

IS-269	-	33 grade ordinary portland cement.
IS2721	-	Galvanized steel chain link fence fabric

IS-278	-	Galvanized steel barbed wire for fencing.
IS-383	-	Coarse and fine aggregates from natural sources for concrete.
IS-432 (P1 and P2)	-	Mild steel and medium tensile steel bars and hard-dawn steel wire for concrete reinforcement.
IS-456	-	Code of practice for plain and reinforced concrete.
IS-516	-	Method of test for strength of concrete.
IS-800	-	Code of practice for general construction in steel.
IS-806	-	Steel tubes for structural purposes.
IS-1172	-	Basic requirements for water supply, drainage and sanitation.
IS-1199	-	Methods of sampling and analysis of concrete.
IS-1566	-	Hard-dawn steel wire fabric for concrete reinforcement.
IS-1742	-	Code of Practice for Building drainage.
IS-1785	-	Plain hard-drawn steel wire for prestressed concrete.
IS-1786	-	High strength deformed Steel Bars and wires for concrete reinforcement.
IS-1811	-	Methods of sampling Foundry sands.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-2062	-	Steel for general structural purposes.
IS-2064	-	Selection, installation and maintenance of sanitary appliances- code of practices.
IS-2065	-	Code of practice for water supply in buildings.
IS-2090	-	High tension steel bars used in prestressed concrete.
IS-2140	-	Standard Galvanized steel wire for fencing.
IS-2470 (P1 & P2)	-	Code of practice for installation of septic tanks.
IS-2514	-	Concrete vibrating tables.
IS-2645	-	Integral cement waterproofing compounds.
IS-3025 (Part 1 to Part 48)	-	Methods of sampling and test (Physical and chemical) for water and waste water.
IS-4091	-	Code of practice for design and construction of foundations for transmission line towers and poles.
IS-4111 (Part 1 to P5)	-	Code of practice for ancillary structures in sewerage system.
IS-4990	-	Plywood for concrete shuttering work.
IS-5600	-	Sewage and drainage pumps.

National building code of India 1970

USBR E12	-	Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81	-	Zinc/Coated steel chain link fence fabric
ASTM-D1557-80	-	test for moisture-density relation of soils using 10-lb (4.5 kg) rame land 18-in. (457 mm) Drop.
ASTM-D1586	-	Penetration Test and Split-Barrel (1967) - Sampling of Soils
ASTM-D2049-69	-	Test Method for Relative Density of Cohesionless Soils
ASTM-D2435	-	Test method for Unconsolidated, (1982)
	-	Undrained Strengths of Cohesive Soils in Triaxial Compression.
BS-5075	-	Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures.
CPWD	-	Latest CPWD specifications

ACSR MOOSE CONDUCTOR

IS:6745	Methods for Determination of BS:443-1969 Mass of zinc coating on zinc coated Iron and Steel Articles
IS:8263	Methods for Radio Interference IEC:437-1973Test on High Voltage Insulators NEMA:107-1964 CISPR
IS:209	Zinc Ingot BS:3436-1961
IS:398	Aluminum Conductors for IEC:209-1966
Part – V	Overhead Transmission Purposes
BS:215(Part-II)	Aluminium Conductors galvanized IEC:209- forced extra high

BS:215(Part-II)	voltage (400 kV and above)
IS:1778	Reels and Drums forBS:1559-1949 Bare Conductors
IS:1521	Method for Tensile Testing ISO/R89-1959 of steel wire
IS:2629	Recommended practice for Hot dip Galvanising on Iro and Steel.
IS:2633	Method for Testing Uniformity of coating of zinc Coated Articles.
IS:4826	Hot dip galvanised coatings on round steel wires ASTMA-472-729

GALVANISED STEEL EARTHWIRE

IS:1521	Method for Tensile Testing ISO/R:89-1959 of Steel Wire
IS:1778	Reels and Drums for Bare Conductors
IS:2629	Recommended practice forHot Dip Galvanising on Ironand Steel.
IS:2633	Methods for testing Uniformityof Coating of Zinc Coated Articles.
IS:4826	Hot dip Galvanised Coatings ASTM:A 475-72 a on Round Steel Wires BS:443-1969
IS:6745	Method for Determination BS:443-1969of mass of Zinc Coating on Zinc coated Iron and Steel Articles.
IS:209	Zinc ingot BS:3463-1961
IS:398(Pt. I to P5:1992)	Aluminum Conductors for BS:215 (Part-II) overhead transmission purposes.

Lighting Fixtures and Accessories

(i)	IS:1913	General and safety requirements for electric lighting fittings.
(ii)	IS:3528	Water proof electric lighting fittings.
(iii)	IS:4012	Dust proof electric lighting fittings.
(iv)	IS:4013	Dust tight proof electric lighting fittings.
(v)	IS:10322	Industrial lighting fittings with metal reflectors.
(vi)	IS:10322	Industrial lighting fittings with plastic reflectors.
(vii)	IS:2206	Well glass lighting fittings for use under ground in mines (non-flameproof type).
(viii)	IS:10322	Specification for flood light.
(ix)	IS:10322	Specification for decorative lighting outfits.
(x)	IS:10322	Lumanaries for street lighting
(xi)	IS:2418	Tubular flourescent lamps
(xii)	IS:9900	High pressure mercury vapour lamps.
(xiii)	IS:1258	Specification for Bayonet lamp flourescent lamp.
(xiv)	IS:3323	Bi-pin lamp holder tubular flourescent lamps.
(xv)	IS:1534 (Part-I)	Ballasts for use in flourescent lighting fittings.
(xvi)	IS:1569	Capacitors for use in fluorescent lighting fittings
(xvii)	IS:2215	Starters for flourescent lamps.
(xviii)	IS:3324	Holders for starters for tubular flourescent lamps
(xix)	IS:418	GLS lamps
(xx)	IS:3553	Water tight electric fittings
(xxi)	IS:2713	Tubular steel poles
(xxii)	IS:280	MS wire for general engg. purposes

Conduits, Accessories and Junction Boxes

(1)	IS:9537	Rigid steel conduits for electrical wiring
(2)	IS:3480	Flexible steel conduits for electrical wiring
(3)	IS:2667	Fittings for rigid steel conduits for electrical wiring
(4)	IS:3837	Accessories for rigid steel conduits for electrical wiring
(5)	IS:4649	Adaptors for flexible steel conduits.
(6)	IS:5133	Steel and Cast Iron Boxes
(7)	IS:2629	Hot dip galvanising of Iron & Steel.

Lighting Panels

(1)	IS:13947	LV Switchgear and Control gear(Part 1to 5)
(2)	IS:8828	Circuit breakers for over current protection for house hold and similar installations.
(3)	IS:5	Ready mix paints
(4)	IS:2551	Danger notice plates
(5)	IS:2705	Current transformers
(6)	IS:9224 650V(Part-2)	HRC Cartridge fuse links for voltage above
(7)	IS:5082	Wrought aluminium and Al. alloys, bars, rods, tubes and sections for electrical purposes.
(8)	IS:8623	Factory built Assemblies of Switchgear and Control Gear for voltages upto and including 1000V AC and 1200V DC.
(9)	IS:1248	Direct Acting electrical indicating instrument

Electrical Installation

(1) IS:1293	3 pin plug
(2) IS:371	Two to three ceiling roses
(3) IS:3854	Switches for domestic and similar purposes
(4) IS:5216	Guide for safety procedures and practices in electrical work.
(5) IS:732	Code of practice for electrical wiring installation (system voltage not exceeding 650 Volts.)
(6) IS:3043	Code of practice for earthing.
(7) IS:3646	Code of practice of interior illumination part II & III.
(8) IS:1944	Code of practice for lighting of public through fares.
(9) IS:5571	Guide for selection of electrical equipment for hazardous areas.
(10) IS:800	Code of practice for use of structural steel in general building construction.
(11) IS:2633	Methods of Testing uniformity of coating on zinc coated articles.
(12) IS:6005	Code of practice for phosphating iron and steel.
(13)	INDIAN ELECTRICITY ACT
(14)	INDIAN ELECTRICITY RULES

LT SWITCHGEAR

IS:8623 (Part-I)	Specification for low voltage switchgear and control gear assemblies
IS:13947 (Part-I)	Specification for low voltage switchgear and control gear, Part 1 General Rules
IS:13947 (part-2)	Specification for low voltage switchgear and control gear, Part 2 circuit breakers.
IS:13947 (part-3)	Specification for low voltage switchgear and control gear. Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4)	Specification for low voltage switchgear and control Gear. Part 4 Contactors and motors starters.
IS:13947 (part-5)	Specification for low voltage switchgear and control gear. Part 5 Control-circuit devices and switching elements
IS:13947 (part-6)	Specification for low voltage switchgear and control gear. Part 6 Multiple function switching devices.
IS:13947 (part-7)	Specification for low voltage switchgear and control gear. Part 7 Ancillary equipments
IS:12063	Degree of protection provided by enclosures
IS:2705	Current Transformers
IS:3156	Voltage Transformers

IS:3231	Electrical relays for power system protection
IS:1248	Electrical indicating instruments
IS:722 AC	Electricity meters
IS:5578	Guide for Marking of insulated conductors of apparatus terminals
IS:13703 (part 1)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 1 General Requirements
IS:13703 (part 2)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 2 Fuses for use of authorized persons
IS:6005	Code of practice of phosphating iron and steel
IS:5082	Wrought Aluminum and Aluminum alloys for electrical purposes
IS:2633	Hot dip galvanising

ANNEXURE – D

LIST OF DRAWINGS/DOCUMENTS

1. Single Line Diagram
2. Electrical Layout – Plan and Sections
3. Switchyard structural Layout and Section
4. DSLP Calculation and drawing
5. Earthmat Design
6. Short circuit Force and Critical Span Calculations
7. Busbar Design calculations
8. Cantilever Strength calculations
9. Design calculation for Sag – Tension stringing chart
10. GTP and drawings for Bus-Post Insulator
11. Tension/suspension string insulator and Hardware Assembly GTP and drawing
12. Structure Layout (Plan & Section) drawing
13. Soil Investigation Report

14. **Circuit Breakers (220kV and 33kV)**
    - GA drawing
    - GTP
    - Type test Reports
15. **CTs (220kV and 33kV)**
    - GA drawing
    - GTP
    - Type test Reports
16. **Surge Arrestors (216kV and 30kV)**
    - GA drawing
    - GTP
    - Type test Reports
17. **Isolators (220kV and 33kV)**
    - GA drawing
    - GTP
    - Type test Reports
18. **220kV Transformers (220/33/11kV)**
    - Outline GA drawings
    - Foundation Plan
    - Data Sheet
    - OLTC GA drawing/schematic
    - RTCC GA drawing/schematic
    - OGA and Data sheets for Bushing
    - GA and schematic of Marshalling Kiosk
    - Rating and Diagram Plate
    - Type test Reports
19. **Control and Relay Panels**
    - GTP and technical literature
    - Type test report of Relays/Relays/Equipments
20. **Civil Works**

    Boundary wall

    Control Room Building
    - Structure Design, Foundation Design & Drg., Plinth Beam Design & Drg. and column Design & Drg. upto G.F. Level
    - Transformer foundation design/drawings
    - 220kV Tower foundation design/drawings.

SECTION-IV

SPECIAL EQUIPMENTS

SECTION : 4

SPECIAL EQUIPMENTS

TECHNICAL SPECIFICATION FOR SPECIAL EQUIPMENTS

This part of the document covers detailed technical requirement for the diagnostic tools complete with associated components and accessories including required software for storage of data and interpretation of results etc.

1.0 DEW POINT METER.

The meter shall be capable of measuring the dew point of SF6 gas of the circuit breaker/GIS equipment. It should be portable and adequately protected for outdoor use. The meter shall be provided with dew point hygrometer with digital indication to display the dew point temperature in degree C, degree F or PPM. It should be capable of measuring the corresponding pressure at which dew point is being measured.

The measurement and use of the instrument must be simple, direct without the use of any other material /chemical like dry ice/acetone etc. It should be battery operated with rechargeable batteries.

TECHNICAL SPECIFICATION:

1. Measuring Range: Upto-100 º C dew point.
2. Accuracy : ± 2 º C.
3. Display : 4 digit LCD , 0.5 inch high.

2.0 PORTABLE PD MONITORING SYSTEM FOR GAS INSULATED SWITCHGEAR

DELETED

3.0 THREE PHASE AUTOMATION RELAY TEST KIT.

The test kit/set should be capable of performing the following functions in automatic as well as in manual mode.

1. "Steady state" testing of current, voltage, frequency and impedance relays to test the characteristic of protective relays.
2. Testing of over fluxing relay and check synchronizing relay.
3. Testing of electro-mechanical backup over-current relays for operating current upto 2x, 5x and 10x rated current (minimum pickup instantaneous and time delayed characteristics).
4. Testing of frequency relays for rate of change of frequency, minimum pickup, pickup to drop out ratio, under/over frequency setting and time characteristics.
5. Testing of distance relays of three phase including features such as power swing blocking, switch on to fault and when connected to weak system.
6. Testing of voltage relay for pickup to drop out ratio, instantaneous and time delayed characteristics.
7. Testing of three winding differential relays (9 current sources) including checking of Percentage Bias, Inrush stability, Over excitation stability.
8. Programmable Relay test kit should work as—
   i) Relay test tool for all type of relays mentioned.
   ii) "Database" to document relay settings.
   iii) Storage of test history.
9. Software programme should be menu driven and should run on Microsoft Windows(98, NT.2000 or latest version).
10. The test programme/plan should allow user to define the control parameters to control changes to magnitude, phase and frequency of selected source values and allow user to :
    i) Ramp up/down (at user defined rates) to test the pick up/ dropout values.
    ii) Step up/step down the magnitude, phase angle of frequency.

iii) Quickly find the pick up value.
iv) Test the characteristic angle for impendence relays/ directional relays.

11. The programmable/automatic Relay test kit should be capable of doing simulation of power system states like pre-fault, fault and post fault conditions for dynamic state testing.
12. Test program/plan should enable user of creating a number of system states to test protection scheme/relay for realistic fault conditions and should be capable to calculation voltage and current phasors during fault conditions.
13. Suitable ANSI-SQL 92 complaint RDBMS Database system to allow user to store historical test parameters and rest result.
14. For observing the performance of distance relay under various grid conditions. The transient and Dynamic testing shall be possible.
15. Reply of Distance recorder output through COMTRADE format should be possible.
16. Through Report generation software, it shall be possible to compare previous test result and deviations can be brought out with permissible tolerance in the report.
17. Through test set –
    It shall be possible to generate conditions such as breaker failure. Carrier fail etc.
18. Test kit shall have provision to carryout end test using GPS receivers available at both local and remote S/tn.

Features of Software :

Licensed, latest version of automatic testing software certified by manufacturer only to be supplied to DTL. It shall be WINDOW based and can be customized by user without knowledge of programming language. All operation using software shall be through user friendly GUI (Graphical User Interface). Calibration Software & Hardware to be supplied to DTL.

Out Put Requirements :

(i) Voltage Output : 3 phase, 0-300 V per phase, accuracy : 0.1% or better
(ii) Current Output : 3 phase, 10 amps per phase, 400 VA at 40 Volts. Accuracy : 0.1 or better
(iii) Phase angle : 0 to 360 degrees.
(iv) Frequency : DC to 200 Hz.

Other Essential Requirements :

(i) Equipment shall be capable of upgrading to latest version manufactured for next 5 Years.
(ii) An adequate calibration box provided to calibrate the current and voltage of the test kit. This should be apart from the software calibration.

4.0 CONTACT RESISTANCE METER

General

The equipment shall measure and display the static contact resistance of circuit breaker, isolator, bus bar joints and earth switches etc: directly in micro-ohms under live switchyard conditions.

Technical Specification

Ranges: 1999.9 micro ohm, 1999 micro ohm and 19.99m. ohm.
Resolution: 0.1 micro ohm, 1 ohm, and 10 micro ohm.
Respectively.
Accuracy: Value *: ±1% :* ± *2* digits.
Current : 200 ADC,
Display : Two,3½ digit ½ inch LCD, for current and resistance Values.
Power : 220 VAC ± 10% 50 Hz ± 5%, 30VA
Battery : Instrument operation on input rechargeable battery (12 V, 7 AH Maintenance free).

5.0 CIRCUIT BREAKER OPERATIONAL ANALYSER

General : Main Equipment

(i) The Computer Aided CB Analyzer system comprising of CB operation unit, programme unit, travel analyzer unit & analysis software should be capable to perform close, open ,close-open, open-close, open-close, open operation on CB under test, with a facility to introduce time delays between composite operation.

(ii) The CB Analyzer should be capable to measure, record and analyze the CB operation timing.

(iii) The CB Analyzer should be able to measure and record current rise and fall of tripping coils as well as of closing coils of all three poles of CB simultaneously.

(iv) The CB Analyzer should be capable to measure and record travel and speed of movement of operating mechanism of CB.

(v) The CB Analyzer should be capable to measure and record dynamic contact resistance of main and arcing contacts of CB with injection of minimum 100 Amp. DC current.

(vi) The CB Analyzer should be capable to measure pole discrepancy timing.

(vii) The CB Analyzer should be capable of measuring contact closing & opening timing up to four (04) main and four(04) no. PIR contact.

(viii) The CB Analyzer should be capable to calculate and print all contact closing & opening tuning in tabular form also.

(ix) Suitable mounting kits for transducers and sensors, alongwith sensor cable of suitable length should be supplied with CB analyzer system.

(x) Test leads with suitable clamp and connectors and having length suitable for leads with suitable clamp and connectors and having length suitable for connection to EHV CBs should be supplied with CB Analyzer system for

(xi) Necessary custom built travel transformer cum fixtures suitable for mounting on BHEL/ABB/CGL/Siemens/ALSTOM (132 KV and above) makes of CBs, to monitor travel related parameters like contact gap. Contact insertion, over travel etc. should be supplied with CB Analyzer.

System Operation hardware/software, peripherals and analysis software.

(i) The test report for recording motion should provide test results both in form of curve and tables. The tables should consist of calculated CB parameters such as closing/opening speed etc.

(ii) The entry of various data/parameters (pertaining to CB) be possible sing built in display of menu.

(iii) The battery backup and real time clock should be provided for automatic date and time functions.

(iv) a) The computer aided analysis software should have sampling frequency upto 40 KHz or more.

b) The analyzer should be capable to record transient phenomenon for a duration at least 500 ms.

(v) The binary channel accuracy and analogue channel accuracy should be suitable meet all desired functions(stated above).

(vi) The CB analyzer should be provided with facility of down loading data to a IBM compatible PC.

(vii) The printer provided with CB analyzer should be preferably a plain paper printer.

(viii) The computer aided CB analysis software should be supported with suitable report generation.

(ix) It should be possible to change scale factor of time axis to enable enlarged view of part of diagram.

(x) It should be possible to change amplitude scale to make best use of available space.

(xi) It should be possible to study on speed curve, the damping and speed variations at CB opening and closing time.

(xii) The CB analyzer should be supplied with portable memory bank to store test result taken by test kit to enable further down loading to centrally located PC.

(xiii) Window based PC down loading software should be provided with CB analyzer to facilities downloading test result from memory bank to PC where it can be analyzed and stored in proper directory/file.

(xiv) It should be possible to compare present results with previous one. The feature of Zooming the graph and moving the cursors on graph, thereby indicating instantaneous values of test parameters should also be provided.

(xv) The latest version of CB analyzer system (hardwares and softwares) to be supplied and time to time updating of software should be offered.
(xvi) As and when required, technical support for analysis of critical test result to be offered, on regular basis.

Other Essential Requirements.

(i) The CB analyzer should operate on power supply of 220 volts(± 10%) at 50 Hz (± 5%) frequency .
(ii) The CB analyzer should be capable of working in high electro-magnetic and electrostatic conditions.
(iii) The CB analyzer should be capable of functioning accurately in environmental condition of temperature 0° to 50° C and humidity (RH) up to 95 %(non-condensing).
(iv) The CB analyzer should be portable so as to facilitate moment from one site to other and supplied with suitable transportation case.
(v) The supplier should have adequate after sale service facility.
(vi) As per ISO:9001 requirement, celebration certificates for each instrument should be supplied.
(vii) Installation :
a) Indoor/outdoor
b) The equipment should be portable easy to handle robust and sturdy, for field applications.

6.0 SF6 Gas leak Detector

The SF6 gas leak detector shall comprise of transducers and other accessories.

a) The detector shall be free from induced voltage effects.
b) The sensing probe shall be such that it can reach all the points on the breaker where leakage is to be sensed.

7.0 Technical Specifications of Automatic Primary Current Injection Test Kit.

Functional specification:

The instrument should be capable of injecting single phase 50 HZ AC high value current for testing of EHV equipments like current transformers in 400kV live switchyard required to simplify comprehensive testing and condition assessment of EHV CT and its commissioning, and to test turns ratio of current transformer for that require high variable currents along with polarity test.

Technical specification:

1. Test set Input power supply should be 230Volts ±10% AC, 50Hz ± 5% Hz.
2. Output current range 0-2000A up to 20 sec.
3. The combined weight of Main unit and Current Amplifier or Booster if any should be of maximum 70 Kg.
4. Test set should be microprocessor controlled, self-contained digital, modular in design and portable. Test set should be current pre-set using low current to prevent test sample heating.
5. The Output of the test should be variable in a smooth, continuous break-less manner.
6. The control and current injection test set has to be modular design for user configuration of current module selection. There shall be continuous current control by variable auto transformer with resolution of 1A.
7. There shall be current measurement by of accuracy better than 1%.

8. Test set should be of extremely rugged construction suitable for use in 400/220/66/33kV substations, the kit should be mounted on castor wheels with necessary transport packing arrangement for easy movement.
9. Tests can be performed from a distance of 10 meters and it should be suitable up-to 400 kV Current transformers. The bidder should provide standard accessories including Cu cable set, clamps, connectors, spare fuses, indication lamps, power supply cable, etc all that is required for carrying out measurement for one unit.
10. Test set control unit display should be LED/LCD, display should provide time, Current, voltage, current input value and phase angle and should be cable of scroll through entities like Z, P, Q, R, X, S, power factor (Cos φ) and I max.
11. Test set should have automatic injection stop generation or should stop after a user specified interval or when condition at the input is met.
12. Test set should be certified on the following Environment standard with CE marking.
    a. LVD low voltage directive 2006/95/IEC.
    b. EMC directive 2004/108/EC.
    c. Safety should conform to IEC 61010-1with latest amendments
13. Test set should proper function high voltage substations and industrial environment with, operating temperature range 0^{o} C to 50^{o} C storage temp 0^{o}C to $+55^{o}$C and Humidity 5% to 95%RH, no condensing.
14. Test set should be Thermal cut off protection built in during output current generation and primary side protected by a miniature circuit breaker with over current, earth fault and short circuit protection.
15. The copper cable shall be of suitable size along with standard clamp arrangement to deliver the current of 2000A for 20 sec safely without heating/damage the testing kit.
16. The bidder should have suitable facilities for prompt repair, calibration and servicing equipment in India.
17. The bidder shall have to ensure kit is made user friendly for all the CTs available in Delhi Transco Limited. The bidder shall have to arrange necessary training to engineers of DTL.
18. Calibration certificate:-
    Kit should have automatic self calibration feature. However supplier will have to submit the calibration certificate from/traceable to, NABL accredited lab or internationally reputed lab shall be submitted. Data of calibration shall not be older than two months from the date of supply of kit.
19. Testing standards as per IEC 60044-1, IEC 61869-2 and ANSI C57.13.
20. The test records/reports shall be able to download to a PC in Windows Excel/equivalent format. CT test equipment shall be operated through external laptop/PC also.
21. Primary injection kit should display automatic assessment of the test result as per the relevant standard; the deviating results should be highlighted.
22. Safety functions such as ground connection checks, self diagnostics, overload, over current and over temperature management.
23. The equipment should be capable of storing at least 10 test results and kit should be able to upload stored test results through External laptop through USB/RS232/Ethernet port communication.
24. The test kit should be portable on wheels. It should be easily movable/Transportable to other locations.

25. All inputs are equipped with overvoltage and surges protection devices.
26. Kit shall be warrantee for minimum 5(five) years from the date of supply. If the kit needs to be shifted to supplier's works for repairs, supplier will have to bear the cost of spares, transportation, transit insurance (to & fro) etc. of kit for repair at test lab/works. Kit after repairs, need to be returned within thirty days from the date of dispatch..
27. The bidder offering such Primary Current Injection Test Kit shall be required to demonstrate the functionality of the offered Test Kit at any of the substations in DTL. Only upon successful demonstration of the Primary Current Injection Test Kit so offered model shall be considered for Technical evaluation before opening of price bid. The supplier shall have to ensure the kit made user friendly easily movable/transportable at other locations. The instrument failed during the demonstration shall be rejected and no repairs are allowed.

GUARANTEED TECHNICAL PARTICULARS (G.T.P.)
Of 2000 Amp. Primary AC Injection Set.

Sr. No.	**Description**	**To be F illed b y BIDDER**
1.	Name of manufacturer	
2.	Type & Model	
3.	Input Supply (A.C.)	
4.	Maximum Output current	
5.	Current Ranges	
6.	Duty Cycle	
7.	Cooling	
8.	Current Control	
9.	Movability	
10.	Protection	
11.	Housing	
12.	Weight (Kg)	
13.	Indications	
14.	Display(LCD/LED)	
15.	Environment i)Temperature ii)Humidity	
16.	Standard Lead Sizes (Copper)	
17	Standard accessories including Cu cable set, clamps, connectors,	

	spare fuses, indication lamps, power supply cable, etc all that is required for carrying out measurement for one unit.	
17.	Input/Binary input maximum voltage	
18.	IS/IEC Marking and Safety Standards	
19	Calibration certificate/Reports	
20	Warranty period	
21.	Whether the primary Injection set is free from Electrostatic and Electromagnetic induction prevalent in switchyard up to 400 KV?	
22.	Whether the primary Injection set is suitable for testing polarity of CT‟s	
23.	Whether the primary Injection set has a USB/RS232/Ethernet port for communication with PC?	
24.	Whether the primary Injection set has provision to stop Injection automatically after user defined interval or when condition at input is met?	
25.	Whether the primary Injection set has Internal memory to save/recall test results? Specify storage capacity	
26	The test records/reports shall be able to download to a PC in Windows Excel/equivalent format. CT test equipment shall be operated through external laptop/PC also.	

SECTION-V

FIRE PROTECTION SYSTEM

SECTION : 5

FIRE PROTECTION SYSTEM

1. 0 INTENT OF SPECIFICATION

This section covers the design and performance requirements of the following type of fire protection systems:

a) Portable Fire Extinguishers

1.1 It is not the intent to completely specify all details of design and construction. Nevertheless, the system design and equipment shall conform in all respects to high standard of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Owner. The system design shall also conform to TAC/ NFPA norms.

1.2 The scope of work includes complete installation of fire protection system wherever it is required.

1.3 The equipment offered shall comply with the relevant IEC. The equipment conforming to any other approved international standards shall meet the requirement called for the latest revision of relevant Indian Standard or shall be superior.

1.4 Ambient temperature for design of all equipment shall be considered as 50^0 C.

1.5 The successful bidder shall prepare detailed layout and piping drawing and also other drawing such as road, drainage, cable trench, switch yard layout, etc. as furnished by the Employer during detailed engineering.

2.0 PORTABLE FIRE EXTINGUISHERS

2.1 **Intent of Specification**

This specification lays down the requirement regarding fire extinguishers of following types:

Portable fire extinguishers.

a) Dry chemical powder type

b) Carbon Dioxide type

2.2 All the extinguishers offered by the Bidder shall be of reputed make and should have been approved by Tariff Advisory Committee of India or any other international authorities like FOC - London/NFPA-USA. Certificates to this effect shall be furnished by the Bidder. All extinguishers shall be ISI marked.

2.3 Adequate number of smoke detector and Portable Fire Extinguishers of Dry Chemical Powder and Carbon dioxide shall be provided in suitable location in control room building, GIS Hall and DG set room. These extinguishers will be used during the early phases of fire to prevent its spread and costly damage.

2.4 **Design and Construction**

2.4.1 All the portable extinguishers shall be of freestanding type and shall be capable of discharging freely and completely in upright position.

2.4.2 Each extinguisher shall have the instructions for operating the extinguishers on its body itself.

2.4.3 All extinguishers shall be supplied with initial charge and accessories as required.

2.4.4 Portable type extinguishers shall be provided with suitable clamps for mounting on walls or columns.

2.4.5 All extinguishers shall be painted with durable enamel paint of fire red colour conforming to relevant Indian Standards.

2.4.6 Dry chemical powder type extinguisher shall conform to IS: 2171.

2.4.7 Carbon Dioxide type extinguisher shall conform to IS: 2878.

2.5 **Tests and Inspection**

2.5.1 Particulars of shop tests and procedure shall be submitted to the Employer before hand for his approval.

2.5.2 A performance demonstration test at site of five (5) percent or one (1) number whichever is higher, of the extinguishers shall be carried out by the Contractor. All consumable and replaceable items require for this test would be supplied by the Contractor without any extra cost to Employer.

2.5.3 Performance testing of extinguisher shall be in line of applicable Indian Standards. In case where no Indian Standard is applicable for a particular type of extinguisher, the method of testing shall be mutually discussed and agreed to before placement of order for the extinguishers.

2.6 **Performance Guarantee**

The contractor shall guarantee all equipment supplied by him against any defect due to faulty design, material and workmanship. The equipment shall be guaranteed to operate satisfactorily at the rated conditions at site.

2.7 **Painting**

Each fire extinguisher shall be painted with durable enamel paint of fire red colour conforming to relevant Indian Standards

SECTION-VI

LT SWITCHGEAR

SECTION : 6

LT SWITCHGEAR

1.1 CONSTRUCTIONAL DETAILS OF SWITCHBOARD AND DISTRIBUTION BOARDS

1.1.1 All boards shall be of metal enclosed, indoor floor mounted, compartmentalized construction and freestanding type.

1.1.2 All board frames, shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary.

1.1.3 All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.

1.1.4 The complete structures shall be rigid, self-supporting free form flaws, twists and bends. All cut-outs be true in shape and devoid of sharp edges.

1.1.5 All boards shall be of dust and vermin proof construction and shall be provided with a degree of protection of IP:42 as per IS 2147. However, the busbar chambers having a degree of protection of IP:42, in accordance with IS:2147, are also acceptable where continuous busbar rating exceeds 1000 Amp. Provision shall be made in all compartments for providing IP:42 degree of protection, when Circuit breaker or module trolley, has been removed. All cut-outs shall be provided with neoprene/Synthetic rubber gaskets.

1.1.6 Provision of louvers on boards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous bus bar rating exceeds 1000 Amps.

1.1.7 All boards shall be uniform height not exceeding 2450 mm.

1.1.8 Boards shall be easily extendible on both sides, by the addition of the vertical sections after removing the end covers.

1.1.9 Boards shall be supplied with base frames made of structural steel sections, alongwith all necessary mounting hardware required for welding the base frames to the insert plates.

1.1.10 All boards shall be divided into distinct vertical sections, each comprising of :

i) A completely enclosed busbar compartment for running horizontal and vertical busbars. Busbar chamber shall be completely enclosed with metallic portions. Bolted covers shall be provided for access to horizontal and Vertical bus bars and all joints for repair maintenance, which shall be feasible without disturbing feeder compartment.

ii) Completely enclosed switchgear compartment(s) one for each circuit for housing circuit breaker or MCCB or motor starter.

iii) A compartment or alley for power and control cables. Cable alley door shall preferably be hinged. Cable alleys shall have no exposed live parts, and shall have no communication with busbar chamber. It shall be of atleast 350mm width.

iv) A compartment for relays and other control devices associated with a circuit breaker.

1.1.11 Sheet steel barriers shall be provided between two adjacent vertical panels running to the full he ight of t he s witchboard, except f or t he hor izontal bus bar c ompartment. E ach shipping section shall have full metal sheets at both ends for transport and storage.

1.1.12 All equipments associated with a single circuit except MCB circuits shall be housed in a separate compartment of the vertical section. The Compartment shall be sheet steel enclosed on all sides with the withdrawal units in position or removed. The front of the compartment shall be provided with the hinged single leaf door, with locking facilities.

In case of circuits controlled by MCBs, group of MCB feeders can be offered in common compartment. In such case number of MCB feeder to be used in a common compartment shall not exceed 4 (four) and front of MCB compartment, shall have a viewing port of toughen glass sheet for viewing and sheet steel door of module shall be lockable with star knob/panel key.

1.1.13 After i solation of pow er a nd c ontrol c ircuit c onnections i t s hall be po ssible to safely carryout m aintenance in a com partment w ith the bus bar and adjacent c ircuit l ive. Necessary s hrouding a rrangement s hall be pr ovided f or t his pu rpose ov er the c able terminations located in cable alley.

1.1.14 The minimum clearance in air between phases and between phase and earth for the entire run of h orizontal and v ertical bus bars, s hall be 25 mm. F or a ll o ther c omponents, t he clearance between “two live parts”, “A live part and an earthed part” and isolating distance shall be atleast ten (10) mm throughout. Wherever i t is no t pos sible to m aintain t hese clearances, i nsulation sha ll be p rovided by sl eeving or b arriers. H owever, for horizontal run of busbar minimum clearance of 25mm should be maintained even if they are sleeved.

1.1.15 The temperature rise of ho rizontal & v ertical bus bars w hen carrying rated current along its full run shall in no case exceed 55^0C, with silver plated joints and 40^0C with all other type of joints over an outside ambient temperature of 50^0C.

1.1.16 All s ingle front boards shall be provided w ith r emovable bo lted c overs a t t he r ear. The covers shall be provided with danger labels.

1.1.17 All i dentical circuit b reakers and module c hasis of sam e t est s ize sha ll be f ully interchangeable without having to carryout modifications.

1.1.18 All C ircuit b reaker boa rds s hall b e o f S ingle F ront type, with fully dr awout c ircuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between SERVICE, TEST and ISOLATED positions and for withdrawal from the Switchboard. Testing of the breaker shall be possible in the TEST position.

1.1.19 Wherever two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.

1.1.20 All d isconnecting c ontacts f or pow er c ircuits s hall be of r obust de sign a nd f ully s elf aligning. Fixed and moving contacts of the power drawout contact system shall be silver plated. Both fixed and moving contacts shall be replacement.

1.1.21 All AC & DC boards shall be of single Front type.

1.1.22 All module shall be fixed type except air circuit breaker module, which shall be drawout type.

1.1.23 The c onnections from bus bars t o the m ain s witch s hall be fully i nsulated/shrouded, a nd securely bo lted. The pa rtition between the f eeder co mpartment and cable alley m ay be

non-metallic and shall be such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination.

1.1.24 All equipment and components shall be neatly arrangement and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to Owner's approval. Bidder shall submit dimensional drawings showing complete internal details of Busbars and module components for each type and rating for approval.

1.1.25 The tentative power and control cable entries shall be from bottom. However, Owner reserves the right to alter the cable entries, if required, during detailed engineering, without any additional commercial implications.

1.1.26 Adaptor panels and dummy panels required to meet the various busbar arrangements and layouts required shall be included in Bidder's scope of work.

1.1.27 All sheet work shall be pre-treated, in tanks, in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall 'Class-C' as specified in IS:6005. The phosphated surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating after primer application, two coats of finishing synthetic enamel paint on panels shall be applied, Electrostatic painting shall also be acceptable.

1.1.28 Finishing paint on panels shall be shade 692 (Smoke grey) of IS:5 unless required otherwise by the OWNER. The inside shall be properly stoved. The paint thickness shall be coated by peelable compound by spraying method to protect the finished surfaces from scratches grease dirt and oily spots during testing, transportation, handling and erection.

1.2 DERATING OF EQUIPMENTS

1.2.1 The current ratings of all equipments as specified in the 'Bill of Materials are the minimum standards current ratings at a reference ambient temperature of 50^0C as per relevant Indian Standards.

1.2.2 The Bidder shall indicate clearly the derating factors employed for each component and furnish the basis for arriving at these derating duly considering the specified ambient temperature of 50^0C.

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 It bus bars and jumper connections shall be high conductivity aluminium/copper of adequate size the bus bar size calculations shall be submitted for approval.

1.3.3 The Cross-Section of the busbars shall be uniform through out the length of Switchgear and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents.

1.3.4 All bus bars shall be adequately supported by Non-hygroscopic, non-combustible, track resistant & high strength type Polyester fibre glass Moulded Insulators. Separate supports shall be provided for each phase and neutral busbar. If a busbar support is provided anti-tracking barriers shall be provided between the supports.

1.3.5 All busbars joints shall be provided with high tensile steel bolts. Belleville/sprint washers and nuts, so as to ensure good contacts at the joints. Non-silver plated Busbars joints shall be thoroughly cleaned at the joint locations and a suitable contact grease shall be applied just before making a joint.

1.3.6 All busbars shall be colour coded as per IS:375.

1.3.7 The Bidder shall furnish calculations alongwith the bid, establishing the adequacy of busbar sizes for specified current ratings, on the basis of short circuit current and temperature rise consideration at specified ambient temp.

1.4 EARTH BUS

1.4.1 A 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 beaker earthing contact bar vertical bus shall be provided in each vertical section which shall in turn be bolted/welded to main horizontal ground bus.

1.4.2 The earth bus shall have sufficient cross-section to carry the monetary short circuit and short time fault currents to earth as indicated in 'Bill of Material's without exceeding the allowable temperature rise.

1.4.3 Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Owner's earthing conductors. The horizontal earth bus shall project out the switchboard ends and shall have predrilled holes for this connection. A joint spaced and taps to earth bus shall be made through at least two bolts.

1.4.4 All non-current metal work of the Switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosures frame work and the truck shall be maintained even after painting.

1.4.5 The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions. SERVICES & ISOLATED, as well as through out the intermediate travel.

1.4.6 Each module frame shall get engaged to the vertical earth bus. Before the disconnecting contacts on these module are engaged to the vertical busbar.

1.4.7 All metallic cases of relays, instruments and other panel mounted equipments shall be connected to earth by independent standard copper wires of size not less than 2.5mm2. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connections and soldering is not acceptable. Looping of earth connections which would result in loss of earth connection to the devices when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths or earth bus is acceptable.

1.4.8 VT and CT secondary neutral point earthing shall be at one place only, on the terminal block. Such earthing shall be made through links so that earthing on one secondary circuit shall be removed without disturbing the earthing of other circuit.

1.4.9 All hinged doors shall be earthed through flexible earthing braid.

1.4.10 Caution nameplate 'Caution-Live Terminals' shall be provided at all points where the terminals are like to remain live and isolation is possible only at remote end.

1.5 AIR CIRCUIT BREAKERS

1.5.1 Circuit breakers shall be three-pole air break horizontal drawout type and shall have inherent fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified parameter only after provision of releases or any other devices shall not be acceptable.

1.5.2 Circuit breakers shall be mounted along with operating mechanism on a wheeled carried. Suitable guides shall be provided to minimise misalignment of the breaker.

1.5.3 There shall be 'Service', 'Test' and 'Fully withdrawn positions for the breakers. In "Test' position the circuit breaker shall be capable of being tested for operation without

energising the power circuits i.e. the power contacts shall be disconnected while Control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the 'SERVICE', 'TEST' or FULLY WITHDRAWN' position. It shall be possible to close the door in TEST position.

1.5.4 All circuit breakers shall be provided with 4 NO and 4 NC potential free auxiliary contacts. These contacts shall be addition to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be provided in both 'SERVICE & 'TEST' position of the breaker. All contacts shall be rated for making continuously carrying and breaking 10 Amps at 240 V AC and 1 Amp (Inductive) at 220 DC.

1.5.5 Suitable mechanical indications shall be provided on all circuit breakers to show 'OPEN'. 'CLOSE', 'SERVICE', TEST' and 'SPRING CHARGED' positions.

1.5.6 Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half cycle of rated frequency.

1.5.7 All circuit breakers shall be provided with the interlocks as explained in further clauses.

1.5.8 Movement of a circuit breaker between SERVICE AND TEST positions shall not be possible unless it is OPEN position. Attempted withdrawl 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 SREVICE, TEST POSITION or in FULLY WITHDRAWN POSITION.

1.5.10 Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationery isolated contacts when the breaker is withdrawn. It shall however, be possible to open the shutters intentionally, against spring pressure for testing purpose.

1.5.11 A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.

1.5.12 Circuit breakers shall be provided with electrical anti-pumping and trip feature, even if mechanical antipumping feature is provided.

1.5.13 Mechanical tripping shall be possible by means of front mounted RED 'TRIP' push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.

1.5.14 Breaker controlled motors shall operate satisfactorily under the following conditions :-

i) Direct on-line starting of Induction Motors rated 110kW to 220 kW with a locked rotor current of seven times the rated current, and starting time of up to 30 seconds.

ii) Breaking on-load, full load and locked motor currents of Induction Motors for rated 100 kW to 220kW.

1.5.15 Means shall be provided to slowly close the circuit breaker in withdrawn position. If required for inspection and setting of Contacts, in service position slow closing shall not be possible.

1.5.16 Power operated mechanism shall be provided with a universal motor suitable for operation 220V DC Control supply with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class 'E' or better.

1.5.17 The motor shall be such that if requires not more than 30 seconds for fully charging the closing spring.

1.5.18 Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring.

1.5.19 The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close open operation shall be possible.

1.5.20 Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.

1.5.21 All circuit breakers shall be provided with closing and trip coils. The closing coils shall operate correctly at all values of Voltage between 85% to 110% at rated control voltage. The trip coil shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage.

1.5.22 Provision for mechanical closing of the breaker only in 'TEST' and 'WITHDRAWN' positions shall be made.

1.5.23 PROTECTION CO-ORDINATION

1.5.23.1 It shall be the responsibility of the Contractor to fully co-ordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers/fuses/motor starters, to provide satisfactory discrimination.

1.6 MOULDED CASE CIRCUIT BREAKER (MCCB) and MCB

1.6.1 MCCB shall in general conform to IS:13949 Part-2, All MCCB shall be P2 duty.

1.6.2 MCCB shall be flush mounted on the AC/DC distribution boards.

1.6.3 MCCBs shall be provided with thermo-magnetic type release for over current and short circuit protection. The setting of the thermal release shall be adjustable between 75% to 100% of the rated current. The MCCB shall have breaking capacity not less than 20kA.

1.6.4 MCCBs used for ACDB incomers and Bus coupler shall be equipped with stored energy mechanism for electrical closing and tripping. All other MCCBs shall be manually operated. The operating handle should give a clear trip indication.

1.6.5 Miniature circuit breaker (MCB) shall conform to IEC:898-1998 and IS:8928.

1.7 RELAYS

1.7.1 All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a drawout construction for easy replacement from the front. They shall either have built-up test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-drawout cases.

1.7.2 All AC relays shall be suitable for operation, at 50 Hz with 110 Volts secondary and 1 amp or 5 amp CT secondary.

1.7.3 All protective relays and timers shall have at least two potentially free output contracts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on the relay cases for applicable relaying schemes.

1.7.4 All protective relays auxiliary relays and timers shall be provided with hand rest operation indicators (flags) and analysing the case of operation.

1.7.5 All relays shall withstand a test voltage of 2 KV (rms) for one minute.

1.7.6 Motor starters shall be provided with three element, ambient temperature compensated, time lagged, hand reset type overload relays with adjustable settings. The setting ranges shall be properly selected to suit the motor ratings. These relays shall have a separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.

1.7.7 All fuse-protected contractor-controlled motors shall have phasing protection, either as a distinct feature in the overload relays (by differential movement of bimetallic strips), or as a separate device. The single phasing protection shall operate even with 80% of the set current flowing in two of the phases.

1.8 CONTACTORS

1.8.1 Motor starter contactors shall be air break, electromagnetic type rated for uninterrupted duty as per IS:13957 (Part 4).

1.8.2 Contactors shall be double break, non-gravity type and their main contacts shall be silver faced.

1.8.3 Direct on line starter contactors shall be utilisation category AC2. These contactors shall be as IS:13947 (Part 4).

1.8.4 Each contactor shall be provided with two (2) normally open (NO) and two (2) normally close (NC) auxiliary contacts.

1.8.5 Operating coils of contactors shall be of 240V AC Unless otherwise specified elsewhere. The Contactors shall operate satisfactorily between 85% to 110% of the rated voltage. The Contactor shall drop out at 70% of the rated voltage.

1.9 INSTRUMENT TRANSFORMERS

1.9.1 All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchgear is operating at its rated condition and the outside ambient temperature is 50^0C.

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 transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.

1.9.4 Current transformers may be multi or single core type. All voltage transformers shall be single phase type. The bus VTs shall be housed in a separate compartment.

1.9.5 All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides.

1.10 INDICATING INSTRUMENTS

1.10.1 All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 degree scales, and shall have an accuracy class of 2.5 or better. The covers and cases of instrument and meters shall provide a dust and vermin proof construction.

1.10.2 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustments without removing or dismantling the instruments.

1.10.3 All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.

1.10.4 Ammeters provided on Motor feeders shall have a compressed scale at the upper current region to cover the starting current.

1.10.5 Watt-hour meters shall be of 3 phase three element type, Maximum demand indicators need not be provided.

1.11 CONTROL & SELECTOR SWITCHES

1.11.1 Control & Selector switches shall be of rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress be preferred.

1.11.2 Circuit breaker selector switches for breaker controlled motor shall have three stay put positions marked 'Switchgear', 'Normal' and 'Trial' respectively. They shall have two contacts of each of the three positions and shall have black shade handles.

1.11.3 Ammeter and voltmeter selector switches shall have four stay out position with adequate number of contacts for three phase 4 wire system. These shall have oval handles Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries.

1.11.4 Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.

1.11.5 The contact ratings shall be at least the following :

i) Make and carry continuously	10 Amp.
ii) Breaking current at 220V DC	1 Amp (Inductive)
iii) Breaking current at 240V DC	5 Amp (at 0.3 pf lagging)

1.12 AIR BREAK SWITCHES

1.12.1 Air breaker switch shall be of the heavy duty, single throw group operated, load break, fault make type complying with IS:4064.

1.12.2 The Bidder shall ensure that all switches are adequately rated so as to be fully protected by the associated fuses during all abnormal operating conditions such as overload, locked motor, short circuit etc.

1.12.3 Switch operating handles shall be provided with padlocking facilities to lock them in 'OFF' position.

1.12.4 Interlocks shall be provided such that it is possible to open the cubicle door only when the switch is in 'OFF' position and to close the switch only when the door is closed. However suitable means shall be provided to intentionally defeat the interlocks explained above.

1.12.5 Switches and fuses for AC/DC control supply and heater supply wherever required shall be mounted inside and cubicles.

1.13 PUSH BUTTONS

1.13.1 Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 240V and 0.5A (inductive) at 220V DC.

1.13.2 All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.

1.13.3 All push-buttons shall be provided with integral escutcheon plates marked with its function.

1.13.4 The colour of the button shall be as follows :-

i) GREEN	:	For motor START, Breaker CLOSE
ii) RED	:	For motor TRIP, Breaker OPEN
iii) BLACK	:	For overload rest

1.13.5 All push-buttons on panels shall be located in such a way that Red-push-buttons shall always be to the left green push-buttons.

1.14 INDICATING LAMPS

1.14.1 Indicating lamps shall be of the panel mounting cluster LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary.

1.14.2 Lamps shall have translucent lamp-covers of the following colours, as warranted by the application :

i) RED	:	For motor ON, Breaker CLOSED
ii) GREEN	:	For motor OFF, Breaker OPEN
iii) WHITE	:	For motor Auto-trip
iv) BLUE	:	For all healthy conditions (e.g. control supply, and also for 'SPRING CHARGED"
v) AMBER	:	For all alarm conditions (e.g. overload) Also for 'SERVICE' and 'TEST' positions indicators.

1.14.3 Lamps shall be easily replaceable from the front of the cubicle.

1.14.4 Indication lamps should be located just above the associated push buttons/control switches. Red Lamps shall 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 415 AC, and for DC circuits Class 1 type 5 kA breaking current.

1.15.2 Fuses shall have visible operation indicators.

1.15.3 Fuses shall be mounted on fuses carriers, which are mounted on fuse bases, wherever it is not possible to mount fuses on carriers fuses shall be directly mounted on plug in type of bases, In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

1.15.4 Fuse rating shall be chosen by the Bidder depending upon the circuit requirements and these shall be subject to approval of OWNER.

1.16 TERMINAL BLOCKS

1.16.1 Terminal blocks shall be of 1100 volts grade and have continuous rating to carry the maximum expected current on the terminals. It shall be complete with insulating barriers, clip-on-type/stud type terminals for Control Cables and identification strips. Making on terminal strip shall correspond to the terminal numbering on wiring on diagrams. It shall be similar to 'ELEMAX' standard type terminals, cage clamp type of Phoenix or WAGO or equivalent.

1.16.2 Terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided distributed on all terminal circuiting and earthing facilities. It shall be similar to 'Elem', 'CATD' – Type.

1.16.3 In all circuit breaker panels at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks. Space for adding another 10% spare terminals shall also be available.

1.16.4 All terminals blocks shall be suitable for terminating on each side, two (2) nos. of 2.5mm square size standard copper conductors.

1.16.5 All terminals shall be numbered for identification and grouped according to the function. Engraved white-on-black labels shall be provided on the terminal blocks.

1.16.6 Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

1.16.7 Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal block. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250 mm.

1.17 NAME PLATES AND LABELS

1.17.1 All switchgears AC/DC distribution boards shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

1.17.2 All name plates shall be of non-rusting metal or 3-ply lamicoid with white engraved lettering on black background. Inscriptions and lettering sizes shall be subject to OWNER approval.

1.17.3 Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel/module. These labels shall be positioned so as to be clearly inside visible and shall give the device number as mentioned in the module wiring drawings.

1.18 SPACE HEATER

1.18.1 Space heater shall be provided in all the boards for preventing harmful moisture condensation.

1.18.2 The space heaters shall be suitable for continuous operation on 240V, AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.

1.19 CONTROL AND SECONDARY WIRING

1.19.1 All switchboards shall be supplied completely wired internally upto the terminal blocks ready to receive Owner's control cables.

1.19.2 All inter cubicle and inter panel wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided by the bidder.

1.19.3 All internal wiring shall be carried out with 1100V grade, single core, 2.5 square mm or larger standard copper wires having colour coded, PVC insulation. CT circuits shall be wired with 2.5 square mm copper wires. Voltages and insulation shall be same as above.

1.19.4 Extra-flexible wires shall be used for wiring to device mounted on moving parts such as hinged doors.

1.19.5 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminals blocks.

1.20 POWER CABLES TERMINATION

1.20.1 Cable termination compartment and arrangement for power cables shall be suitable for standard aluminium conductor, armoured XLPE/PVC insulated and sheathed, single core/three core, 1100V grade cables.

1.20.2 All necessary cable terminating accessories such as Gland plates, supporting clamps and brackets, power cable lugs, hardware etc., shall be provided by successful bidder, suit the final cable sizes which would be advised later.

1.20.3 The gland plate shall be removable type and shall cover the entire cable alley. Bidder shall also ensure that sufficient space is provided for all cable glands. Gland plates shall be factory-drilled according to the cable gland sizes and number which shall be informed to the Contractor later. For all single core cables, gland plates shall be of non-magnetic Material.

1.21 TYPE TESTS

1.21.1 Type test reports of Panels (Switchgear and Control gear assemblies) as per IS 8623 Part-I shall be submitted for the following tests in line with clause 9.0 of Section GTR before the fabrication of switchgear is started :

i) Verification of temperature rise limits
ii) Verification of the dielectric properties
iii) Verification of short circuit strength
iv) Verification of the continuity of the protective circuit
v) Verification of clearances and creepage distances
vi) Verification of mechanical operation
vii) Verification of degree of protection

1.21.2 Contractor shall submit type test reports for the following Switchgear and Control gears before the fabrication of switchgear is started :

1. Circuit breakers / MCCB as per IS 13947 Part-II
2. Protective Relays as per IEC:60255

for the above equipments test conducted once are acceptable (i.e. The requirement of test conducted within last five years shall not be applicable).

1.22 ERECTION, TESTING AND COMMISSIONING

1.22.1 The Contractor shall unload, erect, install, test and put into commercial use all electrical equipment included in this specification.

1.22.2 Equipment shall be installed in a neat, workman like manner so that it is level, plumb, square and properly aligned and oriented. Tolerance shall be as established in Contractor's drawings or as stipulated by Owner. No equipment shall be permanently bolted down to foundations until the alignment has been checked and found acceptable by the Owner.

1.22.3 Contractor shall furnish all supervision, labour tools equipment rigging materials, bolts, wedges, anchors, concrete inserts etc. in proper time required to completely install, test and commission the equipment.

1.22.4 Manufacturer's and Owner's instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment.

1.22.5 Contractor shall move all equipment into the respective from through the regular door or openings specifically provided for this purpose. No part of the structure shall be utilized to lift or erect any equipment without prior permission of Owner.

1.22.6 All boards shall be installed in accordance with Indian Standards IS:3072 and at Owner's instructions. All boards shall be installed on finished surfaces, concrete or steel stills. Contractor shall be required to install and align any channel sills which form part of foundations. In joining shipping sections of switchboards together adjacent housing of panel sections or flanged throat sections shall be bolted together after alignment has bee complete. Power bus, enclosures ground and control splices of conventional nature shall be cleaned and bolted together being drawn up with torque spanner of proper size or by other approved means.

1.22.7 All boards shall be made completely vermin proof.

1.22.8 Contractor shall take utmost care in holding instruments, relaying and other delicate mechanism wherever the instruments and relays are supplied separately they shall be mentioned only after the associated panels have been erected and aligned. The packing materials employed for safe transit of instrument and relays shall be removed after ensuring that panel have been completely installed and to further movement of the same should be necessary. Any damage shall be immediately reported to Owner.

1.22.9 Equipment furnished with finished coats of paint shall be touched by up Contractor if their surface is specified or marred while handling.

1.22.10 After installation of panels, power and control wiring and connections, Contractor shall perform operational tests on all switchboards, to verify proper operation of switchboards/panels and correctness of all equipment in each and every respect. The cable opening and cables entries for cables terminating to the panels shall be sealed with fire sealing materials.

1.23 COMMISSIONING CHECK TESTS

The contractor shall carry out the following commissioning checks, in addition to the other checks and tests recommended by the manufacturers.

1.23.1 General

1.23.1.1 Check name plate details according to the specification.
1.23.1.2 Check for physical damage.
1.23.1.3 Check tightness of all bolts, clamps, joints connecting terminals.
1.23.1.4 Check earth connections
1.23.1.5 Check cleanliness of insulators and bushings
1.23.1.6 Check all moving parts for proper lubrication
1.23.1.7 Check settings of all the relays

1.23.2 Circuit Breakers

1.23.2.1 Check alignment of breaker truck for free movement
1.23.2.2 Check correct operation of shutters
1.23.2.3 Check control wiring for correctness of connections, continuity and IR values
1.23.2.4 Manual operation of breaker completely assembled
1.23.2.5 Power closing/opening operation, manually and electrically
1.23.2.6 Breaker closing and tripping time
1.23.2.7 Trip free and anti-pumping operation
1.23.2.8 IR values, minimum pick up voltage and resistance of coils
1.23.2.9 Contact resistance
1.23.2.10 Simultaneous closing of all the three phases
1.23.2.11 Check electrical & mechanical interlocks provided

1.23.2.12 Check on spring charging motor, correct operation of limit switches and time of charging.
1.23.2.13 All functional checks

1.23.3 Current Transformers
1.23.3.1 Meggar between winding and winding terminals to body
1.23.3.2 Polarity test
1.23.3.3 Ratio identification checking of all ratios on all cores by primary injection of current.
1.23.3.4 Spare CT cores, if available, to be shorted and earthed.

1.23.4 Voltage Transformer
1.23.4.1 Insulation resistance test
1.23.4.2 Ratio test on all cores
1.23.4.3 Polarity test
1.23.4.4 Line connections as per connection diagram

1.23.5 Cubicle Wiring
1.23.5.1 Check all switch developments
1.23.5.2 Each wire shall be traced by continuity tests and it should be made sure that the wiring is as per relevant drawing. All interconnections between panels/equipment shall be similarly checked.
1.23.5.3 All the wires shall be meggared to earth
1.23.5.4 Functional checking of all control circuit e.g. closing, tripping control, interlock, supervision and alarm circuit.

1.23.6 Relays
1.23.6.1 Check connections and wiring
1.23.6.2 Meggar all terminals to body
1.23.6.3 Meggar AC to DC terminals
1.23.6.4 Check operating characteristics by secondary injection
1.23.6.5 Check minimum pick up voltage of DC coils
1.23.6.6 Check operation of electrical/mechanical targets
1.23.6.7 Relays settings
1.23.6.8 Check CT and VT connections with particular reference to their polarities for directional relays wherever required.

1.23.7 **Meters**
1.23.7.1 Check calibration by comparing it with a sub-standard.
1.23.7.2 Megger all insulated portions.
1.23.7.3 Check CT and VT connections with particulars reference to their polarities for power type meters.

1.24 SPECIAL TOOLS AND TACKLES
1.24.1 The Bidder shall include in his proposal any special tools and tackles required for erection, testing commissioning and maintenance of the equipments offered.

1.24.2 The list of these special tools and tackles shall be given in the bid proposal sheets along with their respective prices.

1.24.3 The total price of the special tools and tackles shall be included in proposal sheets.

1.25 EQUIPMENT TO BE FURNISHED
1.25.1 The Bidder shall quote for various AC/DC distribution boards as given in Bill of Materials and in accordance with this specification.

1.25.2 Standard scheme of interconnection of switchboards and distribution boards along with tentative feeder disposition for each board is indicated in Standard SLD of A/C & DC system enclosed bid documents. The bidder shall quote board prices on the basis of standard SLD and their estimation of feeders for entire present and future bays

requirement. Any other feeder required as per system requirement for efficient and reliable operation shall be deemed to be included in bidder's scope.

1.25.3 The Bill of Materials for each type of module shall be as under. These are minimum indicative requirement of the system. The necessary auxiliary relays, push buttons and indicating lamps shall be provided as per scheme requirement. Any other item / component required with in a module for efficient and reliable operation shall be deemed to be included in bidder's scope. The scheme shall have provision for remote annunciation for the followings :

a) Station LT (415V) AC incomer supply unhealthy.
b) 220V DCDB U/V, O/V & Earth leakage relay operated.
c) DG set start
d) DG set protection

1.25.4 **Module Type AE (Electrically controlled circuit breaker for incoming and Bus Coupler Circuit).**

i) One (1) Triple pole air circuit breaker complete with all accessories and power operated mechanism as specified.

ii) Two (2) Neutral Link.

iii) Three (3) Current Transformer for metering.

iv) One (1) Ammeter with selector switch.

v) Three (3) Current Transformer for relaying.

vi) One (1) Triple pole instantaneous over-current relay having the setting range of 200-800% or 500 -2000% of CT secondary and adjustable definite minimum time.

vii) One (1) Instantaneous earth fault relay having and adjustable setting range of 10-40% or 20-80% of CT secondary current and adjustable definite minimum time. The earth fault relay shall be provided with a stabilizing resistor.

1.25.5 **Module Type – M1 (Circuit Breaker Controlled Motor Feeder)**

i) One (1) Triple pole Air Circuit Breaker complete with accessories, and power operated mechanism as specified.

ii) One (1) Three position 6 pole selector switch 'SWITCHGEAR / NORMAL / TRIAL'.

iii) Three (3) Current Transformer for meeting.

iv) One (1) Ammeter with Ammeter Selector Switch.

v) Three (3) Current Transformer for relaying.

vi) One (1) Triple pole instantaneous over-current relay for providing positive sequence current protection in all the three phases. The relay setting range shall be continuously adjustable between 200-800% or 400-1600% of CT secondary rated current as required.

vii) One (1) Double pole inverse definite minimum time over current relays connected in R&B phases for over current protection of motor rated 110kw – 200kw. The relay shall have an adjustable setting range of 50% -200% of CT Secondary current and time setting range of 0-30 Second. The relay shall be CDGM-22 of EE or equivalent.

viii) One (1) Single pole adjustable definite time delay for motor overload alarm connected in Y-phase only. The relay shall have resetting ratio of not less than 90%. The relay shall have continuously adjustable time delay range of 2.5 to 25 Sec.

ix) One (1) Instantaneous earth fault relay having an adjustable setting range of 10 - 40% or 20-80% of CT secondary current. The earth fault relay shall be provided with a stabilizing resistor.

1.25.6 **Module Type E**

i) One (1) Four pole MCCB

1.25.7 **Module G-1 (VT Module with under Voltage Relay)**

i) Three (3) 415/√3/110√3volts single phase voltage transformer star / star connect with star point solidity earthed mounted on common draw out chassis. Accuracy Class 0.5 for protection and metering with 50VA Burden.

ii) HRC Fuses mounted on the above chassis.

iii) One (1) Four Position voltmeter selector switch.

iv) One (1) Voltmeter (0-500V)

v) One (1) Double pole instantaneous under voltage relays with continuous variable setting range of 40-80% of 110 Volts.

vi) One (1) Time delay pick up relay having a time setting range of 0.5 to 3 secs. With 3 'No'. Self reset contacts, suitable for 220V DC.

vii) One (1) Auxiliary relay 220V DC with 2 No. self reset contacts.

viii) Three (3) Indicating lamps with series resistor and colour lenses (Red, Blue & Yellow).

1.25.8 **Module Type G-2**

i) Three (3) HRC Fuse

ii) One (1) Voltmeter (0-500V)

iii) One (1) Voltmeter selector switch four position (R-Y, Y-B, B-R OFF).

iv) Three (3) Indication lamps (Red, Blue & Yellow)

1.25.9 **Module Type H & H (BC) (Isolating Switch Controlled Incoming Circuit)**

i) One (1) Four pole MCCB

ii) One (1) Red Indicating lamp to indicate isolating switch closed position.

1.25.10 **Module Type S : (DC Metering and Protection Module)**

i) One (1) Voltmeter 300-0-300V DC for 220V DC DB.

ii) One (1) Three (3) position voltmeter selector switch

iii) One (1) Instantaneous under voltage relay with 95% of 220 V DC. The resetting ratio of relay should not be more than 1.25. the relay shall be provided with a series resistor and a push button across it for resetting (pick up) the relay at about 105% of the drop out voltage.

iv) One (1) Instantaneous over voltage relay with setting range of 110% of 220V DC. The resetting ratio of relay should not be less than 0.8. the relay shall have a push button in series of resetting the relay at about 95% of the operating voltage.

v) One (1) Earth leakage relay only for 220V DC system having adjustable pick up range be tween 3 t o 7 m illiamps t he r elay s hall be s uitable f or 220 V DC/240V AC Auxiliary supply.

1.25.11 **Module Type X**

One (1) Double pole 250V MCB

1.25.12 **Module Type-DC (Incomer from Battery & Chargers)**

i) One (1) 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.

iii) Two (2) Double pole 250V DC MCCB / MCB.

iv) One (1) Double pole single throw 250V DC air Break switch connecting battery & charger sections to DC DB.

1.25.13 **Module Type DG-1 (Electrically Controlled Circuit Breaker for Incomer from DG Set)**

a) One (1) Triple po le circuit br eaker com plete w ith all a ccessories an d power operated mechanism as specified.

b) One (1) Frequency meter.

c) One (1) Voltmeter with selector switch.

d) One (1) Remote/Local Selector switch.

e) Three (3) Current Transformer for Metering.

f) Six (6) Current Transformers for differential protection (out of this 3 Nos. will be supplied loose for mounting in DG set panel).

g) Three (3) Current Transformer for relaying.

h) One (1) Ammeter Selector Switch.

i) One (1) Ammeter

j) One (1) Wattmeter of range 0-300 KW

k) One (1) Three p ole v oltage con trolled definite t ime de lay r elay ha ving curr ent setting r ange of 50 -200% of C T s econdary c urrent and a djustable 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 p ole de finite t ime ov er c urrent r elay ha ving a c ontinuous s etting range of 50-200% of CT secondary current and a time delay of 2.5-25 secs connected i n CT of Y pha se for overload alarm. The r elay sha ll have a setting ratio of not less than 90%.

n) One (1) Three pole differential protection relay having an operating current setting range of 10-40% of generator full load current. The relay shall be high impedance type, with necessary stabilizing resistors.

o) Two (2) Push Buttons for Remote starting & stopping of DG Set (Red, Green).

1.25.14 **Module Type H1**

One (1) Double pole DC Switch with pad locking facility in off position.

1.25.15 **Module Type EL**

i) One (1) Four pole MCCB

ii) One (1) Contactor

iii) Electronic Timer suitable for continuous operation, push button and selector switch be as per scheme requirement.

1.26 **PARAMETERS**

1.26.1 **Power Supply**

1.26.1.1 AC System 3 phase, 4 wire, solidly earthed

a) Voltage 415 Volts, $\pm$ 10%
b) Frequency 50 Hz $\pm$ 5%
c) Combined variation $\pm$ 10% Absolute Sum in Voltage & frequency
d) fault Level 20 kA (rms)

1.26.1.2 **DC System** 2 Wire, unearthed

a) System Voltage 220V $\pm$ 10%
b) Fault Level 5 kA

1.26.2 **Control Supply Voltage**

a) Trip and closing coils 220V DC Unearthed
b) Spring charging 220V DC Unearthed

1.26.3 **Cubicle Data**

1.26.3.1 **Busbar Rating**

a) Continuous for Vertical panels As specified in 'Bill of Materials'
b) Short time (1 sec.)kA (rms) 20 kA
c) Momentary (kA) 45 kA
d) Ambient Temperature 50^0C
e) One Minute Power Frequency Withstand
I. Power Circuit 2500 Volts (rms)
II. Control Circuit 2500 Volts (rms)

1.26.3.2 **Cubicle Colour Finish**

a) Interior Glossy White
b) Exterior Smoke Grey shade No. 692 of IS:5

1.26.4 **Circuit Breaker**

a) Type Air break
b) No. of Poles 3

c) Voltage & Frequency	415 ± 10%, 50 HZ + 5%
d) Rated Operating Duty	B-3 Min, M-B-3 Min. MB
e) Symmetrical Interrupting rating	20 kA (RMS)
f) Short Circuit making current	45 kA (Peak)
g) Short time withstand 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 Owner's use on fixed portion of the cubicle
j) Short Circuit breaking current	
I. AC Component	20 kA (RMS)
II. DC Component	As per IS:13947 (Part 2)

1.26.5 **MOULDED CASE CIRCUIT BREAKER**

	AC System	**DC System**
a) No. of poles	4	2
b) Voltage & Frequency	415 ± 10% 50 HZ ± 5%	250 V
c) Rated Operating Duty	P2	P2
d) Symmetrical interrupting rating	20 kA (RMS)	5 KA
e) Short Circuit making current	45 kA (Peak)	--
f) No. of auxiliary contacts	2 NO & 2 NC	2 NO & 2 NC
g) Short Circuit breaking current		
I. AC Component	20 kA (RMS)	As per IS
II. DC Component	As per IS 13947	As per IS 13947

1.26.6 **Meters**

a) Accuracy Class	0.5
b) One minute power frequency withstand test voltage	2.0kV

1.26.7 **Current Transformers**

a) Type	Cast resin, Bar primary
b) Voltage class & frequency	650 V, 50 Hz
c) Class of Insulation	E or better
d) Accuracy class metering CT	Class 1, VA adequate for application but not less than 7.5 VA
e) Accuracy class protection CT	5P 15, VA adequate for application, but not less than 7.5 VA
f) Accuracy class differential protection	PS, KPV = 300 V
g) Short Time Current rating (for CTs Associated with circuit breakers)	
I. Current	20 kA (RMS)
II. Duration	One second
III. Dynamic Rating	45 kA (Peak)
IV. One minute Power frequency Withstand test Voltage	2.5 kv (rms)

1.26.8 **Voltage Transformer**

a) Type	Cast Resin
b) Rated Voltage	

Primary	415/√3 V
Secondary	110/√3 V
c) Method of connection	
Primary	Star
Secondary	Star
d) Rated Voltage Factor	1.1 continuous, 1.5 for seconds
e) Class of insulation	E or better
f) One minute power frequency withstand voltage	2.5 KV (RMS)
g) Accuracy class	0.5, not less than 20 VA

1.26.9 **Relay**

One minute power frequency withstand test	2 kV (rms)

1.27 **AUTOMATIC CONTROL OF OUTDOOR LIGHTING**

1.27.1 EL-type module of 415 V Main lighting distribution board and Emergency lighting distribution board and shall be controlled by timer and contactor module to facilitate its operation automatically.

1.28 **AUTOMATIC SUPPLY CHANGEOVER**

Automatic changeover between Incomer I, Income II and DG set is to be carried out during the failure of supply in one/or both the incomers. After the restoration of the supply, system shall be restored to normal condition automatically. The requirements of changeover under various conditions are as below:-

i) Under normal conditions i.e. when supply is available in both the incomers, incomers I&II of 415 V Main switchboard, ACDB shall be in closed condition and Bus couplers and DG set breaker shall be in open condition.

ii) In case of failure of either of the sources, the incomer of that source shall trip and Bus coupler shall get closed. On restoration of supply, normal conditions described above are to be established automatically.

iii) In case of failure of supply in both the sources, both incomers, incomers of ACDBs and ACDB Bus coupler shall trip and DG Set breaker switched on.

One restoration of one or both sources, DG Set breaker shall trip, DG set stopped and conditions described in paragraph (i)/(ii) shall be restored.

To avoid unnecessary operation of switchgear for momentary disturbances all changeovers from one state to another shall be intimated after a time delay, after the conditions warranting such change has been detected.

SECTION-VII

BATTERY & BATTERY CHARGER

SECTION : 7

BATTERY & BATTERY CHARGER

1.1 GENERAL TECHNICAL REQUIREMENTS

1.1.1 All materials/components used in battery chargers and batteries shall be free from flaws and defects (maintenance free) and shall conform to the relevant Indian/IEC standards with latest amendment and good engineering practice.

1.1.2 For 220/66kV/33kV sub-stations**,** DC System shall consist of two (2) float-cum-boost chargers and two (2) battery sets for 220V system. The capacity of the battery indicated in the specification is tentative. The contractor shall design the size/capacity. However the capacity shall be decided for a 10 Hour discharge rate. The standard scheme drawing is enclosed with this specification.

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

System Voltage	Maximum Voltage during Float operation	Minimum voltage available when no charger working & battery fully discharged upto 1.85V per cell.
220 Volt	242 Volt	198 Volt

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 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)

1.1.4 The tele-communication/SCADA equipments shall be suitable to operate on 220V DC power supply available in the substation.

1.2 Battery

1.2.1 Type

The DC Batteries shall be **VRLA (Valve Re gulated L ead-Acid)** type and shall be Normal Discharge type. These Batteries are intended to be used in air-conditioned atmosphere and shall be suitable for a long life under continuous float operations and occasional discharges. The 220V DC system is unearth.

1.2.2 Constructional Requirements

The design of battery shall be as per field proven practices. Partial plating of cells is not permitted. Paralleling of cells externally for enhancement of capacity is not permitted. Protective transparent front covers with each module shall be provided to prevent accidental contact with live module/electrical connections.

1.2.3 Containers

The container material shall have chemical and electro-chemical compatibility and shall be acid resistant. The material shall meet all the requirements of VRLA batteries and be consistent with the life of battery. The container shall be fire retardant and shall have an Oxygen Index of at least 28%. The porosity of the container shall be such as not to allow any gases to escape except from the regulation valve. The tensile strength of the material of the container shall be such as to handle the internal cell pressure of the cells in the worst working condition.

Cell shall not show any deformity or bulge on the sides under all working conditions. The container shall be capable of withstanding the rigours of transport, storage and handling. The containers shall be enclosed in a steel tray.

1.2.4 Cell Covers

The cell covers shall be made of suitable material compatible with the container material and permanently fixed with the container. It shall be capable to withstand internal pressure without bulging or cracking. It shall also be fire retardant. Fixing of Pressure Regulation Valve & terminal posts in the cover shall be such that the seepage of electrolyte, gas escapes and entry of electro-static spark are prevented.

1.2.5 Separators

The separators used in manufacturing of battery cells, shall be of glass mat or synthetic material having high acid absorption capability, resistant to sulphuric acid and good insulating properties. The design of separators shall ensure that there is no misalignment during normal operation and handling.

1.2.6 Pressure Regulation Valve

Each cell shall be provided with a pressure regulation valve. The valve shall be self re-sealable and flame retardant. The valve unit shall be such that it cannot be opened without a proper tool. The valve shall be capable to withstand the internal cell pressure specified by the manufacturer.

1.2.7 Terminal Posts

Both the +ve and –ve terminals of the cells shall be capable of proper termination and shall ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolt hole shall be coated with an acid resistant and corrosion retarding material. Terminal posts or any other metal part which is in contact with the electrolyte shall be made of the same alloy as that of the plates or of a proven material that does not have any harmful effect on cell performance. Both +ve and –ve posts shall be clearly and unambiguously identifiable.

1.2.8 Connectors, Nuts & Bolts, Heat Shrinkable Sleeves

Where it is not possible to bolt the cell terminals directly to assemble a battery, separate non-corroding lead or copper connectors of suitable size shall be provided to enable connection of the cells. Copper connections shall be suitably lead coated to withstand corrosion due to sulphuric acid at a very high rate of charge or discharge.

Nuts and bolts for connecting the cells shall be made of copper, brass or stainless steel. Copper or brass nuts and bolts shall be effectively lead coated to prevent corrosion. Stainless steel bolts and nuts can be used without lead coating. All inter cell connectors shall be protected with heat shrinkable silicon sleeves for reducing the environmental impact including a corrosive environment.

1.2.9 Flame Arrestors

Each cell shall be equipped with a Flame Arrestor to defuse the Hydrogen gas escaped during charge and discharge. Material of the flame 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 Celsius for a period of 6 months shall not be more than 60% and the cell/battery shall achieve 85% of its rated capacity within 3 charge/discharge cycles and full rated capacity within 5 cycles, after the storage period of 6 months. Voltage of each cell in the battery set shall be within 0.05V of the average voltage throughout the storage period. Ampere hour efficiency shall be better than 90% and watt hour efficiency shall be better than 80%.

1.2.12 Expected Battery Life

The battery shall be capable of giving 1200 or more charge/discharge cycles at 80% Depth of discharge (DOD) at an average temperature of 27º Celsius. DOD (Depth of Discharge) is defined as the ratio of the quantity of electricity (in Ampere-hour) removed from a cell or battery on discharge to its rated capacity.

The battery sets shall have a minimum expected life of 20 years at float operation.

1.2.13 Routine Maintenance of Battery system

For routine maintenance of battery system, the contractor shall supply 1 set of following tools:

a) Torque wrench.

b) Cell test voltmeter(-3-0-+3) volts

1.2.14 Type Test of Battery

The contractor shall supply type tested battery. The Contractor shall submit the Battery type test reports of tests conducted on the same make, model, type & rating as offered as per the IEC 896-2 or equivalent IS/EN/BS standards.

1.2.15 List of Factory & Site Tests for Battery

Sl. No.	Test	Factory Tests	Site Tests
1.	Physical Verification	√	√
2.	C/10 Capacity test on the cell	√	
3.	8 Hrs. Charge and 15 minutes discharge test at full rated load		√

1.3 Battery Charger

The DC system for 220 V DC is unearth. The Battery Chargers as well as their automatic regulators shall be of static type and shall be compatible with offered VRLA batteries**.** All battery chargers shall be capable of continuous operation at the respective rated load in float charging mode, i.e. Float charging the associated DC Lead-Acid Batteries at 2.15 to 2.25 Volts per cell while supplying the DC load. The chargers shall also be capable of Boost charging the associated DC Battery at 2.3 +/- 0.02 volts per cell at the desired rate. Charger shall regulate the float/boost voltage in case of prescribed temperature rise of battery as per manufacturers recommendation to avoid thermal runaway. Necessary temperature sensors shall be provided in mid location of battery banks and shall be wired up to the respective charger for feedback control. The manufacturer shall demonstrate this feature during testing of each charger. Battery charger should be thyristor controlled.

1.3.1 All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. When on automatic control mode during Float charging, the Charger output voltage shall remain within ±1% of the set value, for AC input voltage variation of ±10%, frequency variation of ±5%, a combined voltage and frequency variation of ±10%, and a DC load variation from zero to full load.

1.3.2 All battery chargers shall have a constant voltage characteristics throughout the range (from zero to full load) at the floating value of the voltage so as to keep the battery fully charged but without harmful overcharge.

1.3.3 All chargers shall have load limiters having drooping characteristic, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the Load limiter setting of the Charger. The Load-limiter characteristics shall be such that any sustained overload or short circuit in DC System shall not damage the Charger, nor

shall it cause blowing of any of the Charger fuses. The Charger shall not trip on overload or external short circuit.

1.3.4 Uniform and step less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire float charging output range specified. Step less adjustments of the Load-limiter setting shall also be possible from 80% to 100% of the rated output current for Charging mode.

1.3.5 During Boost Charging, the Battery Charger shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode.

1.3.6 The Charger output voltage shall automatically go on rising, when it is operating on Boost mode, as the Battery charges up. For limiting the output voltage of the Charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage any where in the output range specified for Boost Charging mode.

1.3.7 The Charger manufacturer may offer an arrangement in which the voltage setting device for Float charging mode is also used as output voltage limit setting device for Boost charging mode and the Load-limiter of Float charging mode is used as current setting device in boost charging mode.

1.3.8 Suitable filter circuits shall be provided in all the chargers to limit the ripple content (Peak to Peak) in the output voltage to 1%, irrespective of the DC load level, when they are not connected to a Battery.

1.3.9 MCCB

All Battery Chargers shall have 2 Nos. MCCBs on the input side to receive cables from two sources. Mechanical interlock should be provided such that only one shall be closed at a time. It shall be of P2 duty and suitable for continuous duty. MCCB's should have auxiliary contacts for annunciation.

1.3.10 Rectifier Transformer

The rectifier transformer shall be continuously rated, dry air cooled (A.N) and of class F insulation type. The rating of the rectifier transformer shall have 10% overload capacity.

1.3.11 Rectifier Assembly

The rectifier assembly shall be fully/half controlled bridge type and shall be designed to meet the duty as required by the respective Charger. The rectifier shall be provided with heat sink having their own heat dissipation arrangements with natural air cooling. Necessary surge protection devices and rectifier type fast acting HRC fuses shall be provided in each arm of the rectifier connections.

1.3.12 Instruments

One AC voltmeter and one AC ammeter alongwith selector switches shall be provided for all chargers. One DC voltmeter and DC ammeter (with shunt) shall be provided for all Chargers. The instruments shall be flush type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustment. The instruments shall be of 1.5 accuracy class. In addition to the above a centre zero voltmeter with selector switch shall also be provided for 220V chargers for testing purpose.

1.3.13 Air Break Switches

One DC output switch shall be provided in all chargers. They shall be air break type suitable for 500 volts AC/ 250 DC. The contacts of the switches shall open and close with a snap action. The operating handle of the switch shall be fully insulated from circuit. `ON' and `OFF' position on the switch shall be clearly indicated. Rating of switches shall be suitable for their continuous load.
Alternatively, MCCB's of suitable ratings shall also acceptable in place of Air Break Switch.

1.3.14 Fuses

All fuses shall be HRC Link type. Fuses shall be mounted on fuse carriers which are in turn mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type base. In such case one insulated fuse pulling handle shall be supplied for each charger. Fuse rating shall be chosen by the Bidder depending on the circuit requirement. All fuses in the chargers shall be monitored. Fuse failure annunciation shall be provided on the failure of any fuse.

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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 bolt and hardware. The Chargers shall be fabricated from 2.0mm cold rolled sheet steel and shall have folded type of construction. Removable gland plates for all cables and lugs for power cables shall be supplied by the Contractor. The lugs for power cables shall be made of electrolytic copper with tin coat. Power cable sizes shall be advised to the Contractor at a later date for provision of suitable lugs and drilling of gland plates. The Charger shall be tropicalised and vermin proof. Ventilation louvers, if provided shall be backed with screens. All doors and covers shall be fitted with synthetic rubber gaskets. The chargers shall have hinged double leaf doors provided on front and on backside for adequate access to the Charger's internals. All the charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-42 as per IS: 13947 Part I.

1.3.18.1.All indicating instruments, control switches and indicating lamps shall be mounted on the front side of the Charger.

1.3.18.2 Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks and ready for external connections. The control wiring shall be carried out with PVC insulated, 1.5 sq.mm. stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5 sq.mm stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 20% spare terminals shall be provided for control circuits.

1.3.18.3 The insulation of all circuits, except the low voltage electronic circuits shall withstand test voltage of 2 KV AC for one minute. An air clearance of at least ten (10) mm shall be maintained throughout for such circuits, right up to the terminal lugs. Whenever this clearance is not available, the live parts shall be insulated or shrouded.

1.3.19 Painting

All sheet steel work shall be pre-treated, in tanks, in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be `Class-C' as specified in IS:6005. Welding shall not be done after phosphating. The phosphating surfaces shall be rinsed and passivated prior to application of staved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint of shade-631 of IS:5 shall be applied, unless required otherwise by the Owner. The inside of the chargers shall be glossy white. Each coat of finishing synthetic enamel paint shall be properly stoved. The paint thickness shall not be less than fifty (50) microns.

1.3.20 TESTS

1.3.20.1.Battery chargers shall conform to all type tests as per relevant Indian Standard. Performance test on the Chargers as per Specification shall also be carried out on each Charger as per specification. Rectifier transformer shall conform to all type tests specified in IS: 4540 and short circuit test as per IS:2026. Following type tests shall be carried out for compliance of specification requirements:

i) Voltage regulation test
ii) Load limiter characteristics test
iii) Efficiency tests
iv) High voltage tests
v) Temperature rise test
vi) Short circuit test at no load and full load at rated voltage for sustained short circuit.
vii) Degree of protection test
viii) Measurement of ripple by oscilloscope.

1.3.20.2.The Contractor may be required to demonstrate to the OWNER that the Chargers conform to the specification particularly regarding continuous rating, ripple free output, voltage regulation and load limiting characteristic, before dispatch as well as after installation at site. At site the following tests shall be carried out :

i) Insulation resistance test
ii) Checking of proper annunciation system operation.

1.3.20.3.If a Charger fails to meet the specified requirements, the Contractor shall replace the same with appropriate Charger without affecting the commissioning schedule of the Sub-station, and without any extra cost to the OWNER.

1.3.20.4.The Contractor shall present for inspection, the type and routine test certificates for the following components whenever required by the OWNER.

(i) Switches.
(ii) Relays/MCCBs
(iii) Instruments.
(iv) DC fuses.
(v) SCR.
(vi) Diodes.
(vii) Condensers.
(viii) Potentiometers.
(ix) Semiconductor
(x) Annunciator.
(xi) Control wiring
(xii) Push buttons and contactors.

Makes of above equipment shall be subject to Owner’s approval.

1.4 THE POWER SUPPLY SYSTEM FOR SCADA SYSTEM

The tele-communication/SCADA equipments shall be suitable to operate on 220V DC power supply available in the substation.

SECTION-VIII

LIGHTING SYSTEM

SECTION : 8

LIGHTING SYSTEM

1.0 LIGHTING SYSTEM

1.1 The scope of work comprises of design, engineering, testing, supply, installation, testing and commissioning of various lighting fixtures complete with lamps, supports and accessories, ceiling fans complete with electronic regulators, exhaust fans for toilets, pantry and battery room, lighting panels, lighting poles complete with distribution boxes, galvanized rigid steel conduits, lighting wires, G.I. Earthwire, receptacles, tag block & telephone socket, switchboards, switches, junction boxes, pull out boxes complete with accessories, lighting transformer. The lighting system shall be as per Energy Conservation Act. (Latest).

1.2 **SYSTEM DECRIPTION**

A typical arrangement of lightening system shall comprise of the following:

1.2.1 **AC Normal Lighting**

AC lights will be connected to AC lighting panels. All the lights connected to the AC lighting system in different areas will be connected to the main lighting distribution boards.

1.2.2 **AC Emergency Lighting**

This system will be available in control room building, DG Set building & switchyard. AC lighting load will be connected to this system, which will be normally 'ON'. The lighting panels of this system will be connected to the Emergency lighting board, which is fed from diesel generator during the emergency. 50% of lighting fixtures shall be connected on AC emergency lighting.

1.2.3 D.C. Emergency Lighting

A few 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 DG Set building so that the operating personnel can safely find their way even during emergency of a total AC failure. These lights will be normally 'OFF' and will be switched 'ON' automatically when under voltage occurs in the AC main lighting distribution board. GLS lamp down lighters in false ceiling area and Bulkhead fixtures in non-false ceiling area to be used.

1.2.4 Portable Fixtures

Three numbers of battery operated, portables fixtures will be provided in the Control room building and one number shall be provided in DG Set Building.
These fixtures will be provided at important locations in the above-mentioned areas.

1.3 The Lux levels to be maintained in the switchyard shall be as per following :

S.No.	Area	Average Lux Level
1)	Switchyard	Average Lux level 50 Lux on main Equipments (i.e Transformer, ISO) at first level (Equipment Connection level.) 20 Lux on balance area of switchyard and Road at ground level

The minimum Lux level to average Lux level ratio should not be less than 0.3 (i.e. Emin/Eavg>0.3). the maintenance factor for outdoor illumination design shall be considered as 0.65.

For achieving the specified Lux levels in the switchyard, the contractor can provide luminaries of 1x400W/ 1x250W and 2x 400W/ 250 W flood light as per requirement.

The contractor shall submit detailed calculation for reaching the above Lux level. Contractor shall conform the Lux levels at different locations of the switchyard and lighting by measurement.

In addition to the normal lighting provided in the switchyard area to maintain the desired Lux levels, few high beam fixtures on swivel support shall be provided in strategic locations near equipments, which shall be kept normally OFF, and these shall be switched ON in case of maintenance work.

1.4 Adequate nos. of Ceiling fans (1400mm sweep, AC 230 volts) shall be provided in DG set building and all the rooms in the control room building. Wall mounted fans shall be provided in the conference room, shift manager and substation in charge rooms in control room building. In addition exhaust fans shall be provided in toilets, pantry and battery room.

1.5 One no. of aluminium ladder of each size shall be supplied by the contractor for maintenance purpose.

1.6 The following specific areas are included in the scope of lighting:

(i) GIS cum Control Room building.
(ii) Switchyard outside GIS cum Control Room Building.
(iii) DG Set
(iv) Landscape lighting around GIS cum Control Room building
(v) Roads in the substation.

1.7 Street lighting shall be provided through HP sodium vapour lamps.

1.8 **For Outdoor Illumination**

Switchyard design, detailed drawings showing the lighting layout and Electrical distribution diagram shall be prepared by the Contractor and submitted for approval. The above layout drawings will include disposition and location of lighting fixtures, receptacles, etc.

High Mast Lighting System

The High Mast shall be provided for out door illumination. The bidders shall design the proper height of High Mast, control panels and average illumination level for out door switchyard as per IS:3646 (part-2) and subjected to the Employer approval. The required quantity and rate shall be filled by the bidder in relevant BPS (Vol-III). The Mast shaft shall be provided with hot dip galvanised and suitable for wind velocity as per IS 875. It shall also include accessories for high mast including head frame, steel wire rope, trailing cable, double drum winch, galvanised Lantern carriage arrangement suitable for luminaries symmetrically & its control gear boxes and lightning finial etc. The mast shall have an integral power motor installed inside the base compartment for its operation.

The control panel housing shall be contactor circuit for the automatic control of luminaries, outgoing terminals and control circuit for the power motor.

For Indoor Illumination

The conduit layout for substation buildings based on the tender drawings, Electrical distribution diagram for substation buildings & for landscape lighting cable schedule for substation yard etc. shall be prepared by the Contractor. All wiring including telephone wiring (tinned two pair copper) shall be in concealed conduit. Concealed MS junction boxes for sockets and light points shall be provided in all the rooms of GIS cum Control Room Building, DG Set Building etc.

1.9 Each cable and conduct run shall be tagged with number that appears in the cable and conduit schedules. Cables and conduits shall be tagged at their entrance and / or exit from any piece of equipment, junction or pull box, floor opening etc.

1.10 The tags shall be made up of aluminium with the number punched on it and securely attached to the cables by not less than two turns of G.I. wire Cable tags shall be rectangular in shape for power cables and circular shape for control cables.

1.11 Location of cables laid directly under ground shall be indicated clearly by cable marker made of galvanized iron plate embedded in concrete book.

1.12 The location of under ground cable joints if any, shall be clearly indicated with cable marker with an additional inscription “cable joint”.

1.13 The marker, which is a concrete block, shall project 150mm above ground and shall be spaced at an interval of 30 meters and at every change of direction. It shall also be located on both sides of the road or drain crossing.

2.0 DESCRIPTION OF ITEMS

The Contractor shall supply and install the following equipment and accessories in accordance with the specification.

2.1 LIGHTING PANELS

2.1.1 Outdoor

415 V AC lighting panel with 415V, 63A, 3 Phase 4 wire bus and one no. 63A, TPN, MCB with neutral unit as incomer and 20A, MCB as outgoing feeders, the details are as follows.

Type	Description	Details of outgoing Feeders
ACP-2	Outdoor	6 nos. 32A Tripple pole MCB with Neutral suitable timer & contactor for automotive switching.
ACP-3	Outdoor	3 nos., 32A Tripple pole MCB with Neutral Lighting with suitable timer & contractor for automatic switching.

Note: The number of outgoing feeders indicated above are the minimum.

2.1.2 Indoor

415 V Indoor AC lighting panel, 63A, 3 phase, 4 wire bus and one number 63 AMP, TPN, MCB with 300ma 63A, RCCB. Flush Mounted with per phase isolation and indication lamps din mounted. The DB will be flush mounted.

ACP-1	Indoor	18 nos. outgoing 16-32 amp SPMCB

2.2. 220V DC indoor type change over board and 220V DC 32A two wire bus and one 32A contactor backed up by 32A double pole MCB as incomer. The panel shall have local push button controls. Following are the various types of panels required with control timer.

Type	Description	Details of Outgoing Feeders
DCP	Indoor	6 Nos. – 16A DPMCB Unit.

2.3. **Sub-Lighting Panels**

Type	Description
SLD	4 pole 32A Isolator suitable for 415V, 50 cycles AC Supply, with LILO Facility using 8 nos. terminal blocks suitable for cable upto 16m sq cable Enclosure shall be suitable for outdoor use with IP-55 degree of protection as per IS: 13947 (Part-I)

2.4. **Lighting Fixtures and Receptacles**

Lighting Fixtures

Type	Description
IF	CFL/Metal Halide in recessed down light having high purity aluminum reflector electrochemically brightened and anodized. Stainless steel leaf springs and pressure die cast ceiling similar to Philips Cat. No. DN-622 Crompton greaves cat DDLV 10-BC
SF1	Whether proof integral Floor Lighting with housing made of corrosion resistant die cat aluminum painted black. Grey powder coated outside suitable for 150W SON-T lamp complete with all accessories and suitable for termination with conduits/flexible Cat. No. F 69045 (C). Similar to Philips Cat. No. SWF230/150/Bajaj Cat. No. B GEMF-150WSV Crompton Greaves Cat No. FAD 11151H
SF2	2 x 400 / 2 x 250 W HP Sodium vapour lamps in high flood lighting fixture suitable for outdoor mounting with aluminum enclosure: similar to Phillips Cat. No. SNT001/Bajaj Cat. No. DJEF-22CA/Crompton Greaves Cat. No. FHD1324
SF3	1 x 250 W/ 1 x 400 HP Sodium vapour lamps in high flood lighting fixture suitable for out door mounting with aluminum enclosure and integral control gear: similar to Phillips cat. No. SWF 330/CGL Cat. No. FAD 1114/Bajaj Cat. No. BJEF T14CA.

PF 1x11 W CFL/Metal Halide lamp emergency light with Battery operated portable fixture with built in chargeable Batteries and battery charger suitable for a lighting period of six hours similar to ALPHA DELUX of M/s DELTA FLASH LITE/MICRO LITE OF M/s MICRO / BPL MAKE

FB 9W CFL /Metal Halide lamp in Bulkhead fixtures with Cat Aluminium alloy body, suitable for column, wall, and ceiling mounting finished stove enameled silver grey outside white inside, to be supplied complete (with front cover, wire guard, tropicalised gasket and lamp holder taped ¾" E.T. for conduit entry) similar to Phillips Cat. No. FXC 101/Bajaj Cat. No. BJBE-19/Crompton Greaves.

MP 125 HP MV CFL/Metal Halide in weather proof post top lantern with case aluminium canopy, mounting piece, opal acrylic cover tropicated gasket and all other accessories for mounting on pole top similar to Phillips Cat. No. HPC-101/Bajaj/Crompton Greaves.
Cat No. MPT12IH/BC

IB 60/100W CFL/Metal Halide in Bulkhead fixtures with cast Aluminium alloy, body, suitable for column, wall and ceiling mounting finished stove enameled silver grey outside white inside, to be supplied complete (with front glass, wire guard, tropicalised, gasket and E.S. Porcelain, lamp holder taped ¾" E.T. for conduit entry) similar to Phillips Cat. No. NXC101/Crompton Greaves IBH1110/BC

BL 2x9 or 1x18 W, CFL bollard light for landscape lighting FRP/LLDPE housing similar to Phillips FGC202/Crompton Greaves Cat No. CFBL1129

DLR 2x18 W, CFL Down light for recess mounting lighting having similar to Phillips FBH225/2x18 / Crompton Greaves Cat No DDLH218TG

DSM 1x13 WTT surface mounted CFL similar to Art Light Make Cat No. RL 3146

HL 2x18 CFL Decorative hanging down Light Similar no. Cat No Art light RL 3166/HL

CL 1x18 WATT Decorative ceiling mounted luminaries similar to Phillips Dixie Cat FL 343/118

2.5 **RECEPTACLES**

RO 15A, 240V, Outdoor Receptacle 3 Pole, 3 pin type
R1 5/15A, 240V Indoor receptacle 3-in type
RP 63A, 415V, Interlocked switch socket, outdoor receptacle

2.6 **SWITCH BOARDS**
Modular type switches, 5/15 Amp. Receptacles

2.7 **CONDUITS AND ACCESSORIES**
Galvanised Rigid Steel Conduits of 19mm/25mm/32mm/40mm dia

2.8 **JUNCTION BOXES** with 5 nos. of terminal blocks

2.9 **LIGHTING POLES –** Adequate nos. of lighting pole shall be provided.

2.10 **CEILING FANS –** 1400mm Sweep with Electronic regulator

2.11 **MAINTENANCE EQUIPMENT**

i) A type Aluminium ladder of 3 mtr. vertical height.
ii) Cartwheel mounted aluminium ladder Vertical Height 7.5 Mtrs. when extended.

2.12 **LIGHTING TRANSFORMER**
Supply, erection, testing and commissioning of 100 KVA or above (in case the capacity of transformer required is higher than 100 KVA as per approved calculations), 415/415 V, 3

Phase, 50 Hz Dry type natural air cooled lighting transformers. The technical parameters of these lighting transformers are as follows:-

Technical Parameters of Lighting Transformer

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	:	IS:2026

The enclosure for the above transformer shall have degree of protection not less than IP-42. The rating of lighting transformer should be suitable for lighting load. The contractor shall submit the supporting calculation for the rating of lighting transformer.

3.0 LIGHTING FIXTURES AND ACCESSORIES

3.1 General

All lighting fixtures and accessories shall be designed for continuous operation under atmospheric conditions existing at site, without reduction in the life or without any deterioration of materials, internal wiring.

3.2 Temperature Rise

All lighting Fixtures and accessories shall be designed to have a low temperature rise according to the relevant Indian Standards. The design ambient temperature shall be taken as 50 deg.C.

3.3 Supply Voltage

3.3.1 Lighting fixtures and accessories meant for 240 V A.C. operation shall be suitable for operation on 240V A.C. 50Hz, supply voltage variation of ± 10%, frequency variation of ± 5% and combined voltage and frequency variation of ± 10%.

3.3.2 Lighting fixture and accessories meant for 220V DC operation shall be suitable for operation on 220V DC with variation between 190 to 240 Volts.

3.4 Lighting Fixtures

The lighting fixtures shall be Philips or Bajaj or Crompton Greaves make only except for fixtures type 'DSM' & 'HI/ for which make has been specified elsewhere in this section. The different types of lighting fixtures are also indicated elsewhere in this Section.

3.4.1 All Fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection.

3.4.2 All lighting fixtures shall be complete with CFL / mercury vapour/sodium vapour/metal halide lamps as specified and shall be suitably wired up.

3 4.3 High beam Fixtures shall be suitable for pendant mounting and flood lights shall have suitable base plate / frame for mounting on steel structural member. Hook mounted high beam fixtures are not acceptable.

3.4.4 Each lighting Fixture shall be provided with an earthing terminal suitable for connection to 16 SWG GI earthing conductors.

3 .4 5 All light reflecting surfaces shall have optimum light reflecting co-efficient such as to ensure the overall light output as specified by the manufacturer.

3.4.6 Height of fixtures should be such that it is easy to replace the lamps with normal ladder/stool. In case the ceiling height is very high, the fixtures may be placed on the walls for ground lighting.

3.5 ACCESSORIES

3.5.1 **Reflectors**

The reflectors shall be manufactured from sheet steel or aluminium as applicable. They shall be securely Fixed to the captive type.

3.5.2 **Lamp holders and Starter Holders**

Lamp holders/starter for CFL, Metal Halide Lamp and HPMV/HPSV lamps shall be of screwed type, manufactured in accordance with relevant standard and designed to give long and satisfactory service.

3.5.3 **Ballasts**

a) The Ballasts shall be designed, manufactured and supplied in accordance with relevant standard and function satisfactorily under site condition specified. The ballasts shall be designed to have a long service life and low power loss.
b) Ballasts shall be mounted using self locking anti-vibration fixing and shall be easy to remove without dismantling the fixtures. They shall be totally enclosed units.
c) The ballasts shall be of the inductive, heavy duty type, filled with 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 tappings to set the voltage within the range specified. End connections and taps shall be brought out in a suitable terminal block, rigidly fixed to the ballast enclosure.
d) Separate ballast for each lamp shall be provided in case of multi-lamp fixtures.

3.5.4 **Starters**

Starters shall have bimetal electrodes and high mechanical strength. Starters shall be replaceable without disturbing the reflector or lamps and without the use of any tool. Starters shall have brass contacts and radio interference suppressing capacitor.

3.5.5 Capacitors

a) The capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits.
b) The capacitors shall be suitable for operation at supply voltage as specified and shall have a value of capacitance so as to correct the power factors of its corresponding lamp circuit to the extent of 0.98 lag.
c) The capacitors shall be hermetically sealed in a metal enclosure.

3.6 **Lamps**

3.6.1 General Lighting Services (GLS) lamps shall be provided with screwed caps and shall be of 'clear" type unless otherwise specified.

3.6.2 Mercury vapour lamps, sodium vapour lamps shall be colour corrected type, with screwed caps.

3.7 The Bidder shall furnish typical wiring diagram for CFL/Metal Halide lamps, HPMV & HPSV fitting including all accessories. The diagram shall include technical details of accessories i.e. starters, Electronic Chokes, capacitors etc.

3.8 Flexible conduits if required, for any fixture shall be deemed to be included in Contractor's scope.

4.0 RECEPTACLES

a) All receptacles shall be of cast steel/aluminium, heavy duty type, suitable for fixing on wall/column and complete with individual switch.
b) In general the receptacles to be installed are of the following types
i) **Type RO** -15A, 240V, 2 pole, 3 pin type with third pin grounded, metal dad with gasket having cable gland entry suitable for 2C x6 sq.mm. PVC/aluminium armoured cable and a metallic cover tied to it with a metallic chain and suitable for installation in moist location and or outdoor. The switch shall be of rotary type. Receptacles shall be housed in an enclosure made out of 2 mm thick GI sheet with hinged doors with pad locking 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.

5.0 SWITCH AND SWITCHBOARD

(a) All Switch board/boxes, 5/15 Amp Receptacles and electronic fan regulators located in office/building areas shall be modular flush mounted type or brick wall with only the switch knob projecting outside.

(b) Switch boards/boxes shall have conduit knock outs on all the sides. Adequate provision shall be made for ventilation of these boxes.

(c) The exact number of switches including regulator for fans and layout of the same in the switchboard shall be to suit the requirement during installation.

(d) The maximum number of luminaries .controlled by one no 6 amp switch would 4 nos. For DC fixtures there will be no switch and the same shall be controlled from DC LP

(e) The luminaries shall be wired in such a fashion that luminaries on each phase are evenly distributed all over the room.

6.0 CONDUITS & CONDUIT ACCESSORIES

6.1 The conduits shall conform to IS:9537. All conduits shall be seemed by welding, shall be of heavy gauge and shall be hot dip galvanised.

6.2 Flexible conduits wherever required shall be made with bright, cold rolled annealed and electro-galvanised mild steel strips.

6.3 All conduits accessories shall conform to relevant IS and shall be hot dip galvanised.

7.0 JUNCTION BOXES

7.1 The junction boxes shall be concealed type for indoor lighting and suitable for mounting on columns, lighting poles, structures etc., for outdoor lighting.

7.2 Junction boxes shall be of square/rectangular type of 1.6 mm sheet steel with minimum 6 mm thick pressure die cast aluminium material LM-6 and shall have bolted cover with good quality gasket lining.

7.3 The junction box and cover shall be hot dip galvanised.

7.4 The junction boxes shall be complete with conduit knockouts/threaded nuts and provided with terminal strips .The junction boxes shall be suitable for termination of conduit/glands of dia 20 mm, 25 mm, 32 mm, 40 mm on all sides. The junction boxes shall be provided with 4 way terminals suitable for two numbers 10 sq. mm. wire & for switchyard lighting suitable for 2 numbers 4C x 16 Sq.mm Al. cable.

7.5 The junction boxes shall have the following indelible markings

(i) Circuit Nos. on the top.
(ii) Circuit Nos. with ferrules (inside) as per drawings.
(iii) DANGER sign in case of 415 volt junction box.

7.6 The junction boxes shall be weather proof type with gaskets conforming to IP-55 as per IS: 13947 (Part 1). The conduit connections shall also be properly sealed to prevent entry of water.

8.0 TERMINAL BLOCKS

8.1 Each terminal shall be suitable for terminating upto 2 Nos. 10 sq.mm. stranded Aluminium Conductors without any damage to the conductors or any looseness of connections.

9.0 PULL OUT BOXES

9.1 The pull out boxes shall be concealed type for indoor lighting and suitable for mounting on column, structures etc., for outdoor lighting. The supply of bolts, nuts and screws required for the erection shall be included in the installation rates.

9.2 The pull out boxes shall be circular of cast iron or 16 SWG sheet steel and shall have cover with good quality gasket lining.

9.3 The pull out boxes and cover shall be hot dip galvanized.

9.4 The pull out boxes shall be completed with conduit knock outs/threaded hubs and provided at approximately 3 meters intervals in a conduit run.

10.0 LIGHTING PANELS (L.P.)

10.1 Each panel shall be provided with one incoming triple pole MCB with neutral link and outgoing miniature circuit breakers as per clause 2.0. The panels shall conform to IS-8623.

10.2 **Constructional Features**

10.2.1 Panels shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be of thickness not less than 2.00 mm (cold rolled) or 2.5 mm (hot rolled) smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary. The indoor lighting panels will be ready made DB of minimum 20 swg sheet thickness.

10.2.2 The panels shall be of single front construction, front hinged and front connected, suitable for either floor mounting on channels, sills or on walls/columns by suitable M.S. brackets.

10.2.3 Panels shall have a dead front assembly provided with hinged door(s) and out door panels will be with padlocking arrangement with single key supplied in duplicate.

10.2.4 All out door panels, removable covers, doors and plates shall be gasket all around with neoprene gaskets.

10.2.5 The panels shall be suitable for cable/conduit entry from the top and bottom. Suitable removable cable gland-plates shall be provided on the top and bottom of panels. Necessary number of double compression cable gland shall be supplied, fitted on to this gland plate. The glands shall be screwed on top and made of tinned brass.

10.2.6 The panels shall be so constructed as to permit free access to connection of terminals and easy replacement of parts.

10.2.7 Each panel shall have a caution notice fixed on it.

10.2.8 Each panel will be provided with directory holder in which printed and laminated as built circuit directory would be kept

10.2.9 Each Outdoor lighting panel shall be provided with one no. 'ON' indicating lamp for each phase along with fuses. For indoor lighting panels din mounted phase indication lamps will be provided, mounted along side of the MCB

10.3 **Main Bus Bars**

10.3.1 Bus bars shall be of aluminium alloy conforming to IS:5082 and shall have adequate cross-section to carry the rated continuous and withstands 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 I sec. for AC panels and 4 KA for I sec. for DC panels. The Indoor lighting panels shall have copper bus bar.

10.4 **Residual Current Circuit Breakers (RCCB)**

10.4.1 For indoor panels 63A 4 pole 300 ma conforming IS 12640 will be provided along with incomer

10.5 **Miniature Circuit Breaker (MCB)**

a) The miniature circuit breakers shall be suitable for manual closing, opening, automatic tripping under overload and short circuit. The MCBs shall also be trip free.
b) Single pole as well as three pole versions shall be furnished as required in the Schedule of Lighting Panels.
c) The MCBs and panel MCCB together shall be rated for full fault level. In case the MCB rating is less than the specified fault level the bidder shall co-ordinate these breaker characteristics with the back up MCCB in such a way that if fault current is higher than

breaker rating, the MCCB should blow earlier than the breaker. If the fault current is less than MCB breaking capacity, MCB shall operate first and not the incomer MCCB.

d) The MCBs shall be suitable for housing in the lighting panels and shall be suitable for connection with stranded copper wire connection at both the incoming and outgoing side by copper lugs or for bus bar connection on the incoming side.
e) The terminals of the MCBs and the 'open' 'close' and 'trip' conditions shall be clearly and indelibly marked.
f) The tenderer shall check and co-ordinate the ratings of MCBs with respect to starting characteristics of discharge lamps. The vendor has to furnish overload and short circuit curve of MCB as well as starting characteristics curves of lamps for Employer's approval.
g) The MCB shall generally conform to IS:8828.

10.6 **Contactors**

Contactors shall be of the full voltage, direct-on line air break, single throw, electro-magnetic type. They shall be provided with at least 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 dosed. 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 toad.

10.7 **Push Buttons**

All push buttons shall be of push to actuate type having 2 'NO' and 2 'NC' self reset contacts. They shall be provided with integral escutcheon plates engraved with their functions. Push buttons shall be of reputed make.

10.8 **Labels**

a) The lighting panels shall be provided on the front with panel designation labels on a 3 mm thick plastic plate of approved type. The letter shall be black engraved on white back ground.
b) AII incoming and outgoing circuits shall be provided with labels. Labels shall be made of non-rusting metal or 3 ply lamicold. Labels shall have white letters on black or dark blue background.

10.9 **Earthing Terminals**

Panels shall be provided with two separate and distinct earthing terminals suitable to receive the earthing conductors of size 50x6 G.S. Flat.

10.10 Type test reports for following tests on all lighting panels shall be submitted for approval.

(i) Wiring continuity test
(ii) High voltage (2.5 KV for I minute) and insulation test
(iii) Operational test
(iv) Degree of protection (not less than IP-55 test on outdoor Lighting Panels and IP-52 test on indoor Lighting Panels as per IS 13947 (part 1)
(v) Heat run test

10.11 **Lighting Transformer**

Lighting transformer shall be located in MCC room, in seperate enclosure. Enclosure shall have degree of protection not less than IP-42 as per IS-13947 (Part-1).

11.0 Emergency Portable Lighting Fixtures

11.1 The portable fixtures shall have a built in battery rated for six hours, battery chargers and solid state inverters. These shall be of approved make.

11.2 The portable fixtures shall be of a single unit, completely tropicalised and suitable for prolonged use with no maintenance.

11.3 The portable fixtures shall be supplied and necessary supporting brackets of galvanized steel suitable for wall/column mounting shall also be supplied.

11.4 The portable fixture shall come up automatically in the event of failure of normal supply.

12.0 LIGHTING POLES

12.1 In front of GIS cum control room building and DG Set building decorative post top lantern poles and Bollards shall be installed.

12.2 Lighting poles shall be complete with fixing brackets and junction boxes. Junction boxes should be mounted one meter above ground level.

12.3 The lighting poles shall be coated with bituminous preservating paint on the inside as well as on the embedded outside surface. Exposed outside surface shall be coated with two coats of metal primer (comprising of red oxide and zinc chromate in a synthetic medium).

12.4 Wiring from junction box at the bottom of the pole to the fixture at the top of the pole shall be done through 2.5 sq. mm wire.

12.5 Earthing of the poles should be connected to the switchyard main earth mat wherever It is available and the same should be earthed through 3M long, 20 mm dia, earth electrode.

13.0 CEILING & WALL MOUNTED FANS AND REGULATORS

13.1 The contractor shall supply and install 1400 mm sweep ceiling fans complete with electronic regulator and switch, suspension rod, canopy and accessories. The wall-mounted fans shall be of 400 mm sweep

13.2 The contractor shall supply and install the switch, electronic regulator and board for mounting switch and electronic regulator for ceiling fans.

13.3 Winding of the fans and regulators shall be insulated with Class-E insulating material. Winding shall be of copper wire.

13.4 Electronic regulator with smooth control shall be provided.

13.5 One fan for approx 100 sq. feet area shall be provided.
Fans and electronic regulators shall be of Alstom / Crompton Greaves / Bajaj Electricals / Usha Electricals make.

14.0 LIGHTING WIRES

14.1 The wiring used for lighting shall be standard products of reputed manufacturers.

14.2 The wires shall be of 1100 V grade, PVC insulated product of reputed manufacturers.

14.3 The conductor sizes for wires used for point wiring beyond lighting panels shall be single core 4 sq. mm., 6 sq.mm and 10 sq.mm stranded aluminium wires and 2.5 sq.mm, 4 sq.mm, 6 sq.mm and 1.5 sq.mm stranded copper wire.

14.4 The wires used for connection of a lighting fixture from a nearest junction box or for loop-in loop-out connection between two CFL/Metal Halide lamps fluorescent fixtures shall be single core copper stranded conductor, 1100V grade flexible PVC insulated cords, unsheathed, conforming to IS:694 with nominal conductor cross sectional areas of 2.5 sq. mm.

14.5 The wires shall be colour coded as follows:
Red for R – Phase
Yellow for Y - Phase
Blue for B - Phase
Black for Neutral
White for DC (Positive)
Grey for DC (Negative)

15.0 PAINTING OF SHOP MADE ITEMS

15.1 All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with IS:6005 'Code of Practice for Phosphating Iron and Steel'.

15.2 Oil grease and dirt shall be thoroughly removed by emulsion cleaning.

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

15.4 After phosphating through rinsing shall be carried out with clean water, followed by final rinsing with diluted dichromate solution and oven drying.

15.5 The phosphate coating shall be sealed by the application of two coats of ready mixed stoving type metal primer (comprising of red oxide and Zinc chromate in a synthetic medium). The first coat may be 'flash dried' while the second coat shall be stoved.

15.6 After application of the primer, two coats of finishing synthetic enamel paint shall be applied with each coat followed by stoving. The second finishing coat for the external of panels shall be applied after completion of tests. The panels can also be powder coated instead of painting after surface treatment as given above.

15.7 Both outside and inside of lighting panel, sheet metal fabricated junction boxes etc. and outside of lighting fixtures shall be finished in light grey (IS-5 shade 631). Inside of lighting fixtures shall be finished in white. The colour of indoor lighting panels should match with colour of wall.

15.8 Each coat of primer and finishing paint shall be of slightly different shade so as to enable inspection of the painting.

15.9 The final finished thickness of paint film on steel shall not be less than 100 microns and shall not be more than 150 microns. The final thickness of powder coating will not be less than 50 microns. For indoor lighting panels the painting will be as per approved manufacturers specification.

15.10 Finished painted appearance on equipment shall present on aesthetically pleasing appearance, free from dents and uneven surfaces.

16.0 LIGHTING SYSTEM INSTALLATION WORKS

16.1 **General**

16.1.1 In accordance with the specified installation instructions as shown on manufacturer's drawings or as directed by Employer, Contractor shall unload, erect, install, test and put into commercial use all the electrical equipment included in the contract. Equipment shall be installed in a neat, workmanship manner so that it is level, plumb square and property aligned and oriented. Tolerances shall be as established in manufacturers drawing or as stipulated by Purchaser.

16.1.2 All apparatus, connections and cabling shall be designed so as to minimise risk of fire or any damage which will be caused in the event of fire.

16.2 **Conduit System**

16.2.1 Contractor shall supply, store and install conduits required for the lighting installation as specified. All accessories/fittings required for making the installation complete, including but not limited to pull out boxes (as specified in specification ordinary and inspection tees and elbow, check nuts, male and female bushings (brass or galvanised steel), caps, square headed make plugs, nipples, gland sealing fittings, pull boxes, conduits terminal boxes, glands, gaskets and box covers, saddle terminal boxes, and all steel supporting work shall be supplied by the Contractor. The conduit fittings shall be of the same material as conduits. The contractor shall also supply 19 mm PVC conduit and accessories for telephone wiring.

16.2.2 All un-armoured cables shall run within the conduits from lighting panels to lighting fixtures, receptacles, etc.

16.2.3 Size of conduit shall be suitably selected by the Contractor.

16.2.4 Conduit support shall be provided at an interval of 750 mm for horizontal runs and 1000 mm for vertical runs.

16.2.5 Conduit supports shall be clamped on the approved type spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn, shall be securely fixed to the

building steel by welding and to concrete or brick work by grouting or by nylon rawl plugs. Wooden plug inserted in the masonary or concrete for conduit support is not acceptable.

16.2.6 Where conduits are alongwith cable trays they shall be clamped to supporting steel at an interval of 600 mm.

16.2.7 For directly embedding in soil, the conduits shall be coated with an asphalt-base compound. Concrete pier or anchor shall be provided wherever necessary to support the conduit rigidly and to hold it in place.

16.2.8 For long conduit run, pull boxes shall be provided at suitable intervals to facilitate wiring.

16.2.9 Conduit shall be securely fastened to junction boxes or cabinets, each with a lock nut inside and outside the box.

16.2.10 Conduits joints and connections shall be made through water-tight and rust proof by application of a thread compound which insulates the joints. White lead is suitable for application on embedded conduit and red lead for exposed conduit.

16.2.11 The entire metallic conduit system, shall be embedded, electrically continuous and thoroughly grounded. Where slip joints are used, suitable bounding shall be provided around the joint to ensure a continuous ground circuit.

16.2.12 Conduits and fittings shall be properly protected during construction period against mechanical injury. Conduit ends shall be plugged or capped to prevent entry of foreign material.

16.3 **Wiring**

16.3.1 Wiring shall be generally carried out by PVC insulated wires in conduits. All wires in a conduit shall be drawn simultaneously. No subsequent drawings of wires is permissible.

16.3.2 Wires shall not be pulled through more than two equivalent 90 deg. bends in a single conduit run. Where required, suitable junction boxes shall be used.

16.3.3 Wiring shall be spliced only at junction boxes with approved type terminal strip.

16.3.4 For lighting fixtures, connection shall be teed off through suitable round conduit or junction box, so that the connection can be attended without taking down the fixture.

16.3.5 For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/junction box.

16.3.6 Maximum two wires can be terminated to each way of terminal connections.

16.3.7 Separate neutral wires are to be provided for each circuit.

16.3.8 AC and DC wiring should not run through the same conduit.

16.4 **Lighting Panels**

16.4.1 The lighting panels shall be erected at the locations to be finalised during detailed engineering.

16.4.2 Suitable foundations/supporting structures for all outdoor type lighting panels shall be provided by the Contractor.

16.5 **Foundation & civil works**

16.5.1 Foundation for panel foundation and transformer foundation shall be done by the Contractor..

16.5.2 All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grouting of anchor bolts, sills, inserts and fastening devices shall be carried out by the Contractor including minor modification of civil works as may be required for erection.

16.5.3 Any cutting of masonary / concrete work, which is necessary shall be done by the Contractor at his own cost and shall be made good to match the original work.

SECTION-IX

LT TRANSFORMER

SECTION: 9

LT TRANSFORMER

Technical specification for 11/0.433 kV Distribution Transformer

1. SCOPE:

1.1 This specification covers design, engineering, manufacture, assembly, inspection and testing before supply and delivery at site of oil immersed, naturally cooled 3 phase wound and outdoor type 11 kV/0.433 kV distribution transformers, for providing auxiliary power supply to DTL s/stn only.

1.2 It is not the intent to specify completely herein all the details of the design and construction of equipment. However the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.

1.3 The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in operation and maintenance of equipment.

1.4 All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

2. STANDARD RATINGS:

2.1 The standard ratings shall be 10, 16, 25, 63, 100, 160, 200, 250, 315, 400,500, 630, 1000, 1250, 1600, 2000 and 2500 kVA for 11 kV distribution transformers .

3. STANDARDS:

3.1 The materials shall conform in all respects to the relevant Indian/International Standards, with latest amendments thereof unless otherwise specified herein. Some of them are listed below:

Standard	Title
IS -2026 IEC 60076	Specification for Power Transformers
IS 12444	Specification for Copper wire rod
IS-335 IEC 296	Specification for Transformer Oil

IS - 5	Specification for colors for ready mixed paints
IS - 104	Ready mixed paint, brushing zinc chromate, priming
IS – 2099	Specification for high voltage porcelain bushing
IS - 649	Testing for steel sheets and strips and magnetic circuits
IS – 4257 Part-I	Dimensions for clamping arrangements for bushings
IS - 7421	Specification for Low Voltage bushings
IS – 3347 Part-I	Specification for Outdoor Bushings
IS – 9335 IEC 554	Specification for Insulating Kraft Paper
IS – 1576 IEC 641	Specification for Insulating Press Board
IS – 6600 IEC76	Guide for loading of oil Immersed Transformers
IS - 2362	Determination of water content in oil for porcelain bushing of transformer
IS - 6160	Rectangular Electrical conductor for electrical machines
IS - 5561	Electrical power connector
IS - 6103	Testing of specific resistance of electrical insulating liquids
IS - 6262	Method of test for power factor and dielectric constant of electrical insulating liquids
IS - 6792	Determination of electrical strength of insulating oil
IS - 10028	Installation and maintenance of transformers.
IS 3401	Specification of silica gel
IS 6600	Guide for loading of oil immersed transformer
IS 5082	Wrought Aluminium and Aluminium alloy bars, Rods, tubes, sections and sheets for electrical applications.

3.2 Material conforming to other internationally accepted standards, which ensure equal or better quality than the standards mentioned above, would also be acceptable. In case the bidders who wish to offer material conforming to other standards, the bidder shall clearly bring out the salient points of difference between the standards adopted and the specific standards in relevant schedule. Four copies of such standards with authentic English translations shall be furnished along with the offer.

4. CLIMATIC CONDITIONS:

The equipment covered under this specification is for outdoor installation and the climatic conditions that are prevailing in Delhi.

1. Temperature: The reference ambient temperature be taken as 43.3 º C as per IS 9676.		
a.	Maximum ambient air temperature	50ºC
b.	Maximum daily average ambient temp	40^{o}C
2. Relative Humidity:		

a.	Maximum Relative Humidity	100%
b.	Minimum Relative Humidity	10%
3.	Average annual rainfall	750 mm
4.	Average no. of rainy day	50
5.	Average no. of thunderstorm days per annum	40
6.	Altitude	Not exceeding 300 meters
7.	Rain months	June to Oct.
8.	Wind pressure as per IS 875	195 Kg/Sq. meters up to 30 meters

The atmosphere is generally laden with mild acid and dust in suspension during the dry months and is subjected to fog in cold months. Heavy lightening occurs in the area during rainy months (June to October).

All equipment shall be designed to withstand seismic forces, corresponding to an acceleration of 0.3 g horizontal.

5. PRINCIPAL PARAMETERS:

5.1 The transformers shall be suitable for outdoor installation with three phases, 50 Hz, 11 kV systems in which the neutral is effectively earthed and they should be suitable for service with fluctuations in supply voltage up to ±12.5%.

5.2 The transformers shall conform to the following specific parameters :

S.No.	**Item**	**11 kV Distribution Transformers**
1.	System voltage (max.)	12 kV
2.	Rated voltage HV	11 kV
3.	Rated voltage LV	415-240 V
4.	Frequency	50 Hz +/- 5%
5	No. of Phases	Three
6	Connection HV	Delta
7	Connection LV	Star (Neutral brought out)
8.	Vector group	Dyn-11
9.	Type of cooling	ONAN
10	LV Neutral Earthing	The Neutral point of the secondary (LV) winding shall be brought out in a separate insulated terminal and shall be solidly earthed.

Audible sound levels (decibels) at rated voltage and frequency for liquid immersed distribution transformers shall be as (NEMA Standards).

6. Core Material

6.1 The core shall be of high grade cold rolled grain oriented annealed steel lamination having low

loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. 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.

6.2 The bidder should offer the core for inspection and approval by the purchaser during manufacturing stage.

6.3 The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and shall not get saturated. The bidder shall furnish necessary design data in support of this situation.

6.4 No-load current shall not exceed 3% of full load current and will be measured by energising the transformer at 415 volts, 50 Hz on the secondary. Increase of voltage of 415 volts by 12.5% shall not increase the no-load current by 6% (maximum) of full load current.

7. WINDINGS:

7.1 Material:

7.1.1 HV and LV windings shall be wound from Super Enamel covered / Double Paper covered copper conductor.

7.1.2 LV winding shall be such that neutral formation will be at top.

7.1.3 The winding construction of single HV coil wound over LV coil is preferable.

7.1.4 Inter layer insulation shall be Epoxy dotted/ Kraft Paper.

7.1.5 Proper bonding of inter layer insulation with the conductor shall be ensured.
Test for bonding strength shall be conducted.

7.1.6 Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in Guaranteed Technical Particulars.

7.1.7 Current density for HV and LV winding should not be more than 2.5 Ampere per sq mm.

7.1.8 The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

7.1.9 Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor

8. TAPS:

8.1.1 Tapping shall be provided on the higher voltage winding for variation of HV voltage within range of (+) 5.0 % to (-) 5.0 % in steps of 2.5%.

8.1.2 Tap changing shall be carried out by means of an externally operated self position switch and when the transformer is in de-energised condition. Switch position No.1 shall

correspond to the maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Provision shall be made for locking the taping switch handle in position. Suitable aluminium anodised plate shall be fixed for tap changing switch to know the position number of tap.

9. OIL:

9.1 The insulating oil shall comply with the requirements of IS 335 / IEC 60296. Use of recycled oil is not acceptable. The specific resistance of the oil shall not be less than 2.5 $X10^{12}$ ohm-cm at 27 ^{0}C when tested as per IS 6103.

9.2 Oil shall be filtered and tested for break down voltage (BDV) and moisture content before filling. The dielectric strength and water content shall meet as under:

BDV (min):	60
Water content ppm(max):	10

9.3 The oil shall be filled under vacuum.

9.4 The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

10. INSULATION LEVELS:

Sl. No.	Voltage (kV)	Impulse Voltage (kV Peak)	Power Frequency Voltage (kV)
1	0.433	-	3
2	11	95/170	28

11. Losses:

11.1 The bidder shall guarantee individually the no-load loss and load loss without any positive tolerance. The bidder shall also guarantee the total losses at 50% and 100% load condition (at rated voltage and frequency and at 75 ^{0}C).

11.2 The maximum allowable losses at rated voltage and rated frequency permitted at 75^{0}C for 11/0.433 kV transformers shall be as per Energy Efficiency Level-2 specified in IS 1180 (Part-1):2014 with latest, for all kVA ratings of distribution transformers. Further providing of cooling tubes / fans to distribution transformer should be calculated (Bidder shall submit the calculation sheet during detailed engineering) to the Maximum losses as per Level -2 as per IS 1180 with latest revision.

12. TOLERANCES:

12.1 No positive tolerance shall be allowed on the maximum losses displayed on the label for both 50% and 100% loading values.

13 PERCENTAGE IMPEDANCE:

The value of impedance of transformers at 75°C shall be 4.5% for transformers up to 200

kVA and for ratings above 200 kVA as per Ministry of power Gazette notification dated 16.12.2016 with latest amendment, if any.

14 Temperature rise:

The temperature rise over ambient shall not exceed the limits given below when tested in accordance with IS 2026 (Part-2).

14.1 Top oil temperature rise measured by thermometer : 35^0C

14.2 Winding temperature rise measured by resistance method: 40^0C

14.3 The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

15. INSULATION MATERIAL:

15.1 Electrical grade insulation epoxy dotted/ Kraft Paper and pressboard of standard make shall be used.

15.2 All spacers, axial wedges / runners used in windings shall be made of pre-compressed Pressboard-solid, conforming to type B 3.1 of IEC 641-3-2. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges / runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations.

16. TANK:

16.1 The internal clearance of tank shall be such, that it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.

16.2 All joints of tank and fittings shall be oil tight and no bulging should occur during service.

16.3 Inside of tank shall be painted with varnish/hot oil resistant paint.

16.4 The top cover of the tank shall be slightly sloping to drain rain water.

16.5 The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle.

16.6 Manufacturer should carry out all welding operations as per the relevant IS/IEC and submit a copy of the welding procedure and welder performance qualification certificates to the customer.

16.7 **PLAIN TANK:**

16.7.1 The transformer tank shall be of robust construction rectangular/octagonal/round/ elliptical in shape and shall be built up of electrically tested welded mild steel plates of thickness of 6 mm

for bottom & top and 4 mm for sides . Tolerances as per IS1852 shall be applicable.

16.7.2 In case of rectangular tanks above 100 kVA the corners shall be fully welded at the corners from inside and outside of the tank to withstand a pressure of 0.8 kg/cm2 for 30 minutes. In case of transformers of 100 kVA and below, there shall be no joints at corners and there shall not be more than 2 joints in total.

16.7.3 Under operating conditions the pressure generated inside the tank should not exceed 0.4 kg/ sq. cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion. The space above oil level in the tank shall be filled with dry air or nitrogen conforming to commercial grade of IS 1747.

16.7.4 The tank shall be reinforced by welded flats on all the outside walls on the edge of the tank.

16.7.5 Permanent deflection: The permanent deflection, when the tank without oil is subjected to a vacuum of 525 mm of mercury for rectangular tank and 760 mm of mercury for round tank, shall not be more than as specified in table at sr.no. 28.11. The tank shall further be capable of withstanding a pressure of 0.8 kg/ sq.cm (g) and a vacuum of 0.7 kg/sq.cm (g) without any deformation.

16.7.6 The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise.

17. CONSERVATOR:

17.1 When a conservator is provided, oil gauge and the dehydrating breathing device shall be fitted to the conservator which shall also be provided with a drain plug and a filling hole [32 mm (1¼")] normal size thread with cover. In addition, the cover of the main tank shall be provided with an air release plug.

17.2 The dehydrating agent shall be silica gel. The moisture absorption shall be indicated by a change in the colour of the silica gel crystals which should be easily visible from a distance. Volume of breather shall be suitable for 1 kg of silicagel conforming to IS 3401 for transformers.

17.3 The capacity of a conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations. The total volume of conservator shall be such as to contain10% quantity of the oil. Normally 3% quantity the oil shall be contained in the conservator.

17.4 The cover of main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.

17.5 The inside diameter of the pipe connecting the conservator to the main tank should be within 20 to 50 mm and it should be projected into the conservator so that its end is approximately 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to -5 ^{0}C) should be above the sump level.

18. SURFACE PREPARATION AND PAINTING:

18.1 GENERAL

18.1.1 All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

18.1.2 All primers shall be well marked into the surface, particularly in areas where painting is evident and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations. However, where ever airless spray is not possible, conventional spray be used.

18.2 CLEANING AND SURFACE PREPARATION:

18.2.1 After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.

18.2.2 Steel surfaces shall be prepared by shot blast cleaning (IS9954) to grade Sq. 2.5 of ISO 8501-1 or chemical cleaning including phosphating of the appropriate quality (IS 3618).

18.2.3 Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale. These methods shall only be used where blast cleaning is impractical.

18.3 PROTECTIVE COATING:

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

18.4 PAINT MATERIAL:

18.4.1 Following are the types of paint which may be suitably used for the items to be painted at shop and supply of matching paint to site:

Heat resistant paint (Hot oil proof) for inside surface

18.4.2 For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer followed by two coats of synthetic enamel/polyurethene base paint. These paints can be either air drying or stoving.

18.4.3 For highly polluted areas, chemical atmosphere or for places very near to the sea coast, paint as above with one coat of high build micaceous iron oxide (MIO) as an intermediate coat may be used.

18.5 PAINTING PROCEDURE:

18.5.1 All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.

18.5.2 Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or

general softness) the supplier shall remove the unsatisfactory paint coating and apply another coating. As a general rule, dry film thickness should not exceed the specified minimum dry film thickens by more than 25%.

18.6 DAMAGED PAINTWORK:

18.6.1 Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally applied.

18.6.2 Any damaged paint work shall be made good as follows:

18.6.2.1 The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

18.6.2.2 A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.

18.6.2.3 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

18.7 DRY FILM THICKNESS:

18.7.1 To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats may or may not be of the same colour.

18.7.2 Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.

18.7.3 Particular attention must be paid to full film thickness at the edges.

18.7.4 The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below:

Sl.No.	Paint type	Area to be painted	No. of coats	Total dry film thickness(min.) (microns)
1.	Thermo setting powder paint	inside outside	01 01	30 60
2.	**Liquid paint** a)Epoxy (primer) b)P.U. Paint(Finish coat) c) Hot oil paint/ Varnish	 outside outside inside	 01 02 01	 30 25 each 35/10

18.8 TESTS FOR PAINTED SURFACE:

18.8.1 The painted surface shall be tested for paint thickness.

18.8.2 The painted surface shall pass the cross hatch adhesion test and impact test as acceptance tests and Salt spray test and Hardness test as type test as per the relevant IS/IEC.

Note: Supplier shall guarantee the painting performance requirement for a period of not less than 5 years.

19. BUSHINGS:

19.1 The bushings shall conform to the relevant standards specified and shall be of outdoor type. The bushing rods and nuts shall be made of brass material 12 mm diameter for both HT and LT bushings. The bushings shall be fixed to the transformers on side with straight pockets and in the same plane or the top cover. The tests as per latest IS 2099 and IS 7421 shall be conducted on the transformer bushings.

19.2 For 11 kV, 17.5 kV class bushings and for 0.433 kV, 1.1 kV class bushings shall be used.

19.3 Bushing can be of porcelain/epoxy material. Polymer insulator bushings conforming with relevant IEC can also be used.

19.4 Bushings of plain shades as per IS 3347 shall be mounted on the side of the Tank and not on top cover.

19.5 Dimensions of the bushings of the voltage class shall conform to the Standards specified and dimension of clamping arrangement shall be as per IS 4257.

19.6 Minimum external phase to phase and phase to earth clearances of bushing terminals shall be as under:

Voltage(kV)	Medium	Clearance for phase to phase(mm)terminal chamber		Clearance for phase to earth(mm) terminal chamber	
		open	closed	open	closed
0.433	Air	40	25	40	20
11	Air	255	127	140	76

19.7 Arcing horns shall be provided on HV bushings.

19.8 Brazing of all inter connections, jumpers from winding to bushing shall have cross section larger than the winding conductor. All the Brazes shall be qualified as per relevant standard.

19.9 The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for insulators.

19.10 The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.

20. TERMINAL CONNECTORS:

The LV and HV bushing stems shall be provided with suitable terminal connectors as per IS

5082 so as to connect the jumper without disturbing the bushing stem. Connectors shall be with eye bolts so as to receive conductor for HV. Terminal connectors shall be type tested as per IS 5561.

21. CABLE BOXES

In case HV/LV terminations are to be made through cables the transformer shall be fitted with suitable cable box on 11 kV side to terminate cable of suitable size as per the requirement.

The bidder shall ensure the arrangement of HT Cable box so as to prevent the ingress of moisture into the box due to rain water directly falling on the box. The cable box on HT side shall be of the split type with faces plain and machined and fitted with Neo-k-Tex or similar quality gasket and complete with brass wiping gland to be mounted on separate split type gland plate with nut-bolt arrangement and MS earthing clamp. The bushings of the cable box shall be fitted with nuts and stem to take the cable cores without bending them. The stem shall be of copper with copper nuts. The cross section of the connecting rods shall be stated and shall be adequate for carrying the rated currents. On the HV side the terminal rod shall have a diameter of not less than 12 mm. The material of connecting rod shall be copper. HT Cable support clamp should be provided to avoid tension due to cable weight.

The transformer shall be fitted with suitable LV cable box having non-magnetic material gland plate with appropriate sized single compression brass glands on LV side to terminate 1.1 kV/single core XLPE armoured cable (Size as per requirement).

22. TERMINAL MARKINGS:

High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letter 1U, 1V, 1W and low voltage winding for the same phase marked by corresponding small letter 2u, 2v, 2w. The neutral point terminal shall be indicated by the letter 2n. Neutral terminal is to be brought out and connected to local grounding terminal by an earthing strip.

23. FITTINGS:

The following standard fittings shall be provided:

i. Rating and terminal marking plates, non-detachable.

ii. Earthing terminals with lugs - 2 Nos.

iii. Lifting lugs for main tank and top cover

iv. Terminal connectors on the HV/LV bushings (For bare terminations only).

v. Thermometer pocket with cap - 1 No.

vi. Air release device

vii. HV bushings - 3 Nos and 1 no spare

viii. LV bushings - 4 Nos and 1 no spare

ix. Pulling lugs

x. Stiffener

xi. Radiators - No. and length may be mentioned (as per heat dissipation calculations)/ corrugations.

xii. Arcing horns - 3 No.

xiii. Prismatic oil level gauge.

xiv. Drain cum sampling valve.

xv. Top filter valve

xvi. Oil filling hole having p. 1- ¼" thread with plug and drain plug on the conservator.

xvii. Silicagel breather

xviii. Base channel 100 mmx50 mm, 460 mm long with holes to make them suitable for fixing on a platform or plinth.

xix. 4 No. rollers.

xx. Pressure relief device or explosion vent.

24. FASTENERS:

24.1 All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.

24.2 Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals.

24.3 All nuts and pins shall be adequately locked.

24.4 Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.

24.5 All ferrous bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanising, except high tensile steel bolts and spring washers which shall be electro-galvanised/plated. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals.

24.6 Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

24.7 The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.

24.8 Taper washers shall be provided where necessary.

24.9 Protective washers of suitable material shall be provided front and back of the securing screws.

25. OVERLOAD CAPACITY:

The transformers shall be suitable for loading as per IS 6600.

26. **TESTS: All the equipment offered shall be fully type tested by the bidder as per the relevant standards including the additional type tests. The type test must have been conducted on a transformer of same/similar design* as per relevant standards during the last five years at the time of bidding.**

In case, the offered transformer is not type tested, the bidder will conduct the type test as per the relevant standards including the additional type tests at his own cost in CPRI/ NABL accredited laboratory in the presence of employer's representative(s) without any financial liability to employer in the event of order placed on him.

***Definition of similar transformer as per relevant IS/IEC**

26.1 Special tests other than type and routine tests, as agreed between purchaser and bidder shall also be carried out as per the relevant standards.

26.2 The requirements of site tests are also given in this clause.

26.3 The test certificates for all routine and type tests for the transformers oil shall be submitted with the bid.

26.4 The procedure for testing shall be in accordance with IS1180/2026 as the case may be except for temperature rise test.

26.5 Before dispatch each of the completely assembled transformers shall be subjected to the routine tests at the manufacturer's works.

27. ROUTINE TESTS:

27.1 Ratio, polarity, phase sequence and vector group.

27.2 No Load current and losses at service voltage and normal frequency.

27.3 Load losses at rated current and normal frequency.

27.4 Impedance voltage test.

27.5 Resistance of windings at each tap, cold (at or near the test bed temperature).

27.6 Insulation resistance.

27.7 Induced over voltage withstand test.

27.8 Separate source voltage withstand test.

27.9 Neutral current measurement-The value of zero sequence current in the neutral of the star winding shall not be more than 2% of the full load current.

27.10 Oil samples (one sample per lot) to comply with IS 1866.

27.11 Measurement of no load losses and magnetizing current at rated frequency and 90%, 100% and 110% rated voltage.

27.12 Pressure and vacuum test for checking the deflection.

28. ADITIONAL TYPE TESTS:

28.1. In addition to the tests mentioned in clause 26 and 27 following tests shall be conducted:

28.2. Temperature rise test for determining the maximum temperature rise after continuous full load run. The ambient temperature and time of test should be stated in the test certificate. Dissolved gas analysis before and after Temperature Rise Test.

28.3. Impulse voltage test: with chopped wave of IS 2026 part-III. BIL for 11 kV shall be 95 kV peak instead of 75 kV

28.4. Short circuit withstand test: Thermal and dynamic ability.

28.5. Air Pressure Test: As per IS – 1180.

28.6. Magnetic Balance Test.

28.7. Un-balanced current test: The value of unbalanced current indicated by the ammeter shall not be more than 2% of the full load current.

28.8. Noise-level measurement.

28.9. Measurement of zero-phase sequence impedance.

28.10. Measurement of Harmonics of no-load current.

28.11. Transformer tank shall be subjected to specified vacuum. The tank designed for vacuum shall be tested at an internal pressure of 0.35 kg per sq cm absolute (250 mm of Hg) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the values specified below:

Horizontal length of flat plate (in mm)	**Permanent deflection (in mm)**
Upto and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.5
2001 to 2250	11.0
2251 to 2500	12.0
2501 to 3000	16.0
Above 3000	19.0

28.12. Transformer tank together with its radiator and other fittings shall be subjected to pressure corresponding to twice the normal pressure or 0.35 kg / sq.cm whichever is lower, measured at the base of the tank and maintained for an hour. The permanent deflection of the flat plates after the excess pressure has been released, shall not exceed the figures for vacuum

test.

28.13. Pressure relief device test: The pressure relief device shall be subject to increasing fluid pressure. It shall operate before reaching the test pressure as specified in the above class. The operating pressure shall be recorded. The device shall seal-off after the excess pressure has been released.

28.14. Short Circuit Test and Impulse Voltage Withstand Tests:

The offered transformer designed and successfully tested for short circuit and impulse test.

In case the product offered is never type tested the same to be conducted by bidder at his own cost at CPRI/ERDA. The test report shall not be more 5 years old.

28.15. The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test.

28.16. Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations.

28.17. It may also be noted that the purchaser reserves the right to conduct short circuit test and impulse voltage withstand test in accordance with the IS, afresh on each ordered rating at purchaser cost, even if the transformers of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the purchaser either at the manufacturer's works when they are offered in a lot for supply or randomly from the supplies already made to purchaser's stores. The findings and conclusions of these tests shall be binding on the supplier.

SECTION-X

DIESEL GENERATOR SET

SECTION : 10

DIESEL GENERATOR SET

1.1 SCOPE OF SUPPLY

1.1.1 The scope covers supply of Diesel Generator set of stationery type having a net electrical output of 250KVA capacity at specified site conditions of 50 deg.C ambient temperature and 100% relative humidity on FOR site basis. DG set shall be equipped with :

(i) Diesel engine complete with all accessories.
(ii) An alternator directly coupled to the engine through coupling, complete with all accessories.
(iii) Automatic voltage regulator.
(iv) Complete starting arrangement, including two nos. batteries & chargers.
(v) Base frame, foundation bolts etc.
(vi) Day tank of 990 Litre capacity.
(vii) Oil pump for transferring to Day Tank.
(viii) Engine Cooling and lubrication system.
(ix) Engine air filtering system.
(x) Exhaust silencer package.
(xi) Set of GI pipes, valves, strainers, unloading hose pipes as required.
(xii) All lubricants, consumable, touch up paints etc. for first filling, testing & commissioning at site. The fuel oil for first commissioning will also be provided by the contractor.
(xiii) AMF panel for control, metering and alarm.

1.2. SCOPE OF SERVICE

1.2.1. The Contractor shall provide following services :

a) Design, manufacture, shop testing including assembly test.
b) Despatch, transportation to site.
c) Erection, testing & commissioning with all equipments / materials required for the purpose.
d) Drawings, data, design calculations and printed erection, operation & maintenance manual.

1.3 TECHNICAL REQUIREMENTS

1.3.1. The rating of DG sets are as follows :

1.3.1.1 DG sets shall be 250KVA, 1500RPM, 0.8pf, 415V, 3 phase, 50Hz. The above ratings are the minimum requirements.

1.3.1.2 DG sets shall also be rated for 110% of full load for 1 hour/day of continuous running.

1.3.1.3. The output voltage, frequency and limits of variation from open circuit to full load shall be as follows:

a) Voltage variation — ± 5% of the set value provision shall exist to set adjust the value between 90% to 110% of nominal Generator voltage of 415V.

b) Frequency — 50Hz ± 2%

1.3.1.4 The Diesel Generator and other auxiliary motor shall have epoxy thermosetting type insulation but limited to class-B for temperature rise consideration.

1.3.1.5 The Day tank of 990 Litre capacity shall be provided on a suitable fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent, an air breather and necessary piping. The tank shall be painted with oil resistant paint and shall be erected in accordance with Indian explosive act of 1932.

1.3.1.6 Six (6) output terminals shall be provided in alternator box. The neutral shall be formed in AMF panel. The generator terminal box shall be suitable to house necessary cables and should be made of non-magnetic material.

1.3.1.7 For transferring oil to Day tank transfer pumps are envisaged. The capacity of transfer pump shall be adequate to fill the day tank in about 30 minutes.

1.4 SYSTEM DESIGN

1.4.1 The Diesel Generators units shall be installed outdoors with sound proof enclosures as per new environment policy. Exhaust will be let out to outside atmosphere, condensate traps shall be provided on the exhaust pipe.

1.4.2. The fuel used shall be High Speed Diesel Oil (HSD) or Light Diesel Oil (LDO) as per IS:1460

1.4.3. The Diesel Engines shall be directly water cooled. Cooling of water through radiator and fan as envisaged.

1.4.4 The engine shall have closed loop lubricating system. No moving parts shall require lubrication by hand prior to the start of engine or while it is in operation.

1.5. PLANT DESIGN

1.5.1 The equipment shall be safe and proper and without undue vibration or stores for continuous operation at all loads upto rated output at operating and test conditions.

1.5.2. The equipment shall have provision for easy maintenance, overhaul, cleaning and inspection and replacement of parts. All tools for operation and maintenance of equipment shall be supplied.

1.5.3 Diesel engine shall be turbo charged multicylinder V-type in line type with mechanical fuel injection system.

1.5.4 Automatic electric starting by DC starter motor shall be provided. Two nos. battery with automatic battery charger shall be provided. Each battery shall have sufficient capacity to give 10 nos. successive starting impulse to the diesel engine.

1.6. CONTROL AND INSTRUMENTATION

1.6.1. Each D.G. sets shall be provided with suitable instruments, interlock and protection arrangement, suitable annunciation and indications etc. for proper start up, control, monitoring and safe operation of the unit. One local AMF control panel alongwith each D.G. set shall be provided by the Supplier to accommodate these instruments, protective relays, indication lamps etc. The AMF Panel shall have IP-52 degree of Protection as per IS:12063.

1.6.2. The D.G. sets shall be provided with automatic start facility to make it possible to take full load within 30 seconds of Power Supply failure.

1.6.3. Testing facility for automatic operation of D.G. set shall be provided in AMF panel.

1.6.4. A three attempt starting facility using two impulse timers and summation timer for engine shall be proved and if the voltage fails to develop within 40 sec. from receiving the first impulse, the set shall block and alarm to this effect shall be provided in the AMF panel.

1.6.5. Following instruments shall be provided with Diesel Engine.

a) Lub Oil Pressure gauge (engine panel).
b) Lub oil temperature thermometers (both on engine and at local panel)
c) Water temperature thermometers (both on engine and at local panel)
d) Exhaust gas pyrometer with temp. switch (at local panel)
e) Engine tachometer / HR (engine panel)
f) Any other instruments necessary for DG Set operation shall be provided.

1.6.6. DG set shall be capable of being started / stopped manually from remote as well as local. (Remote START/STOP push button shall be provided in 415V ACDB). However, interlock shall be provided to prevent shutting down operation as long as D.G. Circuit breaker is closed.

1.6.7. The diesel generator shall commence a shutdown sequence whenever any of the following conditions appear in the system :

a) Overspeed
b) Overload
c) High temperature of engine, cooling water and lubricating oil.
d) Low Lub oil Pressure.
e) Generator differential protection.
f) Short circuit protection.
g) Under voltage.

h) Over voltage.
i) Further interlocking of breaker shall be provided to prevent parallel operation of DG set with normal station supply.

1.6.8. A suitable battery charger using semi-conductor rectifier shall be provided for quick and trickle charging the battery. AMF panel shall consist of complete battery charging scheme suitable for 24V DC, 25 A operation. Battery charger shall have input switch, transformer – Rectifier unit, choke, control fuses, necessary filters and suitable characteristic for charging the battery and keeping it in fully charged state. The charger shall be provided with suitable DC voltmeter, Ammeter and output voltage control facility mounted on the control cubicle and shall be suitable for connection to single phase 240V Ac supply with ± 10% voltage variation.

1.6.9. Following indication lamps for purposes mentioned as under shall be provided in AMF panel:

1.6.9.1 Pilot indicating lamp for the following :
a) Mains ON
b) Alternator On
c) Charger ON/OFF
d) Breaker On/OFF
e) Main LT Supply ON/OFF

1.6.9.2 Visual annunciation shall be provided for set shut down due to :
a) engine overheating
b) low oil pressure
c) lack of fuel
d) set failed to start in 30 sec after receiving the first start impulse
e) high cooling water temperature
f) low level in daily service fuel tank
g) Over speed trip
h) Audio & visual Annunciation for alternator fault.

1.6.10 Thermostatically controlled space heaters and cubicle illumination operated by Door Switch shall be provided in AMF panel. Necessary isolating switches and fuses shall also be provided.

1.6.11 AMF panel shall have facility for adjustment of speed and voltage including fine adjustments in remote as well as in local mode.

Following shall also be provided in AMF panel :
a) Frequency meter
b) 3 nos. single phase ct's for metering
c) 3 nos. (provided by LT swgr manufacturer) single phase CT's with KPV 300V & RCT 0.25 ohm for differential protection of DG Set on neutral side.
d) One (1) DC Ammeter (0-40A)
e) One (1) DC Voltmeter (0-30V)
f) One (1) Voltmeter Selector switch
g) One (1) AC Ammeter
h) One (1) AC Voltmeter
i) Three (3) Timers (24V DC)
j) Two (2) Auto/Manual Selector Switch
k) Two (2) Auto/test/Manual/ Selector Switch
l) Eleven (11) Aux. Contactors suitable for 24 V DC
m) One (1) motorized potentiometer for voltage adjustment
n) Two (2) set Battery charger as specified in technical specification.
o) One (1) set phase & neutral busbars.
p) Any other item required for completion of control scheme shall be deemed to be included.

1.7 TESTS

1.7.1 The Diesel generator sets shall be tested for routine and acceptance test as per the relevant IS/IEC standards.

1.7.2 **Type Test**

Type test reports as per relevant standard shall be submitted for purchaser's approval.

1.7.3 Commissioning Checks

In addition to the checks and test recommended by the manufacturer, the Contractor shall carryout the following commissioning tests to be carried out at site.

1.7.3.1 Load Test

The engine shall be given test run for a period of atleast 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 carryout the test shall be provided by the purchaser.

1.7.3.2 Insulation Resistance Test for Alternator

Insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with a 500V megger shall not be less than IR=2x (rated voltage in KV)+1

1.7.3.3. Check of Fuel Consumption

A check of the fuel consumption shall be made during the load run test. This test shall be conducted for the purpose of proper tuning of the engine.

1.7.3.4 Insulation Resistance of Wiring

Insulation resistance of control panel wiring shall be checked by 500V Megger. The IR shall not be less than one mega ohm.

1.7.3.5 Functional Tests

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.

1.7.3.6 Measurement of Vibration

The vibration shall be measured at load as close to maximum achievable load and shall not exceed 250 microns.

1.7.3.7 Noise Level (sound pressure level) check.

(i) Noise level measurement shall be done generally following the guidelines given in IS:12065. The measurement shall be carried out with a calibrated interacting sound level meter as per IS:9779.

(ii) Sound level shall be measured all round the Diesel Generator set at a distance of 1m. from the nearest surface of the machine and at a height of 1.5m from the floor level as illustrated in IS:12065 for electrical machines.

iii) A minimum of 8 pts. (5 around diesel engine and 3 around alternator) shall be covered for measurement. Additional measurement points shall be considered in case the criteria indicated in C1.3.3.3 of IS:12065 is not met.

iv) The measurement shall be done with slow response meter on the A- weighting scale. The average of the A-weighted sound level measurement expressed in decibels to a reference of 0.0002 microbar.

v) The tests shall be carried out with the DG set operating at rated speed and at maximum achievable load. Necessary correction for Test environment condition & background noise will be applied as per IS:12065.

SECTION-XI

SWITCHYARD

SECTION: 11

SWITCHYARD ERECTION

1.0. GENERAL

The detailed scope of work includes design, engineering, manufacture, testing at works, supply on FOR destination site basis, insurance, handling, storage, erection testing and commissioning of various items and works as detailed herein.

This section covers the description of the following item

A. Supply of

- String insulators and hardware
- ACSR conductor
- Galvanized Steel Earth wire
- Aluminum Tubular Bus Bars
- Spacers
- Bus post insulators
- Earthing & Earthing materials
- Lightning protection materials
- Cabling material
- Other items

B. Erection of all items

1.1. String Insulator & hardware

The insulators for suspension and tension string shall conform to IEC60383 and long rod insulators shall conform to IEC 60433. Insulator hardware shall conform to IS: 2486.

1.1.1. Construction Features

1.1.1.1 Suspension and tension insulators shall be wet process porcelain with ball and socket connection. Insulators shall be interchangeable and shall be Suitable for forming either suspension or tension strings. Each insulator shall have rated strength markings on porcelain printed and applied before firing.

1.1.1.2 Porcelain used in insulator manufacture shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture

1.1.1.3. Glazing of the porcelain shall be uniform brown colour, free from blisters, burrs and other similar defects

1.1.1.4. When operating at normal rated voltage there shall be no electric discharge between conductor and insulator which would cause corrosion or injury to conductors or insulators by the formation of substances due to chemical action. No radio interference shall be caused when operating at normal rated voltage.

1.1.1.5. The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. All ferrous part shall be hot dip galvanized in accordance with the latest edition of IS: 2629. The zinc used for galvanizing shall be of grade Zn-99.95 as per IS-209. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux, ash; rust

stains bulky white deposits and blisters.

1.1.1.6. Bidder shall make available data on all the essential features of design including the method of assembly of discs and metal parts, number of discs per insulator string insulators, the manner in which mechanical stresses are transmitted through discs to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

1.1.1.7. Clamps for insulator strings and Corona Control rings shall be of aluminum alloy as stipulated for clamps and connectors

1.1.1.8. Insulator hardware shall be of forged steel. Malleable cast iron shall not be accepted except for insulator disc cap. The surface of hardware must be clean, smooth, without cuts, abrasion or projections. No part shall be subjected to excessive localized pressure. The metal parts shall not produce any noise generating corona under operating conditions

1.1.1.9. The tension Insulator hardware assembly shall be designed for 11500 kg tensile load. Earth wire tension clamp shall be designed for 1000 kg tensile load with a factor of safety of two (2).

1.1.1.10 The tension string assemblies shall be supplied along with suitable turn Buckle. Sag compensation springs if required may also be provided.

1.1.1.11 All hardware shall be bolted type.

1.2. Long Rod Insulators

1.2.1 As an alternative to disc insulator, Bidder can offer long rod insulators strings, with suitable hardware. The combination should be suitable for application specified and should offer the identical / equivalent parameters as would be available from insulator string comprising disc insulators and hardware combination.

1.2.2. All constructional features specified at Clause 1.1.1 of this Section shall also apply to the long rod insulator string.

1.3. Tests

In accordance with the stipulations of the specification, the suspension and tension strings, insulator and hardware shall be subjected to the type tests, acceptance tests and routine tests as per relevant standards.

1.4. Parameters

1.4.1. Disc Insulators 220KV

a) Type of Insulators	Anti Fog type
b) Size of insulator units (mm)	255x145
c) Electro mechanical strength	120 KN
d) Creepage distance of individual insulator units (min. and as required to meet total Creepage distance)	430 mm

e) Markings Marking on porcelain shall be printed and applied before firing

1.3 times the actual wet flashover voltage.

* Long rod insulators may be used in place of disc insulators subject to confirmation to equivalent electrical and mechnical parameter.

1.4.2 INSULATOR STRING

S.No.	Description	220 kV
A	Power frequency withstand voltage of the complete string with corona control ring (wet)	460
B	Lightning impulse withstand voltage of string with corona control ring (dry) – kVp	1050
C	Switching surge withstand voltage of string with corona control rings (wet)kVp.	NA
D	Min. corona extinction voltage level of string with corona control rings (dry)- kV rms.	156
E	RIV level in micro volts of string with corona control rings at 156 KV (rms) for 220 KV string across 300 Oh resistor at 1 MHz	1000 (Max.)
F	Total creepage distance of the insulator string (mm)	6125
G	Total no. discs per strings	15

For tension application, double insulator strings and for suspension purpose single suspension insulator string shall be used for 220 KV system.

2.0 ACSR ZEBRA CONDUCTOR

2.1 Details of conductor

2.1.1 The Conductor shall confirm to IS 398: 1982 except where otherwise specified herein.

2.1.2 The details of the conductor are tabulated below:

a) Stranding and wire diameter 54/3.18 mm Al +7/3.18 mm steel

b) No. of strands

Steel	7
Aluminium Layer	54
c) Sectional area of Al.	418.6 mm^2
d)Total sectional area	483.1 mm2
e) Overall diameter	28.62mm
f)Approx. wt.	1621kg/km.
g)Calculated d.c. resistance at 20 C	0.0680 Oh/km

h) Approximate calculated breaking load 13316 Kg.

Workmanship

2.2.1 The finihed conductor shall be smooth, compact, uniform and free from all imperfections including spills and splits., die marks, scratches, abrasions, scuff marks, kinks (protrusion of wires), dents, press marks, cut marks, wire cross over riding, looseness (wire being dislocated by finger/ hand pressure and / or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black spots (on account of reaction with trapped rain water etc.) dirt, grit etc.

2.2.2 All the Al. and steel strands shall be smooth, uniform and free, from all imperfections, such as spills and splits, die marks, scratches, abrasion and kinks after drawing and also after stranding.

2.2.3 The steel strands shall be hot dip galvanized and shall have a minimum zinc coating of 230 gm/sq.m. of the uncoated wire surface. The zinc coating shall be smooth, continuous and of uniform thickness, free from imperfections and shall withstand minimum three dips after stranding Preece tests. The finished strands and the individual wires

shall be of uniform quality and have the same properties and characteristics as prescribed in ASTM designation B 498-74.

2.2.4 The steel strands shall be performed and postformed in order to prevent spreading of strands in the event of cutting composite core wire. Care shall be taken to avoid damage to galvanization during performing and post forming operation.

2.3 **Joints in Wires**

2.3.1 **Aluminium Wires**

No joints shall be permitted in the individual wires in the outermost layer of the finished conductor. However, joints in the inner layers of the conductor shall be allowed but these joints shall be made by cold pressure butt welding.

There shall be no joint of any kind in the finished wire entering into the manufacture of the strand. There shall also be no strand splices in any length of the completed steel core of the conductor.

2.4 **Tolerances**

The manufacturing tolerance to the extent of the following limits only shall be permitted in the diameter of individual Al. and steel strands and lay ratio of the conductor.

2.5 **Materials**

2.5.1 **Aluminium**

The Al. strands shall be drawn from electrolytic aluminium rods having purity not less than 99.5% and a copper content not exceeding 0.04%.

2.5.2 **Steel**

The steel wire strands shall be drawn high carbon steel wire rods and shall confirm to the following chemical composition.

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

2.5.3 **Zinc**

The zinc used for galvanizing shall be electrolytic High Grade Zinc of 99.95% purity. It shall confirm to and satisfy all the requirements of IS 209-1979.

2.6 **Standard Length**

2.6.1 The conductor shall be supplied in standard length of 2150 meters. Bidder shall indicate the standard length of the conductor to be offered by them A tolerance of 10 m on the standard length offered by the Bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths. No joint shall be allowed within a single span of stringing.

2.6.2 Random lengths will be accepted provided no length is less than 70% of the standard length and the total quantity of random shall be more than 5% of the total quantity. In addition, for every bobbin of random length, three (3) others shall be fabricated with a tolerance 10 m and all the above four drums shall be clearly identified and shipped together to the same site so that they can be installed in the same / trench.

2.7 **Tests**

2.7.1 The following type, acceptance and routine tests and tests during manufacturing shall be carried out on the conductor.

2.7.2 **Type Test**

In accordance with the stipulation of specification, the following type test reports of the conductor shall be submitted for approval as per clause 9.2 of section GTR.

a. UTS test on stranded conductor
b. Corona extincton Voltage Test (dry & Wet)
c. Radio Interference voltage test (dry & wet)
d. DC resistance test pm stranded conductor
e. Stess strain test

2.7.3 **Acceptance Tests**

a. Visual check for joints scratches etc. and lengths of conductor
b. Dimensional check on steel and Al. strands.
c. Check for lay ratios of various layers
d. Galvanising test on steel strands
e. Torsion and Elongation test on steel strands
f. Breaking load test on steel and Al. strands
g. Wrap test on steel and Al. strands
h. DC resistance test on Al. strands
i. Visual and dimensional check on drum

Note: All the above tests except test mentioned at (a) shall be carried out on aluminium and steel strands after stranding only.

2.7.4 **ROUTINE TEST**

a. Check to ensure that the joints are as per specification
b. Check that there are no cuts, fins etc. on the strands
c. Check that drums are as per specification
d. All acceptance test as mentioned in Clause 2.7.3 above to be carried out on each coil.

2.7.5 **TEST DURING MANUFACTURE**

a. Chemical analysis of Zinc used for Galvanizing
b. Chemical analysis of Al. used for making Al. strands
c. Chemical analysis of steel used for making steel strands

2.7.6 **Sample Batch for type Testing**

The contractor shall offer material for selection of samples for type testing only after getting quality assurance plans approved from owner's Quality Assurance Deptt. The sample shall be manufactured strictly in accordance with the Quality Assurance Plan approved by Owner.

2.4 GALVANISED STEEL EARTHWIRE

3.1. Details of Earth wire

3.1.1 The galvanised steel earth wire shall generally conform to the specification of ACSR core wire as mentioned in IS: 398 (Part-II)-1976 except where otherwise specified herein.

3.1.2 The details of the earth wire are tabulated below

a)	Stranding and wire diameter	:	7/3.66 mm steel
b)	Number of strands	:	1

	Steel core Outer Steel Layer	:	6
c)	Total sectional area	:	73.65 mm2
d)	Overall diameter	:	10.98 mm
e)	Approximate weight	:	583 kg/km
f)	Calculated d.c. resistance-tance at 20^0C	:	2.5 ohms/km
g)	Minimum ultimate tensile strength	:	68.4 kN
h)	Direction of lay of outer layer	:	Right hand

3.2. TESTS

3.2.1 The following type, routine & acceptance tests and tests during manufacturing shall be carried out on the earth wire.

4.0 TUBULAR BUS CONDUCTORS

4.1 General

Aluminium used shall be grade 63401 WP (range 2) conforming to IS: 5082.

4.2 Constructional Features

4.2.1 For out side diameter (OD) & thickness of the tube there shall be no minus tolerance, other requirements being as per IS: 2678 and IS: 2673

4.2.2 The aluminum tube shall be supplied in suitable cut length to minimize wastage.

4.2.3 The welding of aluminum tube shall be done by the qualified welders duly approved by the owner.

4.3 Tests

In **a**ccordance with standards of the specification, Routine tests shall be conducted on tubular bus conductors as per IS: 5082. Also the wall thickness and ovality of the tube shall be measured by the ultrasonic method. In addition to the above tests, 0.2% proof tests on both parent metal and Aluminium tube after welding shall be conducted.

4.4 Parameters

a)	Size	4"IPS (EH Type)
b)	Outer diameter (mm)	114.2
c)	Thickness (mm)	8.51
d)	Cross-sectional area (sq.mm)	2825.61
e)	Weight (kg/m)	7.7

5.0 BUS POST INSULATORS

The post insulators shall conform in general to latest IS : 2544, IEC-168 and IEC-815.

5.1 **Tests**

In accordance with the stipulations of the specification, the post insulators shall be subject to type, acceptance, sample and routine tests as per IS : 2544 and IEC-168.

5.2. Technical Parameters of Bus Post Insulators.

a)	Type	Solid Core
b)	Voltage class (kV)	245
c)	Dry and wet one minute power frequency withstand voltage(kV rms)	460
d)	Dry lightning impulse Withstand Voltage (kVp)	±1050
e)	Max. radio interference voltage (in micro volts) at voltage of 156kV (rms) for 220 kV between phase to ground	500
f)	Corona extinction voltage (kV rms)	156 (Min.)
g)	Total minimum cantilever Strength (Kg)	800
h)	Minimum torsional moment	------ As per IEC-273--------
i)	Total height of insulator (mm)	2300 (Minimum) Necessary sub-Structure/stool required to match bus height using standard structure shall be provided by the Contractor.
j)	P.C.D	
	Top (mm)	127
	Bottom (mm)	254
k)	No. of bolts	
	Top	4
	Bottom	8
l)	Diameter of bolt/holes(mm)	
	Top	M16
	Bottom	18
m)	Pollution level as per IEC-815	Heavy(III)
n)	Minimum total creepage	6125

5.2.1. If corona extinction voltage is to be achieved with the help of corona ring or any other similar device, the same shall be deemed to be included in the scope of the Contractor.

6.0 EARTHING

6.1 The earthing shall be done in accordance with requirements given hereunder and drawing titled 'Earthing Details' enclosed with the specification. The earthmat design shall be done by the Contractor as per IEEE-80. The soil resistivity measurement shall also be done by the Contractor. The resistively measurement of stone (to be used for stone spreading) shall also be done by the Contractor to confirm the resistivity value of stone considered in earth mat design. For measurement purpose, one sample of stones from each source (in case stones are supplied from more than one source) shall be used. The main earthmat shall be laid in the switchyard area in accordance with the approved design requirements.

6.2 Neutral points of systems of different voltages, metallic enclosures and frame works associated

with all current carrying equipments and extraneous metal works associated with electric system shall be connected to a single earthing system unless stipulated otherwise.

6.3 Earthing and lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.

a) Code of practice for Earthing IS: 3043
b) Code of practice for the protection of Building and allied structures against lightning IS:2309.
c) Indian Electricity Rules 1956 with latest amendments.
d) National Electricity Safety code IEEE-80.

6.4 Details of Earthing System

	Item	Size	Material
a)	Main Earthing Conductor to be buried in ground	40mm dia	Mild Steel rod
b)	Conductor above ground & earthing leads equipment)	75x12mm G.S. flat	Galvanised Steel
c)	Conductor above ground & earthing leads (for columns & aux. structures)	75x12mm G.S. flat	Galvanised Steel
d)	Earthing of indoor LT panels, Control panels and out door marshalling boxes, MOM boxes, Junction boxes& Lighting Panels etc	50x6 mm G.S. flat	Galvanised Steel
e)	Rod Earth Electrode	40mm dia, 3000mm long	Mild Steel
f)	Pipe Earth Electrode (in treated earth pit) as per IS.	40mm dia, 3000mm long	Galvanised Steel
g)	Earthing for motors	25X3 mm GS flat	Mild steel
h)	Earthing conductor along outdoor cable trenches	50x6mm MS flat	Mild steel
i)	Earthing of Lighting Poles	20 mm dia 3000 mm long	mild steel rod

The sizes of the earthing conductor indicated above are the minimum sizes.

6.5. Earthing Conductor Layout

6.5.1. Earthing conductors in outdoor areas shall be buried at least 600 mm below finished ground level unless stated otherwise.

6.5.2. Wherever earthing conductor crosses cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid minimum 300 mm below them and shall be circumvented in case it fouls with equipment/structure foundations.

6.5.3 Tap-connections from the earthing grid to the equipment/structure to be earthed shall be terminated on the earthing terminals of the equipment/structure as per “Earthing Details”. (Drawing enclosed).

Earthing conductors or leads along their run on cable trench, ladder, walls etc. shall be supported

by suitable welding/cleating at intervals of 750 mm. Wherever it passes through walls, floors etc., galvanised iron sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.

6.5.4. Earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500 mm away from such location.

6.5.5. Earthing conductors crossing the road shall be laid 300 mm below road or at greater depth to suit the site conditions.

6.5.6. Earthing conductor's embeded in the concrete shall have approximately 50 mm concrete cover.

6.6. Power Cable Earthing

Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and swithgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.

6.7. Specific Requirement for Earthing Systems

6.7.1 Each earthing lead from the neutral of the power transformer shall be directly connected to two pipe electrodes in treated earth pit (as per IS) which in turn, shall be buried in Cement Concrete pit with a cast iron cover hinged to a cast iron frame to have an access to the joints. All accessories associated with transformer like cooling banks, radiators etc. shall be connected to the earthing grid at minimum two points.

6.7.2. Earthing terminal of each lightning arrester & capacitor voltage transformer shall be directly connected to rod earth electrode which in turn, shall be connected to station earthing grid.

6.7.3 Auxiliary earthing mat comprising of 40mm dia M.S. rods closely spaced (300 mm x 300 mm) conductors shall be provided at depth of 300mm from ground level below the operating handles of the M.O.M. Box of the isolators. M.O.M. boxes shall be directly connected to the auxiliary earthing mat.

7.0 Main Bus Bars

The brief description of the bus switching scheme, bus bar layout and equipment connection to be adopted are indicated elsewhere in the specification. The bus bar arrangements are shown in drgs enclosed with the bid documents.

7.1. The Contractor shall furnish supporting calculations for the bus bars/conductors to show adequacy of design parameters for:

a) Fibre-stress
b) Cantilever strength of post insulators
c) Aeolian vibrations)
d) Short circuit forces in bundle conductor and spacer location for each span of ACSR conductor stringing as per layout drawings.
e) Vertical deflection of bus bars

7.1.1. The welds in the aluminium tubes shall be kept to the minimum and there shall not be more than one weld per span. The procedure and details of welding shall be subject to Owner's approval. Material for welding sleeve shall be same as that of Aluminium tube. Welding sleeve shall be of 600mm length

7.1.2. Corona bells shall be provided wherever the bus extends beyond the clamps and on free ends, for sealing the ends of the tubular conductor against rain and moisture and to reduce the electrostatic discharge loss at the end points. There shall be a small drain hole in the corona bell. The material of Corona bell shall be Aluminium alloy similar to that of clamps & connectors.

7.1.3. To minimise the vibrations in the aluminium tubes, damping conductor shall be provided inside the aluminium tubes. For this purpose, the cut pieces of ACSR conductor which otherwise are considered wastages, shall be used as damping conductor.

7.1.4. Details of past experience of the persons proposed to be employed for Aluminium tube welding and the test reports of the welded pieces to prove the electrical and mechanical characteristics shall also be furnished along with the bid. Welding at site shall be done by adopting a qualified procedure and employing qualified welders as per ASME-Section IX

8.0 CABLING MATERIAL

8.1. CABLE TAGS AND MARKERS

8.1.1. Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule

8.1.2. The tag shall be of aluminium with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire conforming to IS:280. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.

8.1.3 Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanised iron plate.

8.1.4. Location of underground cable joints shall be indicated with cable marker with an additional inscription “Cable joints”.

8.1.5 The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.

8.1.6 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry and at each end & turning point in cable tray/trench runs. Cable tags shall be provided inside the switchgear, motor control centres, control and relay panels etc., wherever required for cable identification, where a number of cables enter together through a gland plate.

8.2 Cable sealing system

Modular multi-diameter cable sealing system consisting of frames, blocks and accessories shall be installed where the underground and over ground cables enter or leave concrete bay kiosks/switchyard panel room & control rooms in the substations. Cable sealing system shall consist of multi-diameter type peel-able blocks of different sizes to suit the various cables. It should be simple, easy and quick to assemble & re-assemble the cable sealing system. Solid blocks shall not be used on frames. Frames & stay plate material shall be of galvanized steel and for compression, single piece wedge with galvanized steel bolts shall be used. 30% spare blocks on the frame shall be provided for expansion in future. Cable sealing system should have been tested for fire/water/smoke tightness.

SECTION-XII

CIVIL WORKS

SECTION : 12

CIVIL WORKS

MODEL TECHNICAL SPECIFICATION FOR CIVIL WORKS OF SUB-STATIONS

1.0 GENERAL TECHNICAL REQUIREMENTS

1.1 SCOPE OF WORK

1.1.1 The scope is to cover design, preparation of general arrangement drawings and working drawings, supply of materials and construction of all civil, structural and architectural works.

1.1.2 Description of the various sections of work under this specification and detailed scope are given herein after. The whole work under this scope is referred to as civil works.

1.1.3 The work to be performed under this specification consists of providing all labour, materials, plants, equipment, temporary works, constructional plant, fuel supplies, transportation and all incidental items not shown or specified but reasonably implied, or necessary for the proper completion of the work, all in strict accordance with the specifications and including revisions and amendments there to as may be required during the execution of the work.

1.1.4 The work under this specification shall consist of but not be limited to items mentioned below: -

(1) GIS room cum Control Room Building, including internal electrification based on the drawings approved by the owner. The building shall be suitable for taking load of additional floor to be constructed in future.

(2) Outdoor DG Set based on the drawings approved by the owner.

(3) Pump House for pumping out the storm water of the yard and water from oil pit of transformers including supplying & installations of pumps/motors of 4.0 KW capacity & electrical fittings of ISI mark or as approved by engineer in charge for operation of the pump house.

(4) Switchyard fencing in accordance with the approved drawing by the owner.

(5) The civil works shall include civil foundations including pile foundations, if required, for transformer, towers, lighting cum lightning mast, equipment support structures, road cum rail arrangement including jack pad etc. as per the requirement for establishment of the sub-station.

(6) Supply and erection of gantry structures, lighting cum, lightning masts and supporting structure for all the equipments as per material and drawings approved by owner.

(7) Construction of cable trenches including removable precast RCC covers with lifting arrangement, cable trench road crossings, necessary sumps, cable trays and proper earthing as per approved drawings/specifications shall be inclusive in the scope of work. 220KV & 66kV outgoing feeders from GIS building up to the boundary wall of the substation, shall be in buried cable trench. Further details shall be finalized during detailed engineering.

(8) Soil sterilization and Development of yard

(9) Cement concrete roads and culverts within sub station boundary wall.

(10) Laying of sewers, storm water drains, water supply lines etc. including making connection with the municipal services after obtaining approval from Municipal Authorities by the contractor.

(11) Any other work required for functional requirement of establishment of the sub-station.

(12) Soil investigation.

(13) Making arrangement for construction water, drinking water and toilet facilities with the establishment of site office.

(14) Construction of septic tank & soak-pit etc. if municipal sewer line does not exist.

(15) Construction of soak pit with sump pit within soak pit and sump well along with pipe drain for collecting oil/ rain water from soak pits of transformers.

(16) Fire protection wall between transformers if required in accordance with Tariff advisory committee (TAC) recommendations.

(17) All buildings shall be built as Green Building in line with green building concept of Energy Conservation cell.

(18) Site surfacing (Gravelling) and anti weed treatment.

(19) Storm water drainage and rain water harvesting.

1.1.5 The scope shall also include carrying out all relevant tests required for the civil works for the project.

1.1.6 The works shall be carried out -according to the design, Structural & Architectural drawings to be developed by the Contractor and approved by the owner. For all building, structures, foundations etc. necessary layout and details are to be developed by the Contractor keeping in view the functional requirement parameters/drawing. Certain minimum requirements are indicated in this specification for guidance and the bid shall cover complete requirement.

1.1.7 Fairly leveled land shall be handed over to the Contractor by the owner. Finished ground level shall be the finished formation level furnished by the owner. The layout and levels of all structures etc. shall be made by the contractor at his own cost from the general grid of the plot and bench marks given by the owner. The contractor shall give all help including instruments, materials and personnel to the owner for checking the detailed layout and correctness of the layout and levels. All the quality standards, fabrication and erection check lists, welding standards and other technical requirements shall be strictly adhered to by the Contractor.

1.1.8 The work in general, shall be executed as per detailed specifications for the civil works. However, in case specifications for a particular item are not specified, the same shall be governed as per the latest Indian Standard specifications/CPWD specifications as per directions of the owner, whose decision shall be final and binding.

1.1.9 220/66 KV GIS cum CONTROL ROOM BUILDING

a) The buildings shall house 220kV and 66kV Gas Insulated Switchgear (GIS) separately and other associated equipments inside in the GIS building.
b) The bidder shall submit the design & construction proposal of the building along with necessary information, data and drawings in the techno- commercial bid according to the complete requirements.
c) Tentative dimensions of GIS cum CONTROL ROOM building are 60mX15m for 220kV and tentative dimensions of GIS hall are 20mX10m for 66kV. However, the bidder shall finalize the dimensions for 220kV and 66kV GIS building according to the equipment offered by them providing enough space & access for erection & maintenance.

2.0 GEOTECHNICAL INVESTIGATION

2.1 GENERAL

The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate, general as well as specific information about the soil profile and the necessary soil parameters of the Site in order that the foundation of the various structures can be designed and constructed safely and rationally.

A report to the effect will be submitted by the Contractor for Purchaser's specific approval giving details regarding data proposed to be utilized for civil structures design.

The Contractor may visit the site to ascertain the soil parameters. Any variation in soil data shall not constitute a valid reason for any additional cost & shall not affect the terms & conditions of the contract. The test must be conducted under all the critical locations i.e. Control Room Building, Lighting cum lightening mast, Tower locations, Transformers etc.

2.2 SCOPE OF WORK

This specification covers all the work required for detailed soil investigation and preparation of a detailed report. The work shall include mobilization of necessary equipment, providing necessary engineering supervision and technical personnel, skilled and unskilled labour etc. as required to carry out field investigation as well as , laboratory investigation, analysis and interpretation of data and results, preparation of detailed Geo-technical report including specific recommendations for the type of foundations and the allowable safe bearing capacity for different sizes of foundations at different founding strata for the various structures of the substation. The Contractor shall make his own arrangement for locating the co-ordinates and various test positions in field as per the information supplied to him and also for determining the reduced level of these locations with respect to the benchmark indicated by the Purchaser.

All the work shall be carried out as per latest edition of the corresponding Indian Standard Codes.

2.2.1 Bore Holes

Bore holes of 150 mm diameter in accordance with the provisions of IS: 1892 at the rate of minimum one number bore hole per hectare up to 10meter depth or to refusal which ever occur earlier shall be drilled. In any case number of boreholes shall not be less than five. Tests shall be carried out in area wherever switchyard, building, road and other allied work has to be executed. By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration. Number of boreholes may be increased in case soil strata is varying from borehole to borehole in order to have fair idea of soil profile. In case of deep pile foundations soil investigation is to be carried out up to 25 m depth from ground level or refusal whichever is earlier. In case rock is encountered, coring in all the boreholes shall be carried out up to 3 meter in rock.

Performing Standard Penetration Tests at approximately 1.5 m interval in the borehole starting from 1.5 m below ground level onwards and at every change of stratum. The disturbed samples from the standard penetrometer shall also be collected for necessary tests.

Collecting undisturbed samples of 100/75 mm diameter 450 mm long from the bore holes at intervals of 2.5 m and every change of stratum starting from 1.0 m below ground level onwards in clayey strata.

The depth of Water Table, if encountered, shall be recorded in each borehole. In case the soil investigation is carried out in winter/summer, the water table for rainy season shall be collected from reliable sources and recorded in the report.

All samples, both disturbed and undisturbed, shall be identified properly with the borehole number and depth from which they have been taken.

The sample shall be sealed at both ends of the sampling tubes with wax immediately after the sampling and shall be packed properly and transported to the Contractor's laboratory without any damage or loss.

The logging of the boreholes shall be compiled immediately after the boring is completed and a copy of the bore log shall be handed over to the Engineer-in-change.

2.2.1.1 Dynamic core penetration test

Dynamic core penetration test of two number shall be carried out with the circulation of betnonite slurry at specified locations and continuous record of penetration resistance (NG) upto 15m from natural ground level or the refusal shall be maintained by the contractor. IS: 4968(Part-2) shall be followed for carrying out the test and reporting results.

The location of test shall be approved by the Engineer-in-charge. On completion of the test, the results shall be presented as a continuous record as the number of blows required for every 300mm penetration of the cone into the soil.

2.2.2 Trial Pits

Trial pits shall be carried at specified one location per Hectare as directed by the Purchaser. The trial pits shall be 2 m x 2 m in size extending to 4 m depths, or as specified by the Owner. Undisturbed samples shall be taken from the trial pits as per the direction of the Purchaser.

2.2.3 Electrical Resistivity Test

This test shall be conducted to determine the Electrical resistivity of soil required for designing safety-grounding system for the entire station area. The specifications for the equipments and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall confirm to IS: 3043. The test shall be conducted using Wagner's four electrode method as specified in IS: 1892, Appendix-B2. Unless otherwise specified at each test location, the test shall be conducted along two perpendicular lines parallel to the coordinate axis. On each line a minimum of 8 to 10 readings shall be taken by changing the spacing of the electrodes from an initial small value of 0.2 m up to a distance of 50.0 m.

2.2.4 Plate load test

Plate load test shall be conducted to determine the bearing capacity, modulus of sub grade reaction and load/settlement characteristics of soil at shallow depths by loading a plane and level steel plate kept at the desired depth and measuring the settlement under different loads, until a desired settlement takes place or failure occurs. The specification for the equipment and accessories required for conducting the test, the test procedure, field observations and reporting of results shall conform to IS: 1888. Modulus of sub grade reaction shall be conducted as per IS: 9214. The location and depth of the test shall be as given below:

(a) One at Control Room Building location at the proposed foundation depth below finished ground level for bearing capacity.

Undisturbed tube samples shall be collected at 1.0 m and 2.5m depths from natural ground level for carrying out laboratory tests.

The size of the pit in plate load test shall not be less than five times the plate size and shall be taken up to the specified depth. All provisions regarding excavation and visual examination of pit shall apply here.

Unless otherwise specified the reaction method of loading shall be adopted. Settlement shall be recorded from dial gauges placed at four diametrically opposite ends of the test plate.

The load shall be increased in stages. Under each loading stage, record of Time vs Settlement shall be kept as specified in IS: 1888.

Backfilling of the pit shall be carried out as per the directions of the Owner. Unless otherwise specified the excavated soil shall be used for this purpose. In cases of gravel-boulder or rocky strata, respective relevant codes shall be followed for tests.

2.2.5 Water Sample

Representative samples of ground water shall be taken when ground water is first encountered before the addition of water to aid drilling of boreholes. The samples shall be of sufficient quantity for chemical analysis to be carried out and shall be stored in air-tight containers.

2.2.6 Back Filling of Bore Holes

On completion of each hole, the Contractor shall backfill all bore holes as directed by the Owner. The backfill material can be the excavated material.

2.2.7 Laboratory Test

1. The laboratory tests shall be carried out progressively during the field work after sufficient numbers of samples have reached the laboratory in order that the test results of the initial bore holes can be made use of in planning the later stages of the field investigation and quantum of laboratory tests.

2. All samples brought from field, whether disturbed or undisturbed shall be extracted/ prepared and examined by competent technical personnel, and the test shall be carried out as per the procedures laid out in the relevant I.S. Codes.

The following laboratory tests shall be carried out

(a) Visual and Engineering Classification.

(b) Liquid limit, plastic limit and shrinkage limit for C-Ø soils.

(c) Natural moisture content, bulk density and specific gravity.

(d) Grain size distribution.

(e) Swell pressure and free swell index determination.

(f) California bearing ratio.

(g) Consolidated drained test with pore pressure measurement.

(h) Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, Ph value, and organic matter and any other chemical harmful to the concrete foundation.

(i) In case of rock samples following tests shall also be conducted:

i. Rock quality designation (RQD), RMR.
ii. UCC test.
iii. Point load index test.

2.2.8 Test Results and Reports

2.2.8.1 The Contractor shall submit the detailed report in two (2) copies wherein information regarding the geological detail of the site, summarised observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. Initially the contractor shall submit draft report and after the draft report is approved, the final report in four (4) copies shall be submitted. The test data shall bear the signatures of the Investigation Agency, Vendor and also site representative of DTL.

2.2.8.2 The report shall include, but not limited to the following :-

(a) A plan showing the locations of the exploration work i.e. bore holes, dynamic cone penetration tests, trial pits. Plate load test etc.

(b) Bore Logs: Bore logs of each bore holes clearly identifying the stratification and the type of soil stratum with depth. The values of Standard Penetration Test (SPT) at the depths where the tests were conducted on the samples collected at various depths shall be clearly shown against that particular stratum.

Test results of field and laboratory tests shall be summarized strata wise as well in combined tabular form. All relevant graphs, charts tables, diagrams and photographs, if any, shall be submitted along with report. Sample illustrative reference calculations for settlement, bearing capacity, pile capacity shall be enclosed.

2.2.8.3 **Recommendations :**

The report should contain specific recommendations for the type of foundation for the various structures envisaged at site. The Contractor shall acquaint himself about the type of structures and their functions from the Owner. The observations and recommendations shall include but not limited to the following:

(a) Geological formation of the area, past observations or historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table etc.

(b) Recommended type of foundations for various structures. If piles are recommended the type, size and capacity of pile and groups of piles shall be given after comparing different types and sizes of piles and pile groups.

(c) Allowable bearing pressure on the soil at various depths for different sizes of the foundations based on shear strength and settlement characteristics of soil with supporting calculations. Minimum factor of safety for calculating net safe bearing capacity shall be taken as 3.0 (three). Recommendation of liquefaction characteristics of soil shall be provided.

(d) Recommendations regarding slope of excavations and dewatering schemes.

(e) Comments on the Chemical nature of soil and ground water with due regard to deleterious effects of the same on concrete and steel and recommendations for protective measures.

(f) If expansive soil is met with, recommendations on removal or retainment of the same under the structure, road, drains, etc. shall be given. In the latter case detailed specification of any special treatment required including specification or materials to be used, construction method, equipments to be deployed etc. shall be furnished. Illustrative diagram of a symbolic foundation showing details shall be furnished.

(g) Recommendations for additional investigations beyond the scope of the present work, if considered such investigation as necessary.

(h) In case of foundation in rocky strata, type of foundation and recommendation regarding rock anchoring etc. should also be given.

3 SITE PREPARATION

The owner shall make fairly leveled land available to the contractor. The contractor at his own cost shall make the layout and levels of all structures etc. from the general grid of the plot and bench set by the contractor and approved by the owner. The Contractor shall give all help including instruments, materials and personnel to the Purchaser for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels.

3.1 SCOPE

This clause covers the design and execution of the work for site preparation, such as, clearing of site, excavation and compaction of backfill for foundation, road construction, drainage, trenches and final topping by stone (broken hard stone).

3.2 GENERAL

1) The Contractor shall develop the site area to meet the requirement of the intended purpose.

2) If fill material is required, the fill material shall be suitable for the above requirement. The fill shall be such a material and the site so designed as to prevent the erosion by wind and water of material from its final compacted position or the in-situ position of undisturbed soil.

3) Material unsuitable for founding of foundations shall be removed and replaced by suitable fill material and to be approved by the owner.

4) Backfill material around foundations or other works shall be suitable for the purpose for which it is used and compacted to the density described under Compaction. Excavated material not suitable or not required for backfill shall be disposed off in areas as directed by engineer in charge upto authorized MCD dumping yard.

3.3 EXCAVATION AND BACKFILL

1. Excavation and backfill for foundations shall be in accordance with the relevant code.

2. Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling.

3. When embankments are to be constructed on slopes of 15% or greater, benches or steps with horizontal and vertical faces shall be cut in the original slope prior to placement of embankment material. Vertical faces shall measure not more than 1 m in height.

4. Embankments adjacent to abutments, culverts, retaining walls and similar structures shall be constructed by compacting the material in successive uniform horizontal layers not exceeding 15 cm in thickness. (Of loose material before compaction). Each layer shall be compacted as required by means of mechanical tampers approved by the Engineer in charge. Rocks larger than 10 cm in any direction shall not be placed in embankment adjacent to structures.

5. Earth embankments for roadways and site areas adjacent to buildings shall be placed in successive uniform horizontal layers not exceeding 20 cm in thickness in loose stage measurement and compacted to the full width specified. The upper surface of the embankment shall be shaped so as to provide complete drainage of surface water at all times.

3.4 COMPACTION

1. The density to which fill materials shall be compacted shall be as per relevant IS and as per direction of engineer in charge. All compacted sand filling shall be confined as far as practicable. Backfilled earth shall be compacted to minimum 95% of the Standard Proctor's density at OMC. The sub grade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC. Cohesion less material sub grade shall be compacted to 70% relative density (minimum).

2. At all times, unfinished construction shall have adequate drainage. Upon completion of the road's surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.

3. Each layer of earth embankment when compacted shall be as close to optimum moisture content as practicable. Embankment material, which does not contain sufficient moisture to obtain proper compaction, shall be wetted. If the material contains any excess moisture, then it shall be allowed to dry before rolling. The rolling shall begin at the edges overlapping half the width of the roller each time and progress to the center of the road or towards the building as applicable. Rolling will also be required on rock fills. No compaction shall be carried out in rainy weather.

3.5 REQUIREMENT FOR FILL MATERIAL UNDER FOUNDATION

The thickness of fill material under the foundations shall be such that the maximum pressure from the footing, transferred through the fill material and distributed onto the original undisturbed soil will not exceed the allowable soil bearing pressure of the original undisturbed soil. For expansive soils the fill materials and other protections etc. to be used under the foundation is to be got approved by the owner.

4.0 ANTIWEED TREATMENT & STONE SPREADING

4.1 SCOPE OF WORK

The Contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification and direction of the owner.

Stone spreading along with cement concrete layer shall be done in the areas of the switchyard under present scope of work within fenced area including spare base within fenced area.

4.2 GENERAL REQUIREMENT

The material required for site surfacing/stone filling shall be free from all types of organic materials and shall be of standard quality, and as approved by the owner.

4.2.1 The material to be used for stone filling/site surfacing shall be uncrushed/crushed/broken stone of 20 mm nominal size (ungraded single size) conforming to Table of IS:383 –1970. Hardness, flakiness shall be as required for wearing courses are given below:

(a) Sieve Analysis limits (Gradation)
(IS: 383)

(b) Hardness

Abrasion value (IS: 2386 Part-IV) – not more than 40%
Impact value (IS: 2366 Part-IV) – not more than 30% and frequency shall be one test per 500 cu.m. with a minimum of one test per source.

(c) Flakiness Index

One test shall be conducted per 500 cu.m. of aggregate as per IS:2386 Part-I and maximum value is 25%.

4.2.2 After all the structures/equipments are erected, antiweed treatment shall be applied in the switchyard where ever stone spreading along with cement concrete is to be done and the area shall be thoroughly de-weeded including removal of roots. The recommendation of local agriculture or horticulture department may be sought where ever feasible while choosing the type chemical to be used. The antiweed chemical shall be procured from reputed manufacturers. The doses and application of chemical shall be strictly done as per manufacturer's recommendation. Nevertheless the effectiveness of the chemical shall be demonstrated by the contractor in a test area of 10MX10M (appx) and shall be sprinkled with water at least once in the afternoon everyday after forty eight hours of application of chemical. The treated area shall be monitored over a period of two to three weeks for any growth of weeds by the Engineer-in-charge. The final approval shall be given by Engineer-in-charge based on the results.

4.2.3 Engineer-in-charge shall decide final formation level so as to ensure that the site appears uniform devoid of undulations. The final formation level shall however be very close to the formation level indicated in the approved drawing.

4.2.4 After antiweed treatment is complete, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by Engineer-in-charge. The sub grade shall be consolidated by using half ton roller with suitable water sprinkling arrangement to form a smooth and

compact surface. The roller shall run over the sub grade till the soil is evenly and densely consolidated and behaves as an elastic mass.

4.2.5 In areas that are considered by the Engineer-in-Charge to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipments, the material shall be compacted by hand, if necessary. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling compaction.

4.2.6 The sub grade shall be in moist condition at the time the cement concrete is placed. If necessary, it should be saturated with water for not less than 6 hours but not exceeding 20 hours before placing of cement concrete. If it becomes dry prior to the actual placing of cement concrete, it shall be sprinkled with water and it shall be ensured that no pools of water or soft patches are formed on the surface.

4.2.7 Over the prepared sub grade, 75mm thick base layer of cement concrete in 1:4:8 (1 cement: 4 coarse sand : 8 stone aggregate 20/ 40mm nominal size) shall be provided in the area excluding roads, drains, cable trenches as per detailed engineering drawing. For easy drainage of water, the slope of 1:1000 is to be provided from the ridge to the nearest drain. The ridge shall be suitably located at the center of the area between the nearest drains.

4.2.8 The scope of work for yard development is inclusive of removal of all vegetation growth i.e. grass, shrubs, cleaning and uprooting anti –weed treatment, compaction, grading to required slope and final 3 layer of yard treatment as follows :

(i) 75mm thick base layer of cement concrete 1:4:8 (1 cement: 4 coarse sand : 8 stone aggregate 20/40mm nominal size)

(ii) 100mm thick layer of cement concrete 1:3:6 (1 cement: 3 coarse sand : 6 stone aggregate 20mm nominal size) with 6mm thick asbestos sheet upto full depth for contraction joints. Spacing of joints shall be approved by the Engineer-in-charge.

(iii) 100mm thick final layer of 20mm stone aggregate nominal size (ungraded single size)

5.0 SITE DRAINAGE

Providing rain water drainage system within the sub –station boundary under the present scope including connection at one or more points to the outfall point located outside the substation boundary wall is in the scope of contractor. Invert level of drainage system at outfall point shall be decided in such a way that the water can easily be discharged outside the substation boundary wall. In case outfall point is more than 50M away from boundary wall, only 50 meter drain outside the boundary wall is in the scope of contractor. Outfall point shall be got approved from Engineer- in- charge before commencement of construction. While designing the drainage system following points shall taken care of:

(a) The surface of the switchyard shall be sloped to prevent accumulation of water.

(b) Drain shall be constructed on both sides of roads. In the switchyard maximum spacing between two drains shall not be more than 100 meters. It will be ensured that no area is left undrained.

(c) Open surface trapezoidal drains having 300mm bottom width and sides having slope of 1horizontal: 1.5 vertical with 300mm depth at starting point of drain shall be provided.

(d) Longitudinal slope shall not be less than 1 in 1000.

(e) Open surface drains shall be constructed with minimum100mm thick plain cement concrete 1:2:4 (1 cement : 2 coarse sand: 4 stone aggregate 20mm nominal size). PCC 1:2:4 shall be laid over 75mm thick layer of PCC 1:4:8 (1cement: 4coarse sand: 8 stone aggregate 20mm nominal size.) Internal faces of drain are to be smooth and well finished with neat cement punning as final course.

(f) The side wall of the drains shall be 25 mm above the stone level to prevent falling of stone into drain. Groove of 150 mm width shall be provided at 1500 mm spacing with suitable mild steel 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, IS:456 and IS:783 shall be followed.

(j) Two Nos. of portable pumps of 5 hp capacity for drainage of water shall be provided by the Contractor.

(k) Pipe drains shall be connected through manholes at an interval of maximum 30m.

(l) If the invert level of outfall point is above the last drain point in the substation boundary, sump of suitable size has to be constructed with in the substation boundary.

(m) The drainage scheme and associated drawings shall be got approved from the engineer in charge before commencement of construction.

6.0 RAINWATER HARVESTING

(a) In addition to drainage of rainwater in accordance with clause 5.0 above the contractor shall make arrangement for rainwater harvesting also. Rainwater harvesting shall not be done if the depth of water table is within 8.0m from finished ground level.

(b) Providing one number recharge structure with bore wells shall do Rainwater harvesting. The recharge structure shall be suitably located within the sub-station. Branch drains from the main drain carrying rainwater from entire switchyard, constructed in accordance with clause 5.0, shall be connected to the recharge structure.

(c) The internal diameter of recharge shafts shall be 4.5 meter with 230mm thick lining of brick work upto a depth of 2.0 meter from ground level and 345mm thick brickwork below 2.0 meter depth. The brickwork shall be constructed with cement mortar 1:6 (1cement: 6 coarse sand). The overall depth of shaft shall be 5.0 meter below invert level of drain. The shaft shall be covered with RCC slab for a live load of 300 kg. per sqm. Two openings of size 0.7 x 0.7 meter shall be provided in the RCC cover slab. An iron cover made of 5mm thick chequered plate with hinges shall be provided on the openings. Galvanized M.S. rungs of 20mm diameter at spacing of 300 mm shall be provided in the wall of shaft below the opening in the RCC slab to facilitate cleaning of shaft.

(d) A 300 mm diameter bore well shall be drilled in the centre of the shaft. The depth of bore well shall be 5.0 meter more than the depth of sub soil water.

(e) A 100 mm dia medium duty MS pipe conforming to IS:1161 shall be lowered in the bore well keeping bail plug towards bottom of bore well. The pipe shall have 1.58mm holes for 4.0 meter length starting from 1.0 meter from bottom of bore well. Holes of 3.0mm diameter shall be provided for a length of 2.0 meter starting from the bottom level of coarse sand and down wards. The overall length of pipe shall be equal to total depth of bore well plus depth of shaft.

(f) Gravel of size 3mm to 6mm shall be filled around 100 diameter MS pipe in the bore well. The shaft shall be filled with 500 mm thick layers each from the bottom of shaft with boulders of size 50mm to 150mm, gravel of size 5mm to 10mm, coarse sand having particle size 1.5mm to 2.0mm and boulders of size not less than 200mm respectively.

Drawing based on above details of recharge structure for rainwater harvesting has to be prepared by contractor and to be approved from engineer in charge.

7.0 ROADS AND CULVERTS

(a) All the roads within the substation under the present scope is in the scope of contract. Layout of the roads, General detail & Arrangement drawing for the substation to be prepared by contractor and got

approved from engineer in charge. Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. Road to the transformer shall be as short and straight as possible. The top level of roads shall be 300mm above finished formation level of switchyard.

(b) The double lane cement concrete road with minimum reinforcement shall have 7.0m width, 1.6 m wide 100 mm thick PCC(1:2:4) and earthen shoulder on either side of the road. Other roads shall be with 3.75 m cement concrete and 1.3 m wide 100 mm thick PCC(1:2:4) and earthen shoulder on either side of the road. All design and drawings of road shall be got approved from engineer in charge. The road from main gate upto control room building shall be double lane road and other roads in and around the substation shall be single lane road.

(c) All roads shall be designed for class "C" traffic as per relevant IRC.

(d) CPWD specification shall be followed for construction of Roads.

(e) All the culverts and allied structures (required for road/rail, drain, trench crossings etc.) shall be designed for class AA loading as per IRC standard / IS code and should be checked for transformer loading.

8.0 TRANSFORMER FOUNDATIONS, RAIL TRACK/ ROAD CUM RAIL TRACK

The Contractor shall provide a RCC Rail cum road system integrated with the transformer foundation to enable installation and the replacement of any failed unit. The transfer track system shall be suitable to permit the movement of any failed unit fully assembled (including OLTC, bushings) with oil. This system shall enable the removal of any failed unit from its foundation to the Main road. If trench/drain crossings are required then suitable R.C.C. culverts shall be provided in accordance with I.R.C. standard / relevant IS.

The Contractor shall provide a pylon support system for supporting the fire fighting system if provided.

Each transformer including oil conservator tank and cooler banks etc. shall be placed in a self-sufficient pit surrounded by retaining walls (Pit walls). The clear distance of the retaining wall of the pit from the transformer shall be 20% of the transformer height or 0.8m whichever is more. The oil collection pit thus formed shall have a void volume equal to 100% volume of total oil in the transformer. The minimum height of the retaining walls shall be 20 cm above the finished level of the ground to avoid outside water pouring inside the pit. The bottom of the pit shall have a uniform slope towards the sump pit. While designing the oil collection pit, the movement of the transformer must be taken into account. The soak pits of all transformers shall be connected to a common sump well through a piping system. The capacity of sump well shall be designed with the consideration of volume of transformer and rainwater.

The grating shall be made of MS flat of size 50mmx5mm placed at 30mm center to center and 25mmx5mm MS flat at a spacing of 150mm at right angle to each other. Maximum length of grating shall be 1500mm and width shall not be more than 500mm. The gratings, supported on ISMB 150mm, shall be placed at the formation level and will be covered with 100mm thick layer of broken/crushed/non-crushed stone having size 40mm to 60mm which acts as an extinguisher for flaming oil.

Each oil collection pit shall be drained towards a sump pit whose role is to drain water and oil due to leakage within the collection pit so that collection pit remains dry.

8.1 MATERIAL

Complete foundation shall be made of reinforced cement concrete M25 grade and shall be designed as per guidelines for design of foundations given in relevant clauses in IS codes.

8.2 DRAINAGE

One 5.0 H.P pump of approved make for sump well shall be supplied and installed by the Contractor to evacuate the fire fighting & rain water from the sump well in to the nearest drain. Pump house with one door & window to accommodate pump should be constructed.

9.0 FIRE PROTECTION WALLS

9.1 GENERAL

Fire protection walls shall be provided, if required, in accordance with Tariff Advisory Committee (TAC) recommendations.

9.2 MATERIAL

The firewall may be made of reinforced cement concrete (M-25 grade) as per the system requirement. Materials used must conform to the standards of the national Fire Prevention Association & TAC Norms.

9.3 FIRE RESISTANCE

The firewall shall have a minimum fire resistance of 4 hours. The partitions, which are made to reduce the noise level, shall have the same fire resistance. The walls of the building, which are used as firewalls, shall also have a minimum fire resistance of 4 hours.

The firewall shall be designed to protect against the effect of radiant heat and flying debris from an adjacent fire.

9.4 DIMENSIONS

The barrier shall extend at least 300 mm above the transformer bushing and pressure relief vent and length wise 600 mm beyond the transformer including any radiators and tap changer enclosure.

These dimensions might be reduced in special cases, as per the approval of owner where there is lack of space. A minimum of 2.0 meter clearance shall be provided between the equipments e.g. Autotransformer and firewalls.

The building walls, which act as firewalls, shall extend at least 1 m above the roof in order to protect it.

The firewall shall be made of reinforced cement concrete (M-25 grade), as per the system requirements.

9.5 MECHANICAL RESISTANCE

The fire wall shall have the mechanical resistance to withstand local atmosphere conditions. If this wall shall serve as a support for equipment such as insulators etc, it mechanical rigidity must be increased.

10.0 CABLE & PIPE TRENCHES

(a) The cable trenches and pre-cast removable RCC covers with angle/channel nosing all around (with lifting arrangement) shall be constructed using RCC of M25 grade.

(b) The cable trench walls shall be designed for the following loads.

(i) Dead load of 155 kg/m length of cable support + 75 Kg on one tier at the outer edge of tier.

(ii) Earth pressure + uniform surcharge pressure of 2T/m2.

(c) Cable trench covers shall be designed for self-weight of top slab + concentrated load of 150 kg at center of span on each panel.

(d) Necessary sumps shall be provided and each sump shall be provided with pump of 5 HP capacity. Cable trenches shall not be used as storm water drains.

(e) The top of trenches shall be kept at least 100 mm above the final level of stone layer of yard development. The top of cable trench shall be such that the surface rainwater does not enter the trench.

(f) All metal parts inside the trench shall be connected to the earthing system.

(g) Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.

(h) The trench bed shall have a slope of 1/500 along the run & 1/250 perpendicular to the run.

(i) Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 (1cement:6 fine sand) and plaster with 12mm thick 1:6(1cement:6 fine sand) cement sand mortar.

(j) Cable trench crossing the roads/rails shall be designed for class AA loading of IRC and should be checked for transformer loading also.

(k) All the construction joints of cable trenches i.e. between base slab to the base slab and the junction of vertical wall to the base slab as well as from vertical wall to wall and all the expansion joints shall be provided with approved quality PVC water stops and approximately 230x5mm size for those sections where the ground water tube is expected to rise above the junction of base slab and vertical wall of cable trenches.

11.0 FOUNDATION /RCC CONSTRUCTION

11.1 GENERAL

(a) Work covered under this Clause of the Specification comprises the design and construction of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, drains, jacking pad, pulling block, control cubicles, bus supports, transformer, marshalling kiosks, auxiliary equipments, buildings, tanks or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to the other RCC constructions.

(b) Concrete shall conform to the requirements mentioned in IS:456 (latest) and all the tests shall be conducted as per relevant Indian Standard Codes as mentioned in Standard field quality plan appended with the specification.

A minimum grade of M25 concrete shall be used for all structural/load bearing members as per latest IS 456 (latest).

(c) If the site is sloppy, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate such slopes.

(d) The switchyard foundation's plinths and building plinths shall be minimum 300mm and 500 mm above finished ground level respectively.

(e) Minimum 75 mm thick lean concrete (1:4:8) shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.

(f) Concrete made with Portland slag cement shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering.

(g) The design and detailing of foundations shall be done based on the approved soil data and sub-soil conditions as well as for all possible critical loads and the combinations thereof. The Spread footings foundation or pile foundation as may be required based on soil/sub-soil conditions and superimposed loads shall be provided.

(h) If pile foundations are adopted, the same shall be cast-in-situ driven/bored or pre-cast or under reamed type as per relevant parts of IS Code 2911. Only RCC piles shall be provided. Suitability of the adopted pile foundations shall be justified by way of full design calculations. The bidder showing complete details of piles/pile groups, proposed to be used, shall submit detailed design calculations.

The bidder at their cost to establish the piles design capacity shall also carry out necessary initial load test. Only after the design capacity of piles has been established, the Contractor shall take up the job of piling. Routine tests for the piles shall also be conducted. All the work (design & testing) shall be planned in such a way that these shall not cause any delay in project completion.

11.2 DESIGN

(a) All foundation shall be of reinforced cement concrete. The design and construction of RCC structures shall be carried out as per IS:456 and minimum grade of concrete shall be M-25. Higher grade of concrete than specified above may be used at the discretion of Contractor without any additional financial implication to the DTL.

(b) Limit state method of design shall be adopted unless specified otherwise in the specification.

(c) For detailing of reinforcement IS:2502 and SP:34 shall be followed. Cold twisted deformed bars (Fe=415 N/mm2) conforming to IS:1786 or TMT bars as per CPWD specifications shall be used as reinforcement. However, in specific areas, mild steel (Grade I)conforming to IS:432 can also be used. Two layers of reinforcement (on inner and outer face) shall be provided for wall & slab sections having thickness of 150 mm and above. Clear cover to reinforcement shall be as per IS:456 (latest).

(d) RCC water retaining structures like storage tanks, etc. shall be designed as un cracked section in accordance with IS:3370 (Part I to IV) by working stress method. However, water channels shall be designed as cracked section with limited steel stresses as per IS:3370 (Part I to IV) by working stress method.

(e) The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and or equipment and/or superstructure and other conditions which produces the maximum stresses in the foundation or the foundation component and as per the relevant IS Codes of foundation design. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used.

(f) Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.

(g) Necessary protection to the foundation work, if required shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental/harmful to the concrete foundations.

(h) RCC columns shall be provided with rigid connection at the base.

(i) All sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be taken as mentioned in relevant IS Codes or as stipulated elsewhere in the Specifications. For checking against overturning, weight of soil vertically above footing shall be taken and inverted frustum of pyramid of earth on the foundation should not be considered.

(j) Earth pressure for all underground structures shall be calculated using co-efficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable). However, for the design of substructures of any underground enclosures, earth pressure at rest shall be considered.

(k) In addition to earth pressure and ground water pressure etc., a surcharge load of 2T/Sq.m shall also be considered for the design of all underground structures including channels, sumps, tanks, trenches, substructure of any underground hollow enclosure etc., for the vehicular traffic in the vicinity of the structure.

(l) Following conditions shall be considered for the design of water tank in pumps house, channels, sumps, trenches and other underground structures:

(1) Full water pressure from inside and no earth pressure & ground water pressure & surcharge pressure from outside (application only to structures which are liable to be filled up with water or any other liquid).

(2) Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

(3) Design shall also be checked against buoyancy due to the ground water during construction and maintenance stages. Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the superimposed loadings.

(m) Base slab of any underground enclosure shall also be designed for empty condition during construction and maintenance stages with maximum ground water table (GWT). Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the super-imposed loadings.

(n) Base slab of any underground enclosure like water storage tank shall also be designed for the condition of different combination of pump sumps being emptyd uring maintenance stages with maximum GWT. Intermediate dividing piers of such enclosures shall be designed considering water in one pump sump only and the other pumps sump being empty for maintenance.

(o) The foundations shall be proportioned so that the estimated total and differential movements of the foundations are not greater than the movements that the structure or equipment is designed to accommodate.

(p) The foundations of transformer and circuit breaker shall be of block type foundation. Minimum reinforcement shall be governed by IS: 2974 and IS: 456.

(q) The tower and equipment foundations shall be checked for a factor of safety of 2.2 for normal condition and 1.65 for short circuit condition against sliding, overturning and pullout. The same factors shall be used as partial safety factor over loads in limit state design also.

12.0 ADMIXTURES & ADDITIVES

(a) Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own batch and added to the mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labeled containers to enable identification.

(b) Admixtures in concrete shall conform to IS:9103. The water proofing cement additives shall conform to IS:2645. Concrete Admixtures/ Additives shall be approved by engineer in charge.

(c) The Contractor may propose and the engineer in charge may approve the use of a water-reducing set-retarding admixture in some of the concrete. The use of such an admixture will not be approved to overcome problems associated with inadequate concrete plant capacity or improperly planned placing operations and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.

(d) The water-reducing set-retarding admixture shall be an approved brand of Ligno-sulphonate type admixture.

(e) The water proofing cement additives shall be used as required/advised by the engineer in charge.

13.0 STRUCTURES

13.1 GENERAL

The scope of specification covers design, fabrication, proto-assembly, supply and erection of galvanized steel structures for towers, girders, lightning masts and equipment support structures. All galvanized steel structure shall be of lattice structure fabricated from structural steel conforming to IS 2062 (latest).

It is the intent of the owner to provide structures, which allow interchangeability of equipments at a later stage. Accordingly equipment support structure shall be provided with the provision of stool. Stools shall be provided between the equipment and its support structure to match the bus bar height. The top of stool shall be connected to the equipment and the bottom of the stool shall be connected to the support structure.

The scope shall include supply and erection of all types of structures including bolts, nuts, washers, hangers, shackles, clamps anti climbing devices, bird guards, step bolts, inserts in concrete, gusset plates, equipment mounting bolts, structure earthing bolts, foundation bolts, spring washers, fixing plates, ground mounted marshalling boxes (AC/DC Marshalling box & equipment control cabinets), structure mounted marshalling boxes and any other items as required to complete the job.

The connection of all structures to their foundations shall be by base plates and embedded anchor/foundation bolts. All steel structures and anchor/foundation bolts shall be fully galvanized. The weight of the zinc coating shall be at least 0.610 kg/m2 for anchor bolts / foundation bolts and for structural members. One additional nut shall be provided below the base plate which may be used for the purpose of leveling.

13.2 DESIGN REQUIREMENTS FOR STRUCTURES

(1) For design of steel structures loads such as dead loads, live loads, wind loads etc. shall be based on IS:875,Parts I to V.

(2) For materials and permissible stresses IS:802,Part-I,Section-2 shall be followed in general. However, additional requirements given in following paragraphs shall be also considered.

(3) Minimum thickness of galvanized tower member shall be as follows:

Members	Minimum thickness (mm)
Leg members, Ground wire Peak members/Main members	5
Other members	5
Redundant members	5

(4) Maximum slenderness ratios for leg members, other stressed members and redundant members for compression force shall be as per IS-802.

(5) Minimum distance from hole center to edge shall be 1.5 x bolt diameter. Minimum distance between center to center of holes shall be 2.5 x bolt diameter.

(6) The minimum bolt diameter shall be 16 mm.

13.3 STEP BOLTS

In order to facilitate inspection and maintenance, the structures shall be provided with climbing devices. Each tower shall be provided with step bolts not less than 16mm diameter & 175mm long spaced not more than 450mm apart, staggered on faces on one leg extending from about 1.0 meters above ground level to the top of the tower. The step bolt shall conform to IS: 10238. Ladders on towers with lighting appliances shall be provided with safety guards.

13.4 DESIGN CRITERIA

a) All structures shall be designed for the worst combination of dead loads, live loads, wind loads as per code IS:875, seismic forces as per code IS:1893 (latest),Importance factor of 1.5, loads due to deviation of conductor, load due to unbalanced tension in conductor, torsional load due to unbalanced vertical and horizontal forces, erection loads, short circuit forces including “snatch” in

the case of bundled conductors etc. Short circuit forces shall be calculated considering a fault level of 40.0 kA. IEC-865 may be followed for evaluation of short circuit forces.

b) Switchyard gantry structures shall be designed for the two conditions i.e. normal condition and short circuit condition. In both conditions the design of all structures shall be based on the assumption that stringing is done only on one side i.e. all the three (phase) conductors broken on the other side.

Factor of safety of 2.0 under normal conditions and 1.5 under short circuit condition shall be considered on all external loads for the design of switchyard structures which are of lattice type.

c) Vertical load of half the span of conductors/string and the earth wires on either side of the beam shall be taken into account for the purpose of design. Weight of man with tools shall be considered as 150 kgs. for the design of structures.

d) Terminal/line take off and other gantries shall be designed for a minimum conductor tension of 2 metric tonnes per phase for 220/66kV or as per requirements whichever is higher. The distance between terminal gantry and dead end tower shall be taken as 100 metres. The design of these terminal gantries shall also be checked considering +/- 30 deg deviation of conductor in horizontal planes and plus 30 degree in vertical plane. For other gantries the structural layout requirements shall be adopted in design.

e) The girders shall be connected with lattice columns by bolted joints.

f) All Pipe support structures if used for supporting equipments shall be designed for the worst combination of dead loads, erection load. Wind load/seismic forces, short circuit forces and operating forces acting on the equipment and associated bus bars as per IS:806. The material specification shall be as per IS:1161 read in conjunction with IS:806.

g) If luminaries are proposed to be fixed on gantries/towers, then the proper loading for the same shall be considered while designing. Also holes for fixing the brackets for luminaries should be provided wherever required.

h) Foundation bolts shall be designed for the loads for which the structures are designed.

i) Lighting-cum-lightning Mast shall be 35m in height (32.5m lattice structure plus 2.5m pipe) and designed for diagonal wind condition. Lightning masts shall be provided with a structural steel ladder within its base up to a height of 25 meter. The ladder shall be provided with protection rings. One platform shall be provided at 25.0m height for mounting of lighting fixture. The platform shall also have protection railing. The details of lighting fixtures would be as per the approved drawings. High mast with integral motor technology which shall bring down the Light fixture for ease of maintenance is also acceptable to avoid separate platform at 25.0m height. The bidder shall maintain the lux level as per NIT and provision of lightning protection of switchyard.

13.5 DESIGN DRAWINGS, BILL OF MATETRIALS AND DOCUMENTS

(1) The Contractor shall furnish design, drawing detail BOMs on basis of BOM as enclosed including shop manufacturing drawings for every member to the Purchaser after award of the Contract. However, Contractor shall have to prepare and submit any other drawings, bill of materials (BOM) additionally required during design and construction stage which the Purchaser feels necessary. In case Purchaser feels that any design drawing, BOM are to be modified even after its approval, Contractor shall modify the designs & drawings and resubmit the design drawing, BOM as required in the specification.

(2) The fabrication drawings to be prepared and furnished by the Contractor shall be based on the design approved by the Purchaser. These fabrication drawings shall indicate complete details of fabrication and erection including all erection splicing details and typical fabrication splicing details, lacing details, weld sizes and lengths. Bolt details and all customary details in accordance with standard structural engineering practice whether or not given by the owner. The fabrication drawings shall be submitted to the owner. Proto shall be made only after approval of fabrication drawings.

(3) The fabrication work shall start only after the final approval to the Fabrication drawing is accorded by the owner. The design drawing should indicate not only profile, but section, numbers and sizes of bolts and details of typical joints.

(4) Such approval shall, however, not relieve the Contractor of his responsibility for the safety of the structure and good connections and any loss or damage occurring due to defective fabrication, design or workmanship shall be borne by the Contractor.

13.6 FABRICATION OF STEEL MEMBERS

The fabrication and erection works shall be carried out generally in accordance with IS 802. A reference however may be made to IS 800 in case of non-stipulation of some particular provision in IS 802. All materials shall be completely shop fabricated and finished with proper connection material and erection marks for ready assembly in the field.

13.7 PROTO-ASSEMBLY

(1) The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified camber, if any, is provided. In order to minimize distortion in member the component parts shall be positioned by using the clamps, clips, dogs, jigs and other suitable means and fasteners (bolts and welds) shall be placed in a balanced pattern. If the individual components are to be bolted, paralleled and tapered drifts shall be used to align the part so that the bolts can be accurately positioned.

(2) Sample towers, beams and lighting-cum-lightening masts and equipment support structures shall be trial assembled in the fabrication shop and shall be inspected and cleared by Contractor based on the approved fabrication drawing before mass fabrication.

Pursuant to above the B.O.Ms along with proto-corrected fabrication drawings and shop manufacturing drawings for every member shall be prepared and submitted by the main vendor to owner as document for information. Such BOM, which shall be duly certified by the main vendor for its conformity to the approved design, shall be the basis for owner to carry out inspection.

13.8 BOLTING

i) Every bolt shall be provided with a washer under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together.

ii) All steel items, bolts, nuts and washers shall be hot dip galvanized.

iii) 2.0% extra nuts and bolts shall be supplied for erection.

13.9 WELDING

The work shall be done as per approved fabrication drawings which clearly indicate various details of joints to be welded, type of weld, length and size of weld, whether shop or site weld etc. Symbols for welding on erection and shop drawings shall be according to IS: 813. Efforts shall be made to reduce site welding so as to avoid improper joints due to constructional difficulties.

13.10 FOUNDATION BOLTS

(1) Foundation bolts for the towers and equipment supporting structures and elsewhere shall be embedded in first stage concrete while the foundation is cast. The Contractor shall ensure the proper alignment of these bolts to match the holes in the base plate.

(2) The Contractor shall be responsible for the correct alignment and leveling of all steel work on site to ensure that the towers/structures are plumb.

(3) All foundation bolts for lattice structure, pipe structure are to be supplied by the Contractor.

(4) All foundation bolts shall be fully galvanized so as to achieve 0.61 kg. per Sq.m. of Zinc Coating as per specifications.

(5) All foundation bolts shall conform to IS 5624 but the material, however shall be MS conforming to IS: 2062.

13.11 STABILITY OF STRUCTURE

The Supplier shall be responsible for the stability of the structure at all stages of its erection at site and shall take all necessary measures by the additions of temporary bracings and guying to ensure adequate resistance to wind and also to loads due to erection equipment and their operations.

13.12 GROUTING

The method of grouting the column bases shall be subject to approval of Purchaser and shall be such as to ensure a complete uniformity of contact over the whole area of the steel base. The Contractor will be fully responsible for the grouting operations.

13.13 GALVANISING

(1) All structural steel works and pipe supports shall be galvanized after fabrication.

(2) Zinc required for galvanizing shall have to be arranged by the manufacturer. Purity of zinc to be used shall be 99.95% as per IS:209.

(3) The Contractor shall be required to make arrangement for frequent inspection by the owner as well as continuous inspection by a resident representative of the owner, if so desired for fabrication work.

13.14 TOUCH-UP PAINTING

The touch up primers and paints shall consist of Red Oxide / Zinc chromate conforming to the requirements of IS: 2074 with a pigment to be specified by the owner.

13.15 INSPECTION BEFORE DISPATCH

Each part of the fabricated steel work shall be inspected as per approved quality plans and certified by the owner or his authorized representative as satisfactory before it is dispatched to the erection site. Such certification shall not relieve the Contractor of his responsibility regarding adequacy and completeness of fabrication.

13.16 TEST CERTIFICATE

Copies of all test certificates relating to material procured by the Contractor for the works shall be forwarded to the owner.

13.17 ERECTION

The Contractor should arrange on his own all plant and equipment, welding set, tools and tackles, scaffolding, trestles equipments and all other accessories and ancillaries required for carrying out erection without causing any stresses in the members which may cause deformation and permanent damage.

13.18 SAFETY PRECAUTIONS

The Contractor shall strictly follow at all stages of fabrication, transportation and erection of steel structures, raw materials and other tools and tackles, the stipulations contained in Indian Standard Code for Safety during erection of structural steel work-IS:7205.

All tests mentioned in standard field quality plans have to be carried out and conformity of materials

and workmanship shall be ascertained.

14.0 CHAINLINK FENCING AND GATE

14.1 Fencing and gate shall be provided as per details given below:

1. Fencing shall be provided for complete switchyard as per drawing approved by engineer in charge. Separate gate shall be provided for men and equipment.

2. Internal fence surrounding the various equipments (if) mounted on ground or a height lower than 2.5m. Necessary gates shall be provided for each area so surrounded.

3. Drawing of fencing covering following specifications shall be prepared by contractor and shall got approved from engineer in charge.

14.2 PRODUCT MATERIALS

The minimum requirements are as follows:

Chain link fence fabric (without galvanization) in accordance to IS: 2721.

1.	Size of mesh	:	75mm
2.	Nominal wire size	:	3.15mm diameter
3.	Width of chain link	:	1500mm
4.	Painting	:	Two or more coats of approved standard make synthetic enamel paint over a coat of standard steel primer.

Posts

The posts shall be of medium M.S. tubes of 50mm diameter conforming to grade Yst-22 (Kg/mm2). The tubes shall also conform to IS : 1161/IS 806. The length of tubular post shall be 2600 mm.

An M.S. base plate of size 160 X 160 X 6mm thick shall be welded with the tubular post. The post shall be provided on the top with M S plate.

The tubular post shall be welded with 8 number of M S flat of size 50 x 6mm – 75mm long. Two number of 13.5 mm diameter holes on each cleats shall be provided to bolt the fence fabric panel. The cleats shall be welded at equal spacing in such a way that 4 numbers of cleats are on one side and remaining 4 cleats are on the opposite side of the post. The cleats on the corner posts shall be welded in such a way that it suits the site requirement.

The whole assembly of tubular post shall be hot dip galvanized. The zinc coating shall be minimum 610 gram per sq. meter. The purity of zinc shall be 99.95% as per IS: 209.

Fence Fabric Panel

Chain link fencing shall be fabricated in the form of panel 1300 X 2928 mm. An M.S. flat of at least 50x6 mm size shall be welded all-round fence fabric to form a panel. Four pairs of 13.5mm diameter holes on the vertical M S flat matching the spacing of holes in cleats fixed with pipe shall be provided to fix the fence panel with the tubular posts. A washer shall also be provided below each nut. The contractor, for fixing the panels, shall supply the 12mm diameter bolts including nuts and washers. All nuts, bolts and washers shall be hot dip galvanized.

The fence panel shall be provided with two or more coats of approved standard synthetic enamel paint over approved standard steel primer.

Installation

1. Fence shall be installed along the switchyard line.
2. Post holes shall be excavated by approved method.
3. All posts shall be 3.0m apart measured parallel to ground surface.
4. Posts shall be set in 1:1.5:3 Plain Cement Concrete block of minimum 0.60x0.60x1.2m depth. 100mm thick plain cement concrete 1:4:8 shall be provided below concrete blocks. Posts

shall be braced and held in plumb position and true alignment and elevation until concrete has set.

5. Fence fabric shall not be installed until concrete has cured a minimum of 7 days.
6. Fence fabric panel shall be fixed to the post at 4 nos. MS flat each of 50x6, 75 long through 2 nos. of bolts (12 diameter) on each flat.
7. Tow wall of one brick thick over 75mm thick PCC (1:4:8) shall be provided below all fencing and between fence posts. Tow wall shall be minimum 200 mm above and 500mm below finished ground level. All exposed surface of brick tow wall shall be provided with 1:6 cement sand plaster (15mm thick) and coated with two coats of cement paint over a coat of cement primer.

The painting pattern of fence panels shall be decided by Engineer-in- charge. It shall be preferable to paint the panel in different colour pattern such that it gives better aesthetic look.

Gate

1. The gate shall be made of medium duty M. S. pipe conforming to relevant I.S. with welded joints. The main frame (outer frame) of the gate shall be made of 65mm dia pipe and vertical pipes of 40mm dia shall be welded with the main frame. Other details shall be as per approved drawing.
2. The gates shall be fabricated with welded joints to achieve rigid connections. The gate frames shall be painted with one coat of approved steel primer and two coats of synthetic enamel paint.
3. The gates shall be provided with suitable locking arrangement.
4. The main gate shall be 6.0m wide and shall be of double leaf type. Next to the main gate, a men gate (1.25m wide single leaf) shall also be provided.
5. Two steel rollers in each leaf with rolling MS flat on road shall be provided with the gate.
6. Gate shall be installed in location as per approved drawing.

15.0 BUILDINGS - GENERAL REQUIREMENTS

15.1 GENERAL

The scope includes design, engineering and construction including anti-termite treatment, plinth protection DPC of Building including sanitary, water supply, electrification etc. of control room building, GIS Building etc. The buildings shall be of RCC framed structure of concrete of M25 grade (Min.).

The Contractor shall appoint a reputed architect (to be approved by DTL) for design of architecturally pleasing building.

15.2 AREA REQUIREMENT :-

(A) CONTROL ROOM BUILDING

The position of different floors of rooms are given below:

- Control room FF
- ACDB room GF
- DCDB-cum-battery room GF
- Testing Lab FF
- Conference room FF
- S/Stn. Incharge office FF

  Plus attached Toilet

  Plus PS room
- Room for engineers FF
- Room for non-executives FF

- Lobby FF
- Corridor FF
- Portico GF
- Common toilet FF
  (ladies & gents both separate)
- Changing room FF
- Toilet attached to FF
  Conference room
- Janitor room FF
- Pantry FF
- Store GF
- GIS room GF
- Relay & Protection panels room GF
  (Adjacent to GIS room)

Any future possibility of annexes building shall be taken care of while finalizing the layout of the control room building.

(B) GIS BUILDING :-

Dimensions of the building shall be decided by the bidder depending upon requirement. Provision for extension of the building in future shall be made. A corridor having width of 1500 mm shall be provided all around GIS to facilitate maintenance of equipments. Provision for service bay shall also be made. Panels shall be kept in an air-conditioned enclosure. This enclosure shall be separated from main GIS hall by providing glazed partition made of aluminium frame and 5.5 mm thick glass. Cable cellar room in GIS building shall be provided.

15.2.1 DESIGN

a) The buildings shall be designed :

1. to the requirements of the National Building Code of India, and the standards quoted therein.

2. for the specified climatic & loading conditions.

3. to adequately suit the requirements of the equipment and apparatus contained in the buildings and in all respects to be compatible with the intended use and occupancy.

4. with a functional and economical space arrangement.

5. for a life expectancy of structure, systems and components not less than that of the equipment which is contained in the building, provided regular maintenance is carried out.

6. to be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design.

7. to allow for easy access to equipment and maintenance of the equipment.

8. with, wherever required, fire retarding materials for walls, ceilings and doors, which would prevent supporting or spreading of fire.

9. with materials preventing dust accumulation.

b) Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.

c) Individual members of the buildings frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion etc.

d) Permissible stresses for different load combinations shall be taken as per relevant IS Codes.

e) The building lighting shall be designed in accordance with the requirements of relevant section.

f) The building auxiliary services like air conditioning and ventilation systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements specified in relevant section or elsewhere in this Specification.

15.2.2 DESIGN LOADS

Building structures shall be designed for the most critical combinations of dead loads, super- imposed loads, equipment loads, crane load (if any), wind loads and seismic loads.

Dead loads shall include the weight of structures complete with finishes, fixtures and partitions and should be taken as per IS: 1911.

Super-imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks/hangers and erection, operation and maintenance loads. Equipment loads shall constitute, if applicable, all load of equipments to be supported on the building frame.

For crane loads an impact factor of 30% and lateral crane surge of 10% (lifted weight + trolley) shall be considered in the analysis of frame according to provisions of IS: 875. The horizontal surge shall be 5% of the static wheel load.

The wind loads shall be computed as per IS 875 - 1987, Seismic Coefficient method/Response Spectrum method shall be used for the seismic analysis as per IS 1893 with importance factor 1.5.

Wind and Seismic forces shall not be considered to act simultaneously.

Floors/slabs shall be designed to carry loads imposed by equipment, cables and other loads associated with building. Floors shall be designed for live loads as per relevant IS. Cable load shall also be considered additionally for floors where these loads are expected.

In addition, beams shall be designed for any incidental point loads to be applied at any point along the beams. The floor loads shall be subject to Purchaser's approval.

For consideration of loads on structures, IS: 875 -1987, the following minimum superimposed live loads shall, however, be considered for the design.

a	Roof	1.5 KN/M2 0.75 KN/M2	for accessible roofs for in-accessible roofs
b	RCC-Floor	5 KN/M2 10 KN/M2(min.)	for offices for equipment floors or actual requirement, if higher than 10 kN/sqm based on equipment component weightand layout plans.
c	Stairs & balconies	5 KN/M2	
d	Toilet Rooms	2 KN/M2	
e	Chequered plate floor	4 KN/M2	
f	Walkways	3 KN/M2	

Any additional load coming in the structure shall be calculated as per IS: 875 -1987.

15.2.3 SUBMISSION

The following information shall be submitted for review and approval to the Purchaser:

1. Structural design calculations and drawing (including construction/ fabrication) for all reinforced concrete and structural steel structures.

2. Fully, dimensioned concept plan including floor plans, cross sections, longitudinal sections, elevations and perspective view of each building. These drawings shall be drawn at a scale not smaller than 1:50 and shall identify the major building components.

3. Fully dimensioned drawings showing details and sections drawn to scales of sufficient size to clearly show sizes and configuration of the building components and the relationship between them.

4. Product information of building components and materials, including walls partitions flooring ceiling, roofing, door and windows and building finishes.

5. A detailed schedule of building finishes including colour schemes.

6. A door & window schedule showing door types and locations, door lock sets and latch sets and other door hardware.

Approval of the above information shall be obtained before ordering materials or starting fabrication or construction as applicable.

15.2.4 FINISH SCHEDULE

The finishing schedule is given in subsequent clauses. Internal walls of GIS hall shall be painted with two or more coats of plastic emulsion paint (DSR item code 13.92.1). Paints used in the work shall be of best quality specified in CPWD specification.

15.2.5 FLOORING

Flooring in various rooms of control room building shall be as per detailed schedules given in Table -1. 52mm thick ironite flooring (DSR item code 11.8) shall be provided in GIS hall.

15.2.6 Walls

All the buildings shall be of framed superstructure. All walls shall be non-load bearing walls. Min. thickness of walls shall be 230 mm (one brick) with 1:6 cement sand mortar.

15.2.7 Plastering

All internal walls shall have minimum 15mm thick 1:6 cement sand plaster. The ceiling shall have 6mm thick 1:3 cement sand plaster.

15.2.8 External Finishing

External plaster 12mm thick shall be of 1:6 cement sand plaster. External surface of the control room and GIS building shall be painted with NOVALUX exterior paint as per manufacturer's specification. Minimum 20% area in elevation of control room building and GIS building shall be covered with 6mm thick coloured curtain glazing with powder coated aluminium frame for better aesthetic look in elevation.

Internal finish Schedule for control room building is given in Table -1 below:

INTERNAL FINISHING SCHEDULE TABLE

Sl. No.	Location	Flooring & skirting 150mm high	Wall internal	Ceiling	Doors, Windows ventilators
1.	Control Room, SCADA / communication & computer rooms	Vitrified tiles of approved shade & colour over CC flooring as specified. False ceiling	Surface of internal walls shall be prepared with POP putty to maintain smooth surface and line & levels. The prepared surface shall be finished with plastic emulsion paint/texture paint or any other high quality paint of approved colour and shade.	same as for internal walls	Powder coated Aluminium Indal or equivalent extruded sections as per IS 733 & 1285 Glazing Float glass (Min 5.5mm thick) double glazing with 12mm gap hermetically sealed.
2	Sub-Station in charge, officers, conference library/record, corridor, staff, protection room	Vitrified tiles of approved shade & colour over CC flooring as specified. False ceiling	Surface of internal walls shall be prepared with POP putty to maintain smooth surface and line & levels. The prepared surface shall be finished with plastic emulsion paint/texture paint or any other high quality paint of approved colour and shade.	same as for internal walls	Powder coated Aluminium extruded sections as at 1 door shutter Windows, Ventilators Aluminium as at 1.
3	Reception/lobby corridor	Granite stone as per approved pattern.	Surface of internal walls shall be prepared with POP putty to maintain	same as for internal	Powder coated Alum. Extruded Sections frame as

			smooth surface and line & levels. The prepared surface shall be finished with plastic em ulsion paint/texture paint or any ot her high qua lity paint of approved colour and shade.	walls	at for S.No. 1 i.e. for entrance w ith glazing
4	Battery Room	Acid R esistant Tiles 2 5mm thick	DADO acid resistant title 2. 1M h igh A cid resistant pa int above 2.1 M upto ceiling	Acid resistant paint	Steel do or 45 mm thick doubl e s heet 18G steel suitably reinforced a nd f illed with mineral wool. Hotrolled s teel framed gl azed window and ventilators
5	Electrical Room, D G Bldg. , platform	Ironite flooring	POP with em ulsion paint or oi l bound/ acrylic distemper	POP with emulsion paint or oil bound/ acrylic distemper	Steel door dou ble sheet as abo ve. Hot r olled s teel framed gl azed window and ventilators.
6	Toilet, pantry	Vitrified t iles o f approved s hade & c olour ov er CC f looring as specified.	DADO vitrified tiles upto ceiling h eight for toilet and f or p antry abo ve working plateform upto 750mm.	POP with emulsion paint or oil bound/ acrylic distemper	Provision of water less ur inal i n toilet. Powder c oated Alum. Frame f or pantry do ors and teak wood frame with f lush d oors f or toilets.
7	Stair	Granite stone with hand railing of stainless steel or decorative finish as per approval.	--	Waist slab bottom face white wash inside	Teak w ood f rame flush door s hutter with A nodized Aluminium f ixtures best qu ality Windows, ventilators aluminium as at 1.

Internal finishing of testing lab and changing room shall be as per internal finish schedule table serial no. 5 and 6 respectively.

15.2.9 ROOF

(a) Roof of the Buildings shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be an integral cement based treatment conforming to CPWD specification (item no. 25.8 of DSR 2002). The water proofing treatment shall be of following operations:

(b) Applying and gr outing a s lurry c oat of neat c ement us ing 2.75 k g/m2 of cement adm ixed w ith proprietary w ater proofing c ompounds c onforming t o I S: 26 45 o ver t he R CC s lab i ncluding cleaning the surface before treatment.

(c) Laying c ement c oncrete u sing broken br icks/brick bat s 25m m t o 100m m s ize with 5 0% of cement mortar 1:5 (1 cement : 5 coarse s and) admixed w ith proprietary water pr oofing compound conforming to IS: 2645 over 20mm thick layer of cement mortar of min 1:5 (Cement : 5 c oarse s and) admixed with pr oprietary water pr oofing compound c onforming t o I S: 2645 t o required slope and treating similarly the adjoining walls up to 300mm height including rounding of junctions of walls and slabs.

(d) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to IS: 2645.

(e) Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement : 4 course sand) admixed with proprietary water proofing compound conforming to IS: 2645 and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.

(f) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Engineer-in-charge.

With average thickness of 120 mm and minimum thickness at khurra at 65 mm.

15.2.10 CABLE TRENCH IN GIS HALL

All cable trenches in GIS hall shall be covered with minimum 6mm thick MS chequered plate with suitable stiffeners and aluminium painting.

15.2.11 DOORS AND WINDOWS

The details of doors and windows of the control room building shall be as per finish schedule Table-1 conforming to relevant IS code. Rolling steel shutters and rolling steel grills shall be provided as per layout and requirement of buildings. Frameless glass (12mm thick) door with glass handle and locking arrangement shall be provided at the main entrance of control room building and entrance door of control room. Main entrance door of the control room building shall be double leaf sliding type. Etching pattern on glass of door shall be got approved.

The main control room door and GIS building entrance door shall be provided with access control system and entry shall be restricted through access cards.

15.2.12 PARTITION

Partitions, if required, shall be made of anodised aluminum frame provided with 5.5 mm thick etched glass (as per approved pattern) up to the roof and pre-laminated board up to 600mm above floor.

15.2.13 STAIRCASE

Granite (18mm thick) shall be provided in risers as well as treads. Railing shall be 50mm dia, 14 gauge of stainless steel pipe with stainless steel balusters and 12mm thick toughened glass 600mm high with etching on both sides of staircase between balusters.

15.2.14 PLUMBING & SANITATION

i. All plumbing and sanitation shall be executed to comply with the requirements of the appropriate bye-laws, rules and regulations of the Local Authority having jurisdiction over such matters. The Contractor shall arrange for all necessary formalities to be met in regard to inspection, testing, obtaining approval and giving notices etc.

ii. PVC "SYNTEX" or equivalent make Roof water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided. Minimum 2 Nos 1500 litres capacity shall be provided.

iii. Galvanised MS pipe of medium class conforming to IS: 1239 shall be used for internal & external piping work for potable water supply.

iv. Sand CI pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.

v. Each toilet shall have the following minimum fittings.

(a) WC (Western t ype) 390 mm h igh with t oilet paper r oll h older a nd al l f ittings i n t oilets attached t o c onference an d s ub-station i n c harge of fice and WC (Indian T ype) O rissa Pattern (580 x 440 mm) with all fittings shall be provided in common toilets.

(b) Urinal (430 x 260 x 350 mm size) with all fittings.

(c) Wash basin (550 x 400 mm) with all fittings.

(d) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing.

(e) CP brass towel rail (600 x 20 mm) with C.P. brass brackets

(f) Soap holder and liquid soap dispenser.

(g) All urinals and washbasins shall be provided with built in sensors to regulate the flow of water.

vi. Water c ooler f or dr inking w ater with ade quate water s torage f acility s hall be pr ovided a nd located near control room and not near toilet block.

vii. 1 no. stainless steel kitchen sink with Drain board (510 x 1040 x 178 mm bowl depth) for pantry shall be provided.

viii. All fittings, fastener, grating shall be chromium plated.

ix. All s anitary f ixtures an d f ittings s hall be of appr oved qua lity and type m anufactured b y well known manufacturers. All items brought to site must bear identification marks of the type of the Manufacturer.

x. Soil, waste and drain pipes, for underground works shall be stone ware for areas not subject to traffic load. Heavy duty cast iron pipes shall be used otherwise.

15.2.15 The Furniture of Godrej/ Rittal/ Pyrotech should be supplied by the contractor for control room and other r ooms for ex ecutives & no n-executives. T he make, size & other d etails would be decided during detail engineering.

For 220/66 kV Substations

Control room table	1 no.
Tables for executives	2 nos.
Tables for non-executives	3 nos.
Chairs	19 nos.
Lockers	16 nos.
Almirah	3 nos.
Conference room equipped with projector & screen of latest configuration along with conference table with chairs for 10 persons	**1 set**

15.2.16 a) Control room table: Control room table shall be free standing table top type. The table top of the control room table shall be arc shaped for mounting monitors, keyboards and printers. It shall have concealed cable & wire way management system. The top surface of control room table shall be 30 mm thick with the top 12 mm of acrylic solid surface and the remaining 18 mm of laminated medium density fibre board. It shall consists of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, mouse pads, monitors and concealed cable & wire way management, perforated trays with covers in both horizontal and vertical directions. Sliding keyboard trays shall be provided on the control room table. The CPU's shall be located separately on PC racks. The table shall be arranged in continuous arc shape. The exact profile of the control room table, dimensions, material, construction details etc. shall be as per the actual requirement and shall be finalized during detailed engineering.

b) Chairs: Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/ gas lift) shall be provided for the operators, sub station in-charge and other personal in control room building. These shall be designed for sitting for long duration such that these are plate covered with poly-propylene cladding. Arm-rests in one piece shall be of poly-urethane and twin wheel castor of glass filled nylon. The exact details shall be finished & approved by Employer during detailed engineering.

c) Tables:
(i) Industry standard Executive & non Executive tables shall be provided & shall be as approved by Employer during detailed engineering.
(ii) Conference room standard tables shall be provided with acrylic coat for good finish. Details shall be finalized & approved by Employer during detailed engineering.

d) Lockers: Suitable lockers shall be provided in the control room building for storing of personal articles of sub station personal. Details shall be finalized and approved by employer during detailed engineering.

e) Almirah: Steel Almirahs shall be provided for keeping documents in the control room building. The exact details and location shall be finalized and approved by employer during detailed engineering.

15.3 INTERNAL ELECTRIFICATION

Electrical wiring shall be through heavy duty consealed conduits. All fixtures and wiring shall be of best quality and ISI marked. (Fixtures shall be provided as per provision of energy conservation act), CFL Type.

15.4 All rooms like office, Conference/Library, Control Room, SCADA Room & Reception Lobby of Control Room Building shall be provided with provisions compatible with telephone, computer etc. as per approved layout plan during detailed engineering stage.

15.5 Car/scooter shed as per drawing/design as submitted by contractor of size 10X3.5M approx. and approved by engineer-in-charge with frame of steel pipes etc. and with polycarbonate sheet proofing is to be provided near control room as per concept layout plan prepared by contractor and approved by DTL.

16.0 BUILDING STORM WATER DRAINAGE FOR ALL BUILDINGS

The building drain shall be provided for the collection of storm water from the roofs. This water shall be collected in junction boxes and these boxes shall drain to the main drainage system of the station.

PVC with 10kg/cm^2 pressure rain water down comers with water tight joints shall be provided to drain off the rain water from the roof. These shall be suitably concealed with masonry work of cement

concrete or cladding material. The number and size of down comers shall be governed by IS:1742 and IS:2527.

All drains inside the buildings shall have minimum 40 mm thick grating covers and in areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating.

For all buildings, suitable arrangement for draining out water collected from equipment blow down, leakages, floor washings fire fighting etc. shall be provided for each floor.

17.0 SWITCHYARD CIVIL WORKS

17.1 SCOPE

The scope under this item covers all structural and civil works associated with successful erection and commissioning of station switchyard. The details of scope are as follows. This is only guideline and shall not be taken as exhaustive.

(1) Design, engineering, fabrication, proto-assembly, supply and erection of galvanized steel structures for lighting-cum-lightening mast, towers, beams/girders and equipment support structures, Towers, girders, lighting/lightening mast and equipment support structures shall be lattice type structure fabricated from structural steel conforming to IS 2062 (latest). All galvanized lattice structures shall be inclusive of all fixtures such as nuts, bolts, hangers, shackles, clamps, ant l-climbing device, danger and phase plates, inserts in concrete, foundation bolts, base plates, cap plates, stiffeners, dampers fixtures, for supporting of operating mechanism boxes, control cabinet and any other item to complete the job.

(2) Design engineering, fabrication, supply, erection and painting of supports, embedment in cable trenches, bolts and nuts and any other accessories required to complete the job.

(3) Excavation, dewatering, carriage of excavated earth materials, PCC mud mat piling, casting of concrete foundations pile caps, backfilling etc.

(4) Design, Engineering, excavation, dewatering, carriage of excavated earth, P.C.C. mudmat, construction of R.C.C. cable trench and pipe trenches with necessary precast R.C.C. covers with lifting facilities, sump pit, etc. wherever trenches cross road or rail track the sections below such crossings shall be designed as per Indian Road Congress or Indian Railway Specification. Drainage of the trenches shall be suitably designed.

(5) Drainage of the area is also in Bidder's scope. It may be noted that the cable trench should not be used for drainage purpose.

(6) Drainage of the area in the switchyard is in bidder scope. The drainage water should be collected in suitable sump and arrangements for pumping out water including the provision of pump and pump house is in the bidder scope.

(7) Cable trenches / drains should be provided with RCC trench covers with angle iron nosing all round. Thickness of the trench covers should not be less than 50mm. All trench covers should be provided with suitable arrangement for lifting.

(8) The cable trenches shall be provided with suitable hangers and cable tray with proper earthing to support the cables.

(9) All foundations for the switchyard structures shall be designed as per relevant IS:4091 " Code of practice for design and construction of foundations for transmission line towers and poles" and 13:456 (latest) "Code of practice for plain and reinforced concrete".

(10) The finished level of the Civil Works in the grid sub-station should be fixed in relation to the outside road(Municipal Road) as under:

i)	Outside road (Municipal Road) Final finished level after metalling	100.00M (Reference Point)
ii)	Formation level	100.20M
iii)	Yard level	100.35M
iv)	Inside roads and top of trenches in yard	100.45M
v)	Equipment foundations	100.50M
vi)	plinth level of the control room building	101.20M

18.0 SUBSTATION BOUNDARY WALL : (Deleted)

19.0 MISCELLANEOUS GENERAL REQUIREMENTS

(1) Dense concrete with controlled water cement ratio as per IS-code shall be used for all underground concrete structures such as pump-house, tanks, water retaining structures, cable and pipe trenches etc. for achieving water-tightness.

(2) All joints including and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops shall be used for the base slab and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230mm.

(3) All underground water retaining concrete structures shall have water proofing cement additive conforming to IS:2645 water proofing for walls and base slab of all underground concrete structures like basements pump houses etc. shall be by "Injection Method".

(4) Bricks having minimum 75 kg/cm2 compressive strength can only be used for masonry work. Contractor shall ascertain himself at site regarding the availability of bricks of minimum 75kg/cm2 compressive strength before submitting his offer. All brick work shall be designed as per latest Indian standards and shall be plastered on both faces. All brick walls shall be minimum 230mm thick (excluding plaster). All RCC ceiling shall be plastered with 6 mm thick plaster.

(5) All roofs shall have heavy duty water proofing with roof insulation and grading under bed which shall be provided to give an ultimate run off gradient of not less than 1:100 to effectively dispose off the rain water. The minimum height of RCC parapets on roof shall be 900mm and the thickness shall be 100mm (exclusive of plaster) and plaster shall be provided on both faces.

(6) Rain water down comers shall be concealed either in brick work by encasing in cement concrete or by any other suitable arrangement with approval of Engineer-in-Charge**.**

(7) All roofs shall be provided with access through staircase.

(8) All buildings shall have 750mm wide plinth protection all round.

(9) Monorails, Monorail girders and fixtures shall be provided by the Bidder wherever required.

(10) The scope of drainage of surface/storm water drainage shall include layout and construction of drains, including culverts and connection of drains to the trunk drains including making good the connections of these plant drains with trunk drains.

(11) The scope of disposal of foul water from toilets shall include layout and laying of all sewers for sewerage system including all fittings and fixtures ancillary works such as connections manholes inspection chambers, etc. and disposal thereof to the nearest existing Municipal drain provision of Septic tank and Soak pit. Manholes shall be provided by the Bidder at all the junctions of sewer lines with trunk sewerage line.

i. All the trenches inside the control room building will be covered with 6mm thick M.S. Chequered plates of suitable sizes. The walls of the trenches will be provided with suitable angle iron nosing for placement of the chequered plates. Suitable M.S. iron hangers will be provided in the trenches.

ii. All foundations embedment, inserts, blockouts required for equipments shall be provided by bidder.

iii. 50mm thick DPC shall be provided before laying of masonary.

iv. All steel section and fabricated structures which are required to be transported by sea shall be provided with anti corrosive paint to take care of sea worthiness.

v. All mild steel parts used in the water retaining structures shall be hot-double dip galvanized. The minimum coating of the zinc shall be 750 gm/sq. m. for galvanized structures and shall comply with IS:2629 and IS:2633. Galvanizing shall be checked and tested in accordance with IS:2633. The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS:3416.

vi. A screed concrete layer not less than 100 mm thick and of grade not weaker than M10 conforming to IS:456-2000 shall be provided below all water retaining structures. A sliding layer of bitumen paper or craft paper shall be provided over the screed layer to destroy the bond between the screed and the base slab concrete of the water retaining structures.

vii. Doors and windows on external walls of the buildings (other than areas provided, with insulated metal claddings) shall be provided with RCC sunshade over the openings with 300 mm projection on either side of the openings. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings.

viii. All stairs shall have maximum riser height of 150 mm and a minimum tread width of 300 mm. Minimum width of stairs shall be 1500 mm.

ix. Angles 50x50x6 mm (minimum) with lugs shall be provided for edge protection all round cut outs/openings in floor slab, edges of drains supporting grating covers, edges of RCC cable/pipe trenches supporting covers, edges of manholes supporting covers, supporting edges of manhole precast cover and any other place where breakage of corners of concrete is expected.

x. Anti termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS:6313 and other relevant Indian Standards.

xi. Hand-railing minimum 900mm high shall be provided around all floor/roof openings, projections/ balconies, walk ways, platforms, steel stairs etc. All handrails and ladder pipes shall be 32 mm nominal bore MS pipes (medium class) and shall be galvanized (medium-class as per IS:277). All rungs for ladder shall also be galvanized as per IS:277 medium class. For RCC stairs, hand railing with 20 mm square MS bars, balustrades with suitable MS flats & aluminium handrails shall be provided.

xii. Items/components of buildings not explicitly covered in the specification but required for completion of the project shall be deemed to be included in the scope.

xiii. Bidders shall submit following documents for the proposed buildings along with the offer:
   i) Architectural floor plans, elevations, cross-sections and perspective view in colour of all buildings. (Bidder shall submit three different schemes).
   ii) Blow-up sketch of any typical detail.
   iii) Finishing schedules of both material and colour for both internal and external areas.

(12) As per the directions of Govt. of NCT of Delhi, it has been made mandatory to use following recycled Construction & Demolition waste products as a first choice in all the construction/civil works in the city of Delhi by Private and Govt. agencies:

List of Recycled C&D Products
(1) Kerb Stone (side of roads)
(2) Paving blocks, interlocking tiles and drain covers (pedestrian areas and gardens).

(3) Cold molded bricks (for non load bearing structures such as wall between RCC columns, small to medium height fencing walls, partition walls without additional load, etc.).
(4) Manufactured sand (4.75 mm to 75 u size) - for non structural purposes.
(5) GSB (Granular Sub Base) and BSB (Brick Sub Base) up to 65mm size for road work especially for urban roads. For rural roads up to 30% can be from recycled GSB.
(6) Recycled concrete aggregate can be used in all grades of plain Cement Concrete (PCC) for non structural use.
(7) Recycled aggregates (coarse as well as fine) can be used 100% for lean concrete (less than M15 grade).
(8) Use of soil recovered from mixed C&D for filling purpose (road and embankment making).

Accordingly, it is mandatory to use a minimum of 2% processed/recycled products from C &D waste for building works and 10% processed/recycled products from C &D waste for road works. Such processed/recycled C&D waste shall be procured only from the manufacturers who have been authorized for the purpose either by the Delhi Pollution Control Committee or Urban Local Bodies or other Delhi govt. agencies.

20.0 INTERFACING

The proper coordination & execution of all interfacing civil works activities like fixing of conduits in roofs/walls/floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports/ embedment, provision of cut outs etc. shall be the sole responsibility of the Contractor. He shall plan all such activities in advance and execute in such a manner that interfacing activities do not become bottlenecks and dismantling, breakage etc. is reduced to minimum.

21.0 WATER SUPPLY

(1) Water and electricity shall be arranged by the contractor at his own cost.

(2) The contractor shall carry out all the plumbing/erection works required for supply of water in control room building.
(3) The contractor shall carry out all the plumbing/erection works required for supply of water to all switch yard buildings.
(4) The details of tanks, pipes, fittings, fixtures etc for water supply shall be approved by engineer in charge.
(5) A scheme shall be prepared by the contractor indicating the layout and details of water supply which shall be got approved by the Purchaser before actual start of work including all other incidental items not shown or specified but as may be required for complete performance of the works.
(6) Bore wells and pumps for water supply are in the scope of contractor.

22.0 SEWERAGE SYSTEM

(1) Sewerage system shall be provided for control room building cum administrative building.
(2) The Contractor shall construct septic tank and soak pit suitable for 50 users for sub station if the municipal sewer in the vicinity does not exists. In case municipal sewer line is available in the area, the connection of sewerage system of switch yard building with municipal sewer shall be in the scope of bidder.
(3) The system shall be designed as per relevant IS Codes.

23.0 STATUTORY RULES

(1) Contractor shall comply with all the applicable statutory rules pertaining to factories act (as applicable for the State). Fire Safety Rules of Tariff Advisory Committee. Water Act for pollution control etc.

(2) Provisions for fire proof doors, number of staircases, fire separation wall, plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Tariff Advisory Committee.

(3) Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.

(4) Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation to be carried out by the Bidder.

(5) Foundation system adopted by Bidder shall ensure that relative settlement and other criteria shall be as per provision in IS:1904 and other Indian Standards.

(6) All water retaining structures designed as uncracked section shall also be tested for water tightness at full water level in accordance with clause no. 10 of IS:3370 (Part-I).

(7) Construction joints shall be as per IS: 456-2000.

(8) All underground concrete structures like basements, pumps houses, water retaining structures etc. shall have plasticizer cum water proofing cement additive conforming to IS:9103. In addition, limit on permeability as given in IS:2645 shall also be met with. The concrete surface of these structures in contact with earth shall also be provided with two coat of bituminous painting for water/damp proofing. In case of water leakage in the above structures, Injection Method shall be applied for repairing the leakage.

(9) All building/construction materials shall conform to the best quality specified in CPWD specifications if not otherwise mentioned in this specification.

(10) All tests as required in the standard field quality plans have to be carried out.

(11) The type and treatment of all foundations hall be as per recommendation of geo-technical investigation reports.

24.0 FIELD QUALITY PLAN FOR CIVIL WORKS

The field quality plan for all civil works shall be in accordance with CPWD specification and other relevant Indian Standard Codes. All quality checks and procedures shall be followed as per relevant CPWD norms.

SECTION-XIII

SUBSTATION AUTOMATION

SECTION : 13

SUBSTATION AUTOMATION SYSTEM

1.0 GENERAL

1.1 The substation automation system shall be offered from a manufacturer who must have designed, manufactured, tested, installed and commissioned substation automation system which must be in satisfactory operation on 220 kV system or higher for at least 2 (Two) nos. of similar substation automation system for 2 (two) years as on the date of bid opening.

1.2 The Substation Automation System (SAS) shall be installed to control and monitor all the sub-station equipment from local control center (ALDC)
The SAS shall contain the following main functional parts:

- 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 IEC 60870-5-101 with EMC to suit Substation Automation Environment.
- Gateway for remote supervisory control (to ALDC), the gateway should be able to communicate with ALDC on IEC 60870-5-101 protocol. The specific protocol to be implemented shall be handed over to successful bidder. It shall be the bidder's responsibility to integrate his offered system with existing ALDC system for exchange of desired data. The exact IO point shall be decided during detailed engineering. Communication with RCC/ALDC shall be on 60870-104 system with redundancy provision.
- Remote HMI
- Peripheral equipment like printers, display units, key boards, Mouse etc.
- Bay protection Intelligent Electronic Devices (IEDs) for protection compliant to IEC 61850.
- Integrated switches (built-in bay IEDs) are not acceptable. All the IEDs shall be directly connected to the Ethernet Interbay LAN without use of any gateways. The use of Ethernet hubs shall not be permitted.

1.3 It shall enable local station control via a PC by means of human machine interface (HMI) and control software package, which shall contain an extensive range of supervisory control and data acquisition (SCADA) functions.

1.4 It shall include communication gateway, intelligent electronic devices (IED) for bay control and inter IED communication infrastructure. An architecture drawing for SAS is enclosed at Annexure-A.

1.5 The communication gateway shall facilitate the information flow with remote control centers. The bay level intelligent electronic devices (IED) for protection and control shall provide the direct connection to the switchgear without the need of interposing components and perform control, protection, and monitoring functions.

1.6 The bidder shall ensure that proposed automation system is compatible with the existing SCADA in DTL established under unified scheme. The bidder will quote equipment for the SCADA and auxiliary power supplies and associated fiber optic communication system, for transfer of the SCADA data of the station to ALDC, SLDC and NRLDC.

The bidder shall supply the hard copies and soft copies of complete technical literature describing equipment principle design concepts and design specifications, cable schedule, operation and maintenance manual, source code for software maintenance.
The vendor shall also arrange training to DTL engineers in attending emergencies, repairs and maintenance, etc.

Layout details of Automation equipment has been considered to be as follows:

Bay level intelligent electronic devices (IED) for protection and control shall be provided near each bay. Each IED will be directly connected to the Hot- standby Server PC of the Station Automation system (SAS) through a dual managed Ethernet LAN on fiber optic medium and shall communicate as per the IEC-61850 standard. The SAS shall be equipped with gateway for remote communication as detailed further in the specification**.** SCADA details will be communicated to nearest ALDC via adjoining sub stations and signal will be carried by optic fibre either OPGW for transmission line or optic fibre cable laid in the ground alongwith 220 kV under ground XLPE cable. The Contractor will make arrangement for supplying terminal equipment required for

communication & for converting optic fibre signals into PLCC in case of requirement**.** The existing communication s ystem w orks on I EC-60870 pr otocol an d t he inter op erability document i s enclosed in Annexure-II.

The c ommunication pr otocol of dat a c oncentrator must c onform t o ex isting c ommunication protocol. Besides the Data Concentrator must support the following:-

- The Data Concentrator must be equipped with two Modems.
- The Data Concentrator shall be capable of accepting single point/double point information indication signals.
- The Data Concentrator will also accept telemeasuring signals under the form of DC.
- Data Concentrator will support single point/double point digital controls.
- The Data Concentrator must be capable of time tagging the status changes with a 10 ms resolution.

Communication with RCC/ALDC shall be on 104 system with redundancy provision.

The complete network should be as below:
All 220kV, 66kV, 33kV, LT system and Auxiliary system will be interfaced for control and monitoring in L ocal H MI s ystem w ith redundancy a long with the eng ineering work s tation for c onfiguration purpose. The Local HMI will report to Delhi SLDC for monitoring purpose. There shall be a Remote HMI which will b e c onfigured ex actly t o t he L ocal H MIs f or c ontrol a nd m onitoring s o t hat t he Substation can be unmanned and controlled from Remote Sub Station.
Both the Delhi SLDC and Remote Sub Stations shall be communicated with this substation through communication ring.
However, C ontractor s hall be r esponsible f or c ommissioning of R HMI at r emote s ubstation an d data availability at Delhi SLDC.

1.7 Tele-control plan for 220kV, 66kV and 33 kV level is given below. Following information is required to be communicated to ALDC/SLDC.

220KV Level

Tele- inf.	**220 kV level**
MW	All feeders, Power Trfs(220/33 kV, 220/66 kV)
MVAR	All feeders, Power Trfs.(220/33kV, 220/66 kV)
MWH(units)	All feeders, Power Trfs.(220/33kV, 220/66 kV)
MVARH(units)	All feeders, Power Trfs.(220/33kV, 220/66 kV)
Voltage (kV)	1 measured per main bus limited to two only
Freq. (Hz.)	1 measured per sub-station
T- Taps	All 220/33kV & 220/66 kV Power Transformers.
Current (Amps)	All feeders, Power Transformers (220/33kV, 220/66kV), Bus-Coupler.
Wdg. Temperature	For all Transformers
Oil Temp.	For all Transformers
Status	
CB- Double s tatus information.	All f eeders, Power Trfs., B us C oupler, B us Sections a nd Transfer Bus Coupler.
ISO- single s tatus information.	All Bus, line and Transfer Bus isolators
Control	All feeders

66 kV level

Tele- inf.	**66 kV level**
MW	All feeders, Incomers and Bus Coupler.
MVAR	All feeders, Incomers and Bus Coupler.
MWH(units)	All feeders, Incomers and Bus Coupler.
MVARH(units)	All feeders, Incomers
Voltage (kV)	1 measured per main bus limited to two only
Freq. (Hz.)	1 measured per sub-station. 2 measured per Generating station.
T- Taps	NIL
Current (Amps)	All feeders, Incomers and Bus Coupler.
Wdg. Temp.	--
Oil Temp.	--

Status	
CB- Double status information.	All feeders, Incomers and Bus Coupler
ISO- single status information.	All Bus and line isolators
Control	For all Feeders excluding transformers

33 kV level

Tele- inf.	**33 kV level**
MW	All feeders, Incomers and Bus Coupler.
MVAR	All feeders, Incomers and Bus Coupler.
MWH(units)	All feeders, Incomers and Bus Coupler.
MVARH(units)	All feeders, Incomers
Voltage (kV)	1 measured per main bus limited to two only
Freq. (Hz.)	1 measured per sub-station. 2 measured per Generating station.
T- Taps	NIL
Current (Amps)	All feeders, Incomers and Bus Coupler.
Wdg. Temp.	--
Oil Temp.	--
Status	
CB- Double status information.	All feeders, Incomers and Bus Coupler
ISO- single status information.	All Bus and line isolators
Control	For all Feeders excluding transformers

1.8 Following equipments shall match/support the existing SCADA system:-

1.	RTU Panel*			1 No.
2.	SIC Panel*			Depending upon the requirement of the scheme, no. of bays in the S/Stn.
3.	Communication system requirement:-			
	i.	Fiber Optical System		OLTE, Multiplexes, OPGC able, etc. as per communication scheme being adopted.
4.	Cables For:-			
	i.	C.T. Connection		10x2.5 sq.mm.
	ii.	P.T. Connection		4x2.5 sq.mm.
	iii.	Digital input for breaker and isolators		12x.34 sq.mm.
5.	For each isolators		2 NO/NC Auxiliary contacts.	Each contact rating 5 Amps.
6.	For each breakers		4 NO/NC Auxiliary contacts.	Each contact rating 5 Amps.

* RTU/SIC is not envisaged in bidder's scope. Suitable gateway and other provision as per NIT Section:14 shall be in Bidder's scope.

2.0 SYSTEM DESIGN

2.1 General system design

The Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including future extensions.

The systems shall be of the state-of-the art suitable for operation under electrical environment present in Extra high voltage substations, follow the latest engineering practice, ensure long-term compatibility requirements and continuity of equipment supply and the safety of the operating staff.

The offered SAS shall support remote control and monitoring from Remote Control centers via gateways.

The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.

The system shall incorporate the control, monitoring and protection functions specified, self-monitoring, signaling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

Maintenance, modification or extension of components may not cause a shutdown of the whole substation automation system. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

Bidder shall offer the bay mimic along with relay and protection panels and (described in other sections of technical specifications) housed in air-conditioned Kiosks suitably located in Station HMI in Control Room building for overall optimization in respect of cabling and control room building.

2.2 System architecture

The SAS shall be based on a decentralized architecture and on a concept of bay-oriented, distributed intelligence.

Functions shall be decentralized, object-oriented and located as close as possible to the process.The main process information of the station shall be stored in distributed databases. The typical SAS architecture shall be structured in two levels, i.e. in a station and a bay level.

At bay level, the IEDs shall provide all bay level functions regarding control, monitoring and protection, inputs for status indication and outputs for commands. The IEDs should be directly connected to the switchgear without any need for additional interposition or transducers.

Each bay control IED shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the other bay control units of the station.

The data exchange between the electronic devices on bay and station level shall take place via the communication infrastructure. This shall be realized using fiber-optic cables, thereby guaranteeing disturbance free communication. The fiber optic cables shall be run in G. I. conduit pipes. Data exchange is to be realised using IEC 61850 protocol with a redundant managed switched Ethernet communication infrastructure.

The communication shall be made in 1+1 mode, excluding the links between individual bay IEDs to switch, such that failure of one set of fiber shall not affect the normal operation of the SAS. However it shall be alarmed in SAS. Each fiber optic cable shall have four (4) spare fibers.

At station level, the entire station shall be controlled and supervised from the station HMI. It shall also be possible to control and monitor the bay from the bay level equipment at all times.

Clear control priorities shall prevent operation of a single switch at the same time from more than one of the various control levels, i.e. RCC, station HMI, bay level or apparatus level. The priority shall always be on the lowest enabled control level.

The station level contains the station-oriented functions, which cannot be realised at bay level, e. g. alarm list or event list related to the entire substation, gateway for the communication with remote control centers.

The GPS time synchronizing signal (as specified in the section relay & protection) as per IEC 61850 Standard SNTP (Simple Network Time Protocol) for the synchronization of the entire system shall be provided**.**
The SAS shall contain the functional parts as described in Para 1.2 above.

2.3 FUNCTIONAL REQUIREMENTS

The high-voltage apparatus within the station shall be operated from different places:

- Remote control centers
- Station HMI.
- Local Bay controller IED (in the bays)

Operation shall be possible by only one operator at a time.

The operation shall depend on the conditions of other functions, such as interlocking, synchrocheck, etc. (See description in “Bay level control functions").

2.3.1 Select-before-execute

For security reasons the command is always to be given in two stages: selection of the object and command for operation under all mode of operation except emergency operation. Final execution shall take place only when selection and command are actuated.

2.3.2 Command supervision

Bay/station interlocking and blocking

Software Interlocking is to be provided to ensure that inadvertent incorrect operation of switchgear causing damage and accidents in case of false operation does not take place.

In addition to software interlocking hardwired interlocking are to be provided for Bus Earth switch Interlocking.

It shall be a simple layout, easy to test and simple to handle when upgrading the station with future bays. For software interlocking the bidder shall describe the scenario while an IED of another bay is switched off or fails.
A software interlock override function shall be provided which can be enabled to bypass the interlocking function.

2.3.3 Run Time Command cancellation

Command execution timer (configurable) must be available for each control level connection. If the control action is not completed within a specified time, the command should get cancelled.

2.3.4 Self-supervision

Continuous self-supervision function with self-diagnostic feature shall be included.

2.3.5 User configuration

The monitoring, controlling and configuration of all input and output logical signals and binary inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

It shall also be possible to interconnect and derive input and output signals, logic functions, using built-in functions, complex voltage and currents, additional logics (AND-gates, OR gates and timers). (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.
- Bay protection functions

Separate IEDs shall be provided for bay control function and bay protection function.

3.1.1. Bay control functions

3.1.1.1. Overview

Functions

- Control mode selection

- Select-before-execute principle
- Command supervision:
  - Interlocking and blocking
  - Double command
- Synchrocheck, voltage selection
- Run Time Command cancellation
- Transformer tap changer control (for power transformer bays)
- Operation counters for circuit breakers and pumps
- Hydraulic pump/ Air compressor control and runtime supervision
- Operating pressure supervision
- Display of interlocking and blocking
- Breaker position indication per phase
- Alarm annunciation
- Measurement display
- Local HMI (local gu ided, emergency m ode) t o display t he s ingle line d iagram, status information, alarms and disturbances etc. with password protected access.
- Interface to the station HMI.
- Data storage for at least 200 events
- Extension possibilities with ad ditional I /0's inside t he u nit or via f ibre optic communication and process bus
- All the IEDs must be fully IEC 61850 compliant and shall be directly connected to the Ethernet Interbay LAN without use of any gateways

3.1.1.2. Control mode selection

Bay level Operation
As s oon as t he operator receives t he operation access at ba y l evel t he operation i s normally p erformed v ia bay c ontrol I ED. D uring normal o peration bay c ontrol u nit a llows the safe operation of all switching devices via the bay control IED.

EMERGENCY Operation
It s hall b e possible t o c lose or op en t he s elected C ircuit Breaker with O N or O FF 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 b e controlled only r emotely. C ontrol operation f rom lower levels s hall not be possible in this operating mode.

3.1.1.3. Synchronism and energizing check

The synchronism and energizing check functions shall be bay-oriented and distributed to the bay control and/or protection devices. These features are:

- Settable voltage, phase angle, and frequency difference.
- Energizing for dead line - live bus, live line - dead bus or dead line dead bus with no synchro-check function.
- Synchronising between live line and live bus with synchro-check function

Voltage selection

The voltages relevant for the Synchrocheck functions are dependent on the station topology, i .e. o n t he pos itions of t he c ircuit breakers and/ or t he isolators. The c orrect voltage f or s ynchronizing and energizing i s derived f rom t he aux iliary s witches of t he circuit breakers, t he i solator, and ear thing s witch an d s hall b e s elected a utomatically by the bay control and protection IEDs.

3.1.1.4 Transformer tap changer control

Raise a nd l ower o peration of O LTC t aps of t ransformer s hall be f acilitated t hrough Bay controller IED.

3.1.2. Bay protection functions

3.1.2.1 General

The protection functions are independent of bay control function. The protection shall be provided by separate protection IEDs (numerical relays) and other protection devices as per section Relay & Protection.

IEDs, shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions. The data presentation and the configuration of the various IEDs shall be compatible with the overall system communication and data exchange requirements.

Event and disturbance recording function

Each IED should contain an event recorder capable of storing at least 200 time-tagged events. This shall give alarm if 70% memory is full. The disturbance recorder function shall be as per detailed in section Relay and Protection.

3.2. System level functions

3.2.1. Status supervision

The position of each switchgear, e.g. circuit breaker, isolator, earthing switch, transformer tap changer etc., shall be supervised continuously. Every detected change of position shall be immediately displayed in the single-line diagram on the station HMI screen, recorded in the event list and a hard copy printout shall be produced. Alarms shall be initiated in the case of spontaneous position changes.

The switchgear positions shall be indicated by two auxiliary switches, normally closed (NC) and normally open (NO), which shall give ambivalent signals. An alarm shall be initiated if these position indications are inconsistent or if the time required for operating mechanism to change position exceeds a predefined limit.

The SAS shall also monitor the status of sub-station auxiliaries. The status and control of auxiliaries shall be done through separate one or more IED and all alarm and analogue values shall be monitored and recoded through this IED.

3.2.2. Measurements

Analogue inputs for voltage and current measurements shall be connected directly to the voltage transformers (VT) and the current transformers (CT) without intermediate transducers. The values of active power (W), reactive power (VAR), frequency (Hz), and the rms values for voltage (U) and current (I) shall be calculated.

The measured values shall be displayed locally on the station HMI and in the control centre. The abnormal values must be discarded. The analogue values shall be updated every 2 seconds.

Threshold limit values shall be selectable for alarm indications.

3.2.3. Event and Alarm Handling

Events and alarms are generated either by the switchgear, by the control IEDs, or by the station level unit. They shall be recorded in an event list in the station HMI. Alarms shall be recorded in a separate alarm list and appear on the screen. All, or a freely selectable group of events and alarms shall also be printed out on an event printer. The alarms and events shall be time-tagged with a time resolution of 1 ms.

3.2.4. Station HMI

3.2.4.1. Substation HMI Operation:

On the HMI the object has to be selected first. In case of a blocking or interlocking conditions are not met, the selection shall not be possible and an appropriate alarm

annunciation shall occur. If a selection is valid the position indication will show the possible direction, and the appropriate control execution button shall be pressed in order to close or open the corresponding object.

Control operation from other places (e.g. REMOTE) shall not be possible in this operating mode.

3.2.4.2. Presentation and Dialogues

General

The operator station HMI shall be a redundant with hot standby and shall provide basic functions for supervision and control of the substation. The operator shall give commands to the switchgear on the screen via mouse clicks or keyboard commands.

The HMI shall give the operator access to alarms and events displayed on the screen. Aside from these lists on the screen, there shall be a printout of alarms or events in an event log.

An acoustic alarm shall indicate abnormalities, and all unacknowledged alarms shall be accessible from any screen selected by the operator.

The following standard pictures shall be available from the HMI:

- Single-line diagram showing the switchgear status and measured values
- Control dialogues with interlocking and blocking details. This control dialogue shall tell the operator whether the device operation is permitted or blocked.
- Measurement dialogues
- Alarm list, station / bay-oriented
- Event list, station / bay-oriented
- System status

3.2.4.3. HMI Design Principles

Consistent design principles shall be adopted with the HMI concerning labels, colours, dialogues and fonts. Non-valid selections shall be dimmed out.
The object status shall be indicated using different status colours for:

- Selected object under command
- Selected on the screen
- Not updated, obsolete values, not in use or not sampled
- Alarm or faulty state
- Warning or blocked
- Update blocked or manually updated
- Control blocked
- Normal state

3.2.4.4. Process Status Displays and Command Procedures

The process status of the substation in terms of actual values of currents, voltages, frequency, active and reactive powers as well as the positions of circuit breakers, isolators and transformer tap-changers shall be displayed in the station single-line diagram.

In order to ensure a high degree of security against undesired operation, a "select-before-execute" command procedure shall be provided. After the "selection" of a switch, the operator shall be able to recognize the selected device on the screen, and all other switchgear shall be blocked. As communication between control centre and device to be controlled is established, the operator shall be prompted to confirm the control action and only then final execute command shall be accepted. After the "execution" of the command the operated switching symbol shall flash until the switch has reached its new position.

The operator shall be in a position to execute a command only, if the switch is not blocked and if no interlocking condition is going to be violated. The interlocking statements shall be checked by the interlocking scheme implemented at bay and station level.

After command execution the operator shall receive a confirmation that the new switching position has been reached or an indication that the switching procedure was unsuccessful with the indication of the reason for non-functioning.

3.2.4.5. System Supervision & Display

The SAS system shall be comprehensively self-monitored such that faults are immediately indicated to the operator, possibly before they develop into serious situations. Such faults are recorded as a faulty status in a system supervision display. This display shall cover the status of the entire substation including all switchgear, IEDs, communication infrastructure and remote communication links, and printers at the station level, etc.

3.2.4.6. Event List

The event list shall contain events that are important for the control and monitoring of the substation.
The event and associated time (with 1 ms resolution) of its occurrence has to be displayed for each event.

The operator shall be able to call up the chronological event list on the monitor at any time for the whole substation or sections of it.

A printout of each display shall be possible on the hard copy printer.

The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. It shall be possible to store all events in the computer for at least one month. The information shall be obtainable also from a printed event log.

The chronological event list shall contain:

- Position changes of circuit breakers, isolators and earthing devices
- Indication of protective relay operations
- Fault signals from the switchgear
- Indication when analogue measured values exceed upper and lower limits. Suitable provision shall be made in the system to define two level of alarm on either side of the value or which shall be user defined for each measurand.
- Loss of communication.
  Filters for selection of a certain type or group of events shall be available. The filters shall be designed to enable viewing of events grouped per:
- Date and time
- Bay
- Device
- Function e.g. trips, protection operations etc.
- Alarm class

3.2.4.7. Alarm List

Faults and errors occurring in the substation shall be listed in an alarm list and shall be immediately transmitted to the control centre. The alarm list shall substitute a conventional alarm tableau, and shall constitute a n 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
- ALDC/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. It shall also be possible to use the keyboard for command activation. Data entry is performed with the keyboard. Dedicated control dialogues for controlling at least the following devices shall be available:

- Breaker and disconnector
- Transformer tap-changer

3.2.5. User-authority levels

It shall be possible to restrict activation of the process pictures of each object (bays, apparatus...) within a certain user authorization group. Each user shall then be given access rights to each group of objects, e.g.:

- Display only

- Normal operation (e.g. open/close of switchgear)
- Restricted operation (e.g. by-passed interlocking)
- System administrator

For maintenance and engineering purposes of the station HMI, the following authorization levels shall be available:

- No engineering allowed
- Engineering/configuration allowed
- Entire system management allowed

The access rights shall be defined by passwords assigned during the login procedure. Only the system administrator shall be able to add/remove users and change access rights.

3.2.6 Reports

The reports shall provide time-related follow-ups of measured and calculated values. The data displayed shall comprise:

- Trend reports:
  - Day (mean, peak)
  - Month (mean, peak)
  - Semi-annual (mean, peak)
  - Year (mean, peak)
- Historical reports of selected analogue Values:
  - Day (at 15 minutes interval)
  - Week
  - Month
  - Year

It shall be possible to select displayed values from the database in the process display 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 hour period.

iv. Provision shall be made for logging information about breaker status like number of operation with date and time indications.

v. Equipment operation details shift wise and during 24 hours.

vi. Printout on adjustable time period as well as on demand for MW, MVAR, Current, Voltage on each feeder and transformer as well as Tap Positions, temperature and status of pumps and fans for transformers.

vii. Printout on adjustable time period as well as on demand system frequency and average frequency.

viii. Reports in specified formats which shall be handed over to successful bidder.

3.2.7. Trend display (historical data)

It shall be possible to illustrate all types of process data as trends - input and output data, binary and analogue data. The trends shall be displayed in graphical form as column or curve diagrams with a maximum of 10 trends per screen. Adjustable time span and scaling ranges must be provided.

It shall be possible to change the type of value logging (direct, mean, sum, or difference) on-line in the window. It shall also be possible to change the update intervals on-line in the picture as well as the selection of threshold values for alarming purposes.

3.2.8. Automatic disturbance file transfer

All recorded data from the IEDs with integrated disturbance recorder as well as dedicated disturbance recording systems shall be automatically uploaded (event triggered or once per day) to a dedicated computer and be stored on the hard disc.

3.2.9. Disturbance analysis

The PC-based work station shall have necessary software to evaluate all the required information for proper fault analysis.

3.2.10. IED parameter setting

It shall be possible to access all protection and control IEDs for reading the parameters (settings) from the station HMI or from a dedicated monitoring computer. The setting of parameters or the activation of parameter sets shall only be allowed after entering a password.

3.2.11. Automatic sequences

The available automatic sequences in the system should be listed and described, (e.g. sequences related to the bus transfer). It must be possible to initiate pre-defined automatic sequences by the operator and also define new automatic sequences.

3.3. Gateway

3.3.1 Communication Interface

The Substation Automation System shall have the capability to support simultaneous communications with multiple independent remote master stations,
The Substation Automation System shall have communication ports as follows

(a) Two ports for Remote Control Centre

(b) Two ports for Area Load Dispatch Centre (ALDC)

The communication interface to the SAS shall allow scanning and control of defined points within the substation automation system independently for each control centre. The substation automation system shall simultaneously respond to independent scans and commands from employer's control centres (RCC & ALDC). The substation automation system shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol to each remote control centre.

Also, each control centre's data scan and control commands may be different for different data points within the substation automation system's database.

3.3.2 Remote Control Centre Communication Interface

Employer will supply communication channels between the Substation Automation System and the remote control centre. The communicator channels provided by Employer will consist of optical fibre the details of which shall be provided during detailed Engineering.

3.3.3 Interface equipment:

The Contractor shall provide interface equipments for communicating through optical fiber between Substation Automation system and Remote Control Centre and between Substation Automation system and area Load Dispatch Centre (ALDC).
In case of communication any modem supplied shall not require manual equalization and shall include self-test features such as manual mark/space keying, analogue loop-back, and digital loop-back. The modems shall provide for convenient adjustment of output level and receive sensitivity. The modem should be standalone complete in all respects including power supply to interface the SAS with communication channel. The configuration of tones and speed shall be programmable and maintained in non-volatile memory in the modem. All necessary hardware and software and communication terminal equipments required to be installed for data transfer in the substation shall also be in the scope of bidder except the communication link (optical fiber) between substation control room and Remote Control Centre.

3.3.4 Communication Protocol

The communication protocol between gateway and station shall be open protocol / shall support IEC 60870-5-101. For all levels of communication such as Inter bay level, bay to station HMI etc. the communication protocol shall support IEC 61850.

4.0 System hardware:

4.1 Redundant Station HMI, HMI View Node, Remote HMI and Disturbance Recorder Work station:

The contractor shall provide redundant station HMI in hot standby mode.

It shall be capable to perform all functions for entire substation including future requirements as indicated in the SLD. It shall use industrial grade components. Processor and RAM shall be selected in such a manner that during normal operation not more than 30% capacity of processing and memory are used. Supplier shall demonstrate these features.

The capacity of hard disk shall be selected such that the following requirement should occupy less than 50% of disk space:

1. Storage of all analogue data (at 15 Minutes interval) and digital data including alarm, event and trend data for thirty (30) days.
2. Storage of all necessary software,
3. 20GB space for EMPLOYER'S use. Supplier shall demonstrate that the capacity of hard disk is sufficient to meet the above requirement.

4.1.1 HMI (Human Machine Interface)

The VDU shall show overview diagrams (Single Line Diagrams) and complete details of the switchgear with a colour display. All event and alarm annunciation shall be selectable in the form of lists. Operation shall be by a user friendly function keyboard and a cursor positioning device. The user interface shall be based on WINDOWS concepts with graphics & facility for panning, scrolling, zooming, decluttering etc.

4.1.2 Visual Display Units/ TFT's (Thin Film Technology)

The contractor shall provide three display units, one for station HMI, one for redundant HMI and one for DR work station. These shall have high resolution and reflection protected

picture screen. High stability of the picture geometry shall be ensured. The screen shall be at least 21" diagonally in size and capable of colour graphic displays.

The display shall accommodate resolution of 1280 X 1024 pixels. The HMI shall be able to switch the key board and cursor positioning device, as unit among all the monitors at a consol vis push button or other controls.

4.1.3 Printer

It shall be robust & suitable for operation with a minimum of 132 characters per line. The printing operation shall be quiet with a noise level of less than 45 dB suitable for location in the control room. Printer shall accept and print all ASCII characters via master control computer unit interface.

The printer shall have in built testing facility. Failure of the printer shall be indicated in the Station HMI. The printer shall have an off line mode selector switch to enable safe maintenance. The maintenance should be simple with provisions for ease of change of print head, ribbon changing, paper insertion etc.

All printers mounted in the control room shall be provided with a separate printer enclosure each. The enclosure shall be designed to permit full enclosure of the printers at a convenient level. Plexiglas windows shall be used to provide visual inspection of the printers and ease of reading. The printer enclosures shall be designed to protect the printers from accidental external contact & each should be removable from hinges at the back and shall be provided with lock at the front.

All reports and graphics prints shall be printed on laser printer. One dot matrix printer shall be exclusively used for hourly log printing.

All printers shall be continuously online.

4.1.4 Mass Storage Unit

The mass storage unit shall be built-in to the Station HMI. All operational measured values and indications shall be stored in a mass-storage unit of CD-ROM / DVD-ROM with 700 MB or more capacity. The unit should support at least Read (48X), Write (24X), and Re-Write (10X) operations, with Multi-Session capability. It should support IS09660, Rockridge and Joliet File systems. It should support formatting and use under the operating system provided for Station HMI. The monthly back up of data shall be taken on disc. The facility of back up of data shall be inherent in the software.

4.1.5 Switched Ethernet Communication Infrastructure:

The bidder shall provide the redundant switched optical Ethernet communication infrastructure for SAS. The bidder shall keep provision of 100% spare capacity for employer use. One switch shall be provided to connect all IEDs for two bays of 220kV yard to communication infrastructure. For 66kV & 33KV, one switch shall be provided for three bays.

4.2 Bay level unit

The bay unit shall use industrial grade components. The bay level unit, based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals. They shall incorporate select-before-operate control principles as safety measures for operation via the HMI. They shall perform all bay related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording and shall provide inputs for status indication and outputs for commands. They shall be directly connected to the switchgear. The bay unit shall acquire and process all data for the bay (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the other devices in sub-station automation system. In addition, this shall receive the operation commands from station HMI and control centre. The bay unit shall have the capability to store all the data for at least 24 hours.

One no. Bay level unit shall be provided for supervision and control of each 220kV,66kV & 33kV bay (a bay comprises of one circuit breaker and associated disconnector, earth

switches and instrument transformer). The Bay level unit shall be equipped with analogue and b inary inputs/outputs f or han dling t he c ontrol, s tatus m onitoring and analogue measurement functions. All bay level interlocks are to be incorporated in the Bay level unit so as t o permit c ontrol f rom t he B ay level u nit/ l ocal b ay m imic p anel, with a ll bay interlocks i n pl ace, d uring maintenance and c ommissioning or in c ase of c ontingencies when the Station HMI is out of service.

The B ay level u nit s hall m eet t he r equirements f or w ithstanding el ectromagnetic interference ac cording t o r elevant p arts of I EC 6185 0. F ailure of an y s ingle c omponent within t he e quipment s hall ne ither c ause u nwanted operation n or lead t o a c omplete 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 f rom t he s econdaries of i nstrument t ransformers. The di gital inputs s hall be acquired by exception with 1 ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state.

4.3. Air-conditioned System

The following rooms shall be provided with split Air-Conditioners.

i) Bay level units, bay mimic, relay and protection panels etc. for 220KV bays.
ii) Bay level units, bay mimic, relay and protection panels etc. for 66KV bays.
iii) Bay level units, bay mimic, relay and protection panels etc. for 33kV bays.
iv) Battery room
v) Control room
vi) Electrical Lab. / Protection Room
vii) Conference Room/ Library
viii) Station incharge Room/ DGM's Room
ix) SCADA / PLCC Room
x) Room for Engineers
xi) Room for non-executives

The design of layout plan, capacity, quantity of split AC and their control panels shall be subject to Employer's approval and conform to the IS: 1391(part-2). The split AC shall be installed atleast 4 star rated system as per the Bureau of Energy Efficiency (India). The AC rooms shall also be provided with fire alarm system with at least two detectors and it shall be wired to SAS for monitoring. The air conditionings system shall be provided with control and protection IEDs for performing substation automation and protection functions.

The high wall type split AC unit of suitable capacity shall be complete with high wall type indoor evaporator unit and air cooled outdoor condensing unit having hermetically sealed compressor. Cool mode is required in split AC.

The indoor units shall be high wall type. The indoor unit shall be compact and shall have elegant ap pearance. T hey s hall h ave l ow noise c entrifugal b lowers driven by special motors and c opper t ube al uminium f inned c ooling c oils. R emovable and washable polypropylene filters shall be provided.

Outdoor unit shall comprise of hermetically sealed reciprocating/ rotary compressors mounted on vibration isolators, propeller type axial flow fans and c opper t ube aluminium finned coils all assembled in a sheet metal casing. The casing and the total unit shall be properly treated and shall be weatherproof type. They shall be compact in size and shall have horizontal di scharge of air. The c ompressor shall b e v ery reliable, t rouble f ree and require less maintenance.

Copper refrigerant piping complete with insulation between the indoor and remote outdoor condensers as r equired. PVC dr ain pi ping f rom t he i ndoor units upt o t he n earest dr ain point. Power and control cabling between the indoor unit and outdoor unit and earthing.

The air conditioning is required for critical application i.e. for maintaining the temperature for critical sub-station control and protection equipment. To provide redundancy for such critical applications, each split AC shall be installed with environment control system comprising of air conditioners working in conjunction through a microprocessor based controller for desired operation. The system shall be designed for 24 Hours, 365 days of the year to maintain proper temperature for operation of the critical equipment. One of the air conditioner shall be standby mode and on failure of the any unit, the same shall start automatically. To ensure longer life of the system, all the functional units and standby unit shall also be running in cyclic operation through the controller. Design shall be such that failure of the any unit of Air conditioning system shall not compromise operational requirement.

Standby units in Air conditioning shall be provided and A/C system shall be synchronised for round the clock operation.

4.4 Extendibility in future

Offered substation automation system shall be suitable for extension in future for additional bays. During such requirement, all the drawings and configurations, alarm/event list etc. displayed shall be designed in such a manner that its extension shall be easily performed by the employer. During such event, normal operation of the existing substation shall be unaffected and system shall not require a shutdown. The contractor shall provide all necessary software tools along with source codes to perform addition of bays in future and complete integration with SAS by the user. These software tools shall be able to configure IED, add additional analogue variable, alarm list, event list, modify interlocking logics etc. for additional bays/equipment which shall be added in future with IEDs of same manufacture/ different manufacture.

5.0 Software structure

The software package shall be structured according to the SAS architecture and strictly divided in various levels. Necessary firewall shall be provided at suitable points in software to protect the system. An extension of the station shall be possible with lowest possible efforts. Maintenance, modification or an extension of components of any feeder may not force a shutdown of the parts of the system, which are not affected by the system adaptation.

5.1.1 Station level software

5.1.1.2 Human-machine interface (HMI)

The base HMI software package for the operator station shall include the main SAS functions and it shall be independent of project specific hardware version and operating system. It shall further include tools for picture editing, engineering and system configuration. The system shall be easy to use, to maintain, and to adapt according to specific user requirements. Systems shall contain a library with standard functions and applications.

5.1.2 Bay level software

5.1.2.1 System software

The system software shall be structured in various levels. This software shall be placed in a non-volatile memory. The lowest level shall assure system performance and contain basic functions, which shall not be accessible by the application and maintenance engineer for modifications. The system shall support the generation of typical control macros and a process database for user specific data storage. In case of restoration of links after failure, the software along with hardware shall be capable of automatically synchronising with the remaining system without any manual interface. This shall be demonstrated by contractor during integrated system test.

5.1.2.2 Application software

In order to ensure robust quality and reliable software functions, the main part of the application software shall consist of standard software modules built as functional block elements. The functional blocks shall be documented and thoroughly tested. They form part of a library. The application software within the control/protection devices shall be programmed in a functional block language.

5.1.2.3 Network Management System

The contractor shall provide network management system software for following management functions:

a. Configuration Management
b. Fault Management
c. Performance Monitoring

This system shall be used for management of communication devices and other IEDs in the system. This NMS can be loaded in DR work-station and shall be easy to use, user friendly and menu based. The NMS shall monitor all the devices in the SAS and report if there is any fault in the monitored devices. The NMS shall

(a) Maintain performance, resource usage, and error statistics for all managed links and devices and present this information via displays, periodic reports and on demand reports.
(b) Maintain a graphical display of SAS connectivity and device status.
(c) Issue alarms when error conditions occurs
(d) Provide facility to add and delete addresses and links

5.1.2.4 The contractor shall provide each software in two copies in CD to load into the system in case of any problem related with Hardware/Communication etc.

6.0 TESTS

The substation automation system offered by the bidder shall be subjected to following tests to establish compliance with IEC 61850 for EHV sub station equipment installed in sheltered area in the outdoor switchyard specified ambient conditions:

6.1 Type Tests:

6.1.1 Control IEDs and Communication Equipment

a. Power Input:
- i Auxiliary Voltage
- ii Current Circuits
- 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 phase of the SAS shall be concluded by the factory acceptance test (FAT). The purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. If the FAT comprises only a certain portion of the system for practical reason, it has to be assured that this test configuration contains at least one unit of each and every type of equipment incorporated in the delivered system.

If the complete system consists of parts from various suppliers or some parts are already installed on site, the FAT shall be limited to sub-system tests. In such a case, the complete system test shall be performed on site together with the Site Acceptance Test (SAT).

6.3 Integrated Testing:

The integrated system tests shall be performed as detailed in subsequent clauses as per following configuration:

- Redundant Station HMI, DR work station, switches along with all IEDs and printers.

All other switches for complete sub-station as detailed in section project shall be simulated as needed.

6.3.1 Hardware Integration Tests:

The hardware integration test shall be performed on the specified systems to be used for Factory tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware integration tests.

6.3.2 Integrated System Tests:

Integrated system tests shall verify the stability of the hardware and the software. During the tests all functions shall run concurrently and all equipment shall operate a continuous 100 Hours period. The integrated system test shall ensure the SAS is free of improper interactions between software and hardware while the system is operating as a whole.

6.4 Field Tests:

The field tests shall completely verify all the features of SAS hardware and software.

7.0 SYSTEM OPERATION

7.1 Substation Operation

7.1.1 Normal Operation

Operation of the system by the operator from the remote RCC or at the substation shall take place via industry standard HMI (Human Machine interface) subsystem consisting of graphic colour VDU, a standard keyboard and a cursor positioning device (mouse).

The coloured screen shall be divided into 3 fields:

i) Message field with display of present time and date
ii) Display field for single line diagrams
iii) Navigation bar with alarm/condition indication

For display of alarm annunciation, lists of events etc a separate HMI View node shall be provided.
All operations shall be performed with mouse and/or a minimum number of function keys and cursor keys. The function keys shall have different meanings depending on the operation. The operator shall see the relevant meanings as function tests displayed in the command field (i.e. operator prompting). For control actions, the switchgear (i.e. circuit breaker etc.) requested shall be selectable on the display by means of the cursor keys. The switching element selected shall then appear on the background that shall be flashing in a different color. The operator prompting shall distinguish between:-

- Prompting of indications e.g. fault indications in the switchgear, and

- Prompting of operational sequences e.g. execution of switching operations

The summary information displayed in the message field shall give a rapid display of alarm/message of the system in which a fault has occurred and alarm annunciation lists in which the fault is described more fully.

Each operational sequence shall be divided into single operation steps which are initiated by means of the function keys/WINDOW command by mouse. Operator prompting shall be designed in such a manner that only the permissible keys are available in the command field related to the specific operation step. Only those switching elements shall be accessed for which control actions are possible. If the operation step is rejected by the system, the operator prompting shall be supported by additional comments in the message field. The operation status shall be reset to the corresponding preceding step in the operation sequence by pressing one of the function keys. All operations shall be verified. Incorrect operations shall be indicated by comments in the message field and must not be executed.

The offer shall include a comprehensive description of the system. The above operation shall also be possible via WINDOWS based system by mouse.

8.0 Power Supply

Power for the substation automation system shall be derived from substation 220V DC system.
Inverter of suitable capacity shall be provided for station HMI and its peripheral devices e.g. printer etc. In the event of Power failure, necessary safeguard software shall be built for proper shutdown and restart.

9.0 Documentation

The following documents shall be submitted for employer's approval during detailed engineering:

(a) System Architecture Drawing
(b) Hardware Specification
(c) Sizing Calculations of various components

(d) Response Time Calculation
(e) Functional Design Document

The following documentation to be provided for the system in the course of the project shall be consistent, CAD supported, and of similar look/feel. All CAD drawings to be provide in "dxf" format.

- List of Drawings
- Substation automation system architecture
- Block Diagram
- Guaranteed technical parameters, Functional Design Specification and Guaranteed availability and reliability
- Calculation for power supply dimensioning
- I/O Signal lists
- Schematic diagrams
- List of Apparatus
- List of Labels
- Logic Diagram (hardware & software)
- Kiosk layout drawing
- GA of kiosk and GTP
- Control Room Lay-out
- Test Specification for Factory Acceptance Test (FAT)
- Product Manuals
- Assembly Drawing
- Operator's Manual
- Complete documentation of implemented protocols between various elements
- Listing of software and loadable in CD ROM
- Other documents as may be required during detailed engineering

Two sets of hard copy and four sets of CD ROM containing all the as built documents/drawings shall be provided.

10.0 TRAINING, SUPPORT, SERVICES, MAINTENANCE AND SPARES

10.1 Training

Contractor personnel who are experienced instructors and who speak understandable English shall conduct training. The contractor shall arrange on its own cost all hardware training platform required for successful training and understanding in India. The Contractor shall provide all necessary training material. Each trainee shall receive individual copies of all technical manuals and all other documents used for training. These materials shall be sent to Employer at least two months before the scheduled commencement of the particular training course. Class materials, including the documents sent before the training courses as well as class handouts, shall become the property of Employer. Employer reserves the right to copy such materials, but for in-house training and use only. Hands-on training shall utilize equipment identical to that being supplied to Employer.

For all training courses the travel (e.g. airfare) and pre-diem expenses will be borne by the participants.

The schedule, location, and detailed contents of each course will be finalized during employer and contractor discussions.

10.2 Computer System Hardware Course

A computer system hardware course shall be offered, but at the system level only. The training course shall be designed to give Employer hardware personnel sufficient knowledge of the overall design and operation of the system so that they can correct obvious problems, configure the hardware, preventive maintenance run diagnostic programs, and communicate with contract maintenance personnel. The following subjects shall be covered:

a) System Hardware Overview: Configuration of the system hardware.

b) Equipment Maintenance: Basic theory of operation, maintenance techniques and diagnostic procedures for each element of the computer system, e.g. processors, auxiliary memories, LANs, routers and printers. Configuration of all the hardware equipments.

c) System Expansion: Techniques and procedures to expand and add equipment such as loggers, monitors and communication channels.

d) System Maintenance: Theory of operation and maintenance of the redundant hardware configuration, failover hardware, configuration control panels and failover switches. Maintenance of protective devices and power supplies.

e) Subsystem Maintenance: Theory of design and operation, maintenance techniques and practices, diagnostic procedures, and (where applicable) expansion techniques and procedures. Classes shall include hands-on training for the specific subsystems that are part of Employer's equipment or part of similarly designed and configures subsystems. All interfaces to the computing equipment shall be taught in detail.

f) Operational Training: Practical training on preventive and corrective maintenance of all equipment, including use of special tools and instruments. This training shall be provided on Employer equipment, or on similarly configures systems.

10.3 Computer System Software Course

The Contractor shall provide a computer system software course that covers the following subjects:

(a) System Programming:
Including all applicable programming languages and all stand-alone service and utility packages provided with the system. An introduction to software architecture, Effect of tuning parameters (OS software, Network software, database software etc.) on the performance of the system.

(b) Operating System:
Including the user aspects of the operating system, such as program loading and integrating procedures; scheduling, management, service, and utility functions and system expansion techniques and procedures

(c) System Initialization and Failover:
Including design, theory of operation, and practice Diagnostics:

(d) Including the execution of diagnostic procedures and the interpretation of diagnostic outputs,

(e) Software Documentation: Orientation in the organization and use of system software documentation.

(f) Hands-on Training: One week, with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

10.4 Application Software Course

The Contractor shall provide a comprehensive application software courses covering all applications including the database and display building course. The training shall include:

(a) Overview: Block diagrams of the application software and data flows. Programming standards and program interface conventions.

(b) Application Functions: Functional capabilities, design, and major algorithms. Associated maintenance and expansion techniques.

(c) Software Development: Techniques and conventions to be used for the preparation and integration of new software functions.

(d) Software Generation: Generation of application software from source code and associated software configuration control procedures.

(e) Software Documentation: Orientation in the organization and use of functional and detailed design documentation and of programmer and user manuals.

(f) Hands-on Training: One week, with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

10.5 Requirement of training:

The contractor shall provide training for two batches for two weeks each for following courses.

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 primer esponsibility for keeping the system operational.

12.0 RELIABILITY AND AVAILABILITY

The SAS shall be designed so that the failure of any single component, processor, or device shall not render the system unavailable. The SAS shall be designed to satisfy the very high demands for reliability and availability concerning:

- Mechanical and electrical design
- Security against electrical interference (EMI)
- High quality components and boards
- Modular, well-tested hardware
- Thoroughly developed and tested modular software
- Easy-to-understand programming language for application programming
- Detailed graphical documentation and application software
- Built-in supervision and diagnostic functions
- Security
  - Experience of security requirements
  - Process know-how
  - Select before execute at operation
  - Process status representation as double indications
- Distributed solution
- Independent units connected to the local area network
- Back-up functions
- Panel design appropriate to the harsh electrical environment and ambient conditions
- Panel grounding immune against transient ground potential rise

Outage terms

1) Outage
The state in which substation automation system or a unit of SAS is unavailable for Normal Operation as defined in the clause 7.1 due to an event directly related to the SAS or unit of SAS. In the event, the Employer has taken any equipment system other than Sub-station Automation System for schedule/forced maintenance, the consequent outage to SAS shall not be considered as outage for the purpose of availability.

2) Actual outage duration (AOD)
The time elapsed in hours between the start and the end of an outage. The time shall be counted to the nearest $1/4^{th}$ 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 =ΣAOD

5) Availability
Each SAS shall have a total availability of 99.98 % i.e. the ratio of total time duration minus the actual outage duration to total time duration.

12.1 Guarantees Required

The availability for the complete SAS shall be guaranteed by the Contractor. Bidder shall include in their offer the detailed calculation for the availability. The contractor shall demonstrate their availability guaranteed by conducting the availability test on the total sub-station automation system as a whole after commissioning of total Sub-station Automation system. The test shall verify the reliability and integrity of all sub-systems. Under these conditions the test shall establish an overall availability of 99.98%. After the lapse of 1000 Hours of cumulative test time, test records shall be examined to determine the conformance with availability criterion. In case of any outage during the availability test, the contractor shall rectify the problem and after rectification, the 1000 Hours period start after such rectification. If test object has not been met the test shall continue until the specified availability is achieved.

The contractor has to establish the availability in a maximum period of three months from the date of commencement of the availability test.

After the satisfactory conclusion of test both contractor and employer shall mutually agree to the test results and if these results satisfy the availability criterion, the test is considered to be completed successfully. After that the system shall be taken over by the employer and then the guarantee period shall start.

13.0 Spares

13.1 Consumables:

All consumables such as paper, cartridges shall be supplied by the contractor till the SAS is taken over by the Employer. .

13.2 Availability Spares:

In addition to mandatory spares as listed in section project for SAS, the bidder is required to list the spares, which may be required for ensuring the guaranteed availability during the guaranteed availability period. The final list of spares shall form part of scope of supply and accordingly the price thereof shall be quoted by the bidder and shall be considered in the evaluation of the bids. During the guaranteed availability period, the spare parts supplied by the Contractor shall be made available to the Contractor for usage subject to replenishment at the earliest. Thus, at the end of availability period the inventory of spares with the Employer shall be fully replenished by the Contractor. However, any additional spares required to meet the availability of the system (which are not a part of the above spares supplied by the Contractor) would have to be supplied immediately by the Contractor free of cost to the Employer.

14.0 LIST OF EQUIPMENTS

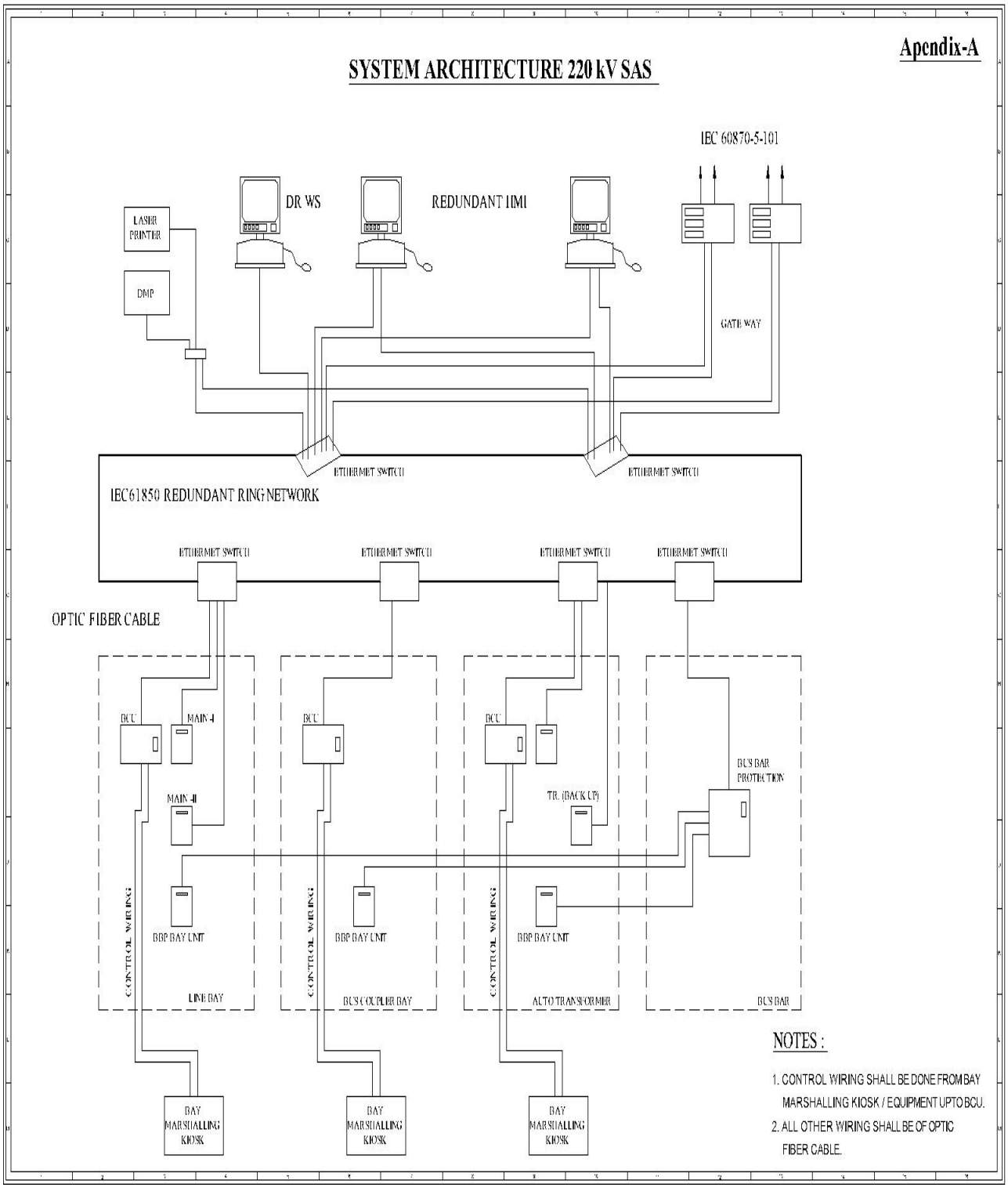
Quantity of equipments shall be decided by bidder in order to achieve guaranteed reliability and availability as declared by bidder.

i) Station HMI
ii) Redundant Station HMI (in Hot-stand by mode)
iii) Bay level units along with bay mimic
iv) Disturbance Recorder Work Station(Maintenance HMI)
v) Colour Laser Printer - 1 No. (For Reports & Disturbance records)
vi) Dot matrix printers - (one each for Alarms and log sheets)
vii) All interface equipment for gateway to RCC and ALDC

viii) Communication infrastructure between Bay level units. Station HMI, Printers, gateways, redundant LAN etc. as required

ix) Remote workstation including HMI and along with one printer

x) Any other equipment as necessary.



Annexure-I

Basic Monitoring requirements are:

- Switchgear status indication
- Measurements (U, I, P, Q, f)
- Event
- Alarm
- Winding temperature of transformers
- Ambient temperature
- Status and display of 415V LT system & 220V DC system
- Status of display of Fire protection system and Air conditioning system.
- Acquisition of all counters for inter-tripping counting the receive/send commands.
- Acquisition of alarm and fault record from protection relays
- Disturbance records
- Monitoring the state of batteries by displaying DC voltage, charging current and load current etc.
- Tap-position of Transformer

List of Inputs

The list of input for typical bays is as below:-

Analogue inputs

i) For line
- Current: R phase, Y phase, B phase
- Voltage: R-Y phase, Y-B phase, B-R phase

ii) For transformer
- Current: R phase, Y phase, B phase
- WTI (for transformer)
- Tap position (for transformer only)

iii) For bus coupler
- Current: R phase, Y phase, B phase

iv) Common

a) Voltage for Bus-1, Bus-II
- Voltage: R-Y phase, Y-B phase, B-R phase

b) Frequency for Bus-1 and Bus-II

b) Ambient temperature (switchyard).

d) LT system
- i) Voltage R-Y, Y-B, B-R of Main Switch Board section-I
- ii) Voltage R-Y, Y-B, B-R of Main Switch Board section-II
- iii) Voltage R-Y, Y-B, B-R of Diesel Generator
- iv) Current from Diesel Generator
- v) Voltage of 220V DCDB-I
- vi) Voltage of 220V DCDB-II
- vii) Current from 220V Battery set-I
- viii) Current from 220V Battery set-II
- ix) Current from 220V Battery charger-I

xi) Current from 220V Battery charger-I
xii) **Current from LT Tfr.-1**
xiii) **Current from LT Tfr.-2**

Digital Inputs

The list of input for various bays/SYSTEM is as follows:

1. Line bays
   - i) Status of each pole of CB, Isolator, Earth switch
   - ii) CB trouble
   - iii) CB operation/closing lockout
   - iv) Pole discrepancy optd
   - v) Trip coil faulty
   - vi) LBB optd
   - vii) Bus bar protn trip relay optd
   - viii) Main bkr auto recloser operated
   - ix) auto recloser operated
   - x) A/r lockout
   - xi) Direct trip-I/II sent
   - xii) Direct trip-I/II received
   - xiii) Main 1/ Main II blocking
   - xiv) Main 1/ Main II -Inter trip send
   - xv) Main 1/ Main II-Inter trip received
   - xvi) O/V stage-I operated
   - xvii) O/V stage-II operated
   - xviii) FAULT LOCATOR FAULTY
   - xix) MAIN-1/ Main II PT FUSE FAIL
   - xx) MAIN-1 PROTN TRIP
   - xxi) MAIN-II PROTN TRIP
   - xxii) MAIN-1 PSB ALARM
   - xxiv) MAIN-1 SOTF TRIP
   - xxv) MAIN-1 R-PH TRIP
   - xxvi) MAIN-1 Y-PH TRIP
   - xxvii) MAIN-1 B-PH TRIP
   - xxviii) MAIN-1 START
   - xxix) MAIN-1/ Main II inter trip
   - xxx) MAIN-1/ Main II fault in reverse direction
   - xxxi) MAIN-1/ Main II ZONE-2 TRIP
   - xxxii) MAIN-1/ Main II ZONE-3 TRIP
   - xxxiii) MAIN-1/ Main II weak end infeed optd
   - xxxiv) MAIN-II PSB alarm
   - xxxiv) MAIN-II SOF TRIP
   - xxxv) MAIN-II R-PHTRIP
   - xxxvi) MAIN-II Y-PH TRIP
   - xxxvii) MAIN-II B-PH TRIP
   - xxxviii) MAIN-II start
   - xxxix) MAIN-II inter trip
   - xl) MAIN-1/ MAIN-II fault in reverse direction
   - xli) Back-up o/c optd
   - xlii) Back-up e/f optd
   - xliii) 220V DC-I/II source fail
   - xliv) SPEECH CHANNEL FAIL
   - xlv) Optic fiber Protection Channel-1 FAIL
   - xlvi) Optic fiber Protection Channel-11 FAIL
   - xlvii) Under frequency Relay Trip (In case of 33kV)

2. Transformer bays
   - i) Status of each pole of CB, Isolator, Earth switch
   - ii) CB trouble
   - iii) CB operation/ closing lockout
   - iv) Pole discrepancy optd
   - v) Trip coil faulty
   - vi) LBB optd
   - vii) Bus bar 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 VT 1/2 FUSE FAIL
xv) MV BUS VT 1/2 FUSE FAIL
xvi) OTI ALARM/TRIP
xvii) PRD OPTD
xviii) OVERLOAD ALARM
xix) BUCHOLZ TRIP
xx) BUCHOLZ ALARM
xxi) OLTC BUCHOLZ ALARM (O.S.R)
xxii) OLTC BUCHOLZ TRIP
xxiii) OIL LOW ALARM
xxiv) Back-up o/c (HV) optd
xxv) Back-up e/f (HV) optd
xxvi) 220V DC-I/II source fail
xxvii) TAP MISMATCH
xxviii) GR-A PROTN OPTD
xxix) GR-B PROTN OPTD
xxx) Back-up o/c (MV) optd
xxxi) Back-up e/f (MV) optd
xxxii) SPR Optd.

3. Busbar Protection
   i) Bus bar Main trip
   ii) Bus bar Check trip
   iii) Bus bar zone-I CT open
   iv) Bus bar zone-II CT open
   v) Bus transfer CT sup. Optd
   vi) Bus protection relay fail

4. Auxiliary system
   i) Incomer-I On/Off
   ii) Incomer-II On/Off
   iii) 415V Bus-I/II U/V
   iv) 415V Bus coupler breaker on/off
   v) DG set bkr on/off
   vi) Alarm/trip signals as listed in Section : DG set
   vii) LT transformer-I Buchholz alarm and trip
   viii) LT transformer-II Buchholz alarm and trip
   ix) LT transformer-I WTI alarm and trip
   x) LT transformer-II WTI alarm and trip
   xi) LT transformer-I OTI alarm and trip
   xii) LT transformer-II OTI alarm and trip
   xiii) Communication exchange fail
   xiv) Time sync. Signal absent
   xv) Alarm trip signals as listed in
   xvi) Battery and Battery charger
   xvii) 220V dc-I earth fault
   xviii) 220V dc-II earth fault
   xix) Alarm/trip signals as listed in Section: Fire protection system

The exact number and description of digital inputs shall be as per detailed engineering requirement. Apart from the above-mentioned digital inputs, minimum of 200 inputs shall be kept for DTL use in future.

Annexure – II

INTEROPERABILITY DOCUMENT

1. Network Configuration

- Point to Point
- Point to multi point

2. Physical Layer

Transmission speed (In monitoring and control direction)

- 200 bps
- 300 bps
- 600 bps
- 1200 bps
- 2400 bps
- 4500 bps
- 9600 bps

3. Link Layer

Frame Format	: FT 1.2
Link transmission procedure	:Unbalanced
Address field of the Link	: 1 Octet

4. Application Layer

Common address of ASDU	: 1 Octet
Information Object address	: 2 Octets
Cause of transmission	: 1 Octet

Selection of Standard ASDUs.

Monitoring Direction

- 1: Single –point information M_SP_NA_1.
- 2: Single –point information with time tag M_SP_TA_1
- 3: Double –point information M_DP_NA_1.
- 4:Double –point information with time tag M _DP_TA_1.
- 5:Step position information M_ST_NA_1.
- 6: Step position information with time tag M_ST_TA_1
- 11:Measured value, scaled value M_ME_NB_1.
- 12: Measured value, scaled value with time tag M_ME_TB_1
- 15: Integrated totals M_IT_NA_1
- 16: Integrated totals with time tag M_IT_TA_1.
- 70:End of initialization M_EI_NA_1

Control Direction

- 45: Single command C_SC_NA_1
- 46: Double command C_DC_NA_1.
- 47: Regulating step command C_RC_NA_1.
- 49: Set point command ,scaled value C_SE_NB_1
- 100: Interrogation command C_IC_NA_1.
- 101: Counter Interrogation command C_CI_NA_1.
- 102: Read command C_RD_NA_1.
- 103: Clock synchronization command C_CS_NA_1.

- 105: Reset process command C_RP_NA_1.

File Transfer

- 120: File ready F_FR_NA_1.
- 121: Section ready F_SR_NA_1.
- 122: Call Directory, select file ,call file , call section F_SC_NA_1.
- 123: Last section , last segment F_LS_NA_1.
- 124: Ack file,ack section F_AF_NA_1.
- 125: Segment F_SG_NA_1.
- 126: Directory F_DR_TA_1.

Note: File transfer is used for uploading the RTU's configuration file, and also to acquire Sequence of Events on demand.

SECTION-XIV

CONTROL & RELAY PANELS

SECTION : 14

RELAY AND PROTECTION PANELS

(Applicable for Sub-station with Automation System)

1.0 GENERAL

1.1 This specification covers the design, engineering, manufacture, assembly, testing, supply and delivery of relay and protection panels complete with wiring, meters, relays, control switches and other miscellaneous equipments specified herein after in this specifications for 400 kV, 220 kV, 66 kV and 33 kV voltage levels in DTL system.

1.2 The relay and protection panels shall be complete with all components and accessories which are necessary or usual for their efficient performance and satisfactory maintenance under the various operating and atmospheric conditions. Such parts shall be deemed to be within the scope of supply, whether specifically included or not in the specifications. The successful bidder shall not be eligible for any extra charges for such accessories etc.

1.3 CLIMATIC CONDITIONS

The climatic conditions prevailing at site are as follows:

1	Maximum ambient air temperature as per IS: 9676		45°C
2	Standard ambient air temperature as per IS: 9676		40°C
3	Maximum Relative Humidity		100%
4	Minimum Relative Humidity		10%
5	Average annual rainfall		750 mm
6	Average no. of rainy day		50
7	Average no. of thunderstorm days per annum		40
8	Altitude		Not exceeding 300 meters
9	Rain months		June to Oct.
10	Wind pressure as per IS 875		195 Kg/Sq. meters up to 30 meters

The atmosphere is generally laden with mild acid and dust in suspension during the dry months and is subject to fog in cold months. The variation between daily minimum and maximum temperature could be to the extent of 15/20 deg. C. Heavy lightening is in the area during the rainy months. All the equipments shall be designed to withstand seismic forces corresponding to seismic zone – IV.

1.4 STANDARDS

1.4.1 The design, manufacture, testing and performance of the equipment provided under this specification shall comply with the standards and rules given in this specification.

1.4.2 Unless otherwise specified the equipment shall confirm to the latest applicable Indian Standards. The equipment complying with any other authorized standards such as British, USA, etc. will also be considered if it ensures performance equivalent or superior to Indian Standards specified below. In the event of supply of equipment confirming to any internationally recognized standards other than the Indian Standards, the salient features of comparison shall be brought out in the tender. The copies of such standard in English language or their English translation shall be attached with the offer.

1.4.3 The bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.

1.4.4 The bidder shall also note that list of standards presented in this specification may not be complete and exhaustive. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

LIST OF STANDARDS

IS-3231	Electrical relays for power system protection.
IS-3842 Part-I to VII	Application guide for electrical relays
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
IEC-60051 : (P1 to P9)	Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories.
IEC-60255 (Part 1 to part 23)	Electrical relays.
IEC-60297 (P1 to P4)	Dimensions of mechanical structures of the 482.6mm (19 inches) series.
IEC-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 meters
IEC-60547	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)
BS-142	Electrical protective relays
IS-722	Energy meters
IS-13010	Watt hour meter
IS-1248	Electrical indicating instrument

IS-6875	Control switches
IEC-337 and 3371	Control switches LV switching device for control and auxiliary circuits
IS-2605	Auxiliary current transformers
IS-3165	Auxiliary potential transformers
IS-1554 part-I	PVC insulated cables up to & including 1100V.
IS-2208	HRC cartridge fuses links up to 650V.
IS-8828	MCB's
IS-2516	Circuit breaker

2. CONSTRUCTIONAL FEATURES

2.1 Simplex panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from front for control & relay panels. In case of panel having width more than 800mm, double leaf-doors shall be provided. Doors shall have handles with either built-in locking facility or will be provided with pad-lock.

2.2 Relay panels shall be of simplex type design as indicated. It is the responsibility of the Contractor to ensure that the equipment specified and such un specified complementary equipment required for completeness of the protective/control schemes is properly accommodated in the panels without congestion and if necessary, provide panels with larger dimensions. No price increase at a later date on this account shall be allowed. However, the width of panels that are being offered to be placed in LCC/control rooms, should be in conformity with the space availability in the LCC/control room.

2.3 Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-42.

2.4 Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0 mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation.

2.5 All doors, removable covers and panels shall be gasketed all around with synthetic rubber gaskets Neoprene/EPDM generally conforming with provision of IS 11149. However, XLPE gaskets can also be used for fixing protective glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh.

2.6 Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces tune and smooth.

2.7 Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Anti vibration strips made of shock absorbing materials which shall be supplied by the contractor, shall be placed

between panel & base frame.

2.8 Cable entries to the panel shall be from the bottom. The bottom plate of the panels shall be fitted with removable gland plates of adequate size for fixing the cable gland. Necessary number of cable glands made of brass (electroplated) of size to suit purchaser's external cables to the panels shall be supplied. Cable glands shall be screw type and made of brass and shall be suitable for PVC armoured cable. 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.

2.9 Relay panels of modern modular construction would also be acceptable.

2.10 Synchronising sockets shall be provided on panel wherever applicable.

3.0 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. No equipment shall be mounted on the doors.

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 be not less than750mm from the bottom of the panel. The centre lines of relays, meters and recorders shall be not less than 450mm from the bottom of the panel.

3.5 The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Like wise the top lines of all meters, relays and recorders etc. shall be matched.

3.6 No equipment shall be mounted on the doors.

3.7 All equipment connections and cabling shall be designed and arranged to minimize the risk of fire and damage which may be caused by fire.

3.8 Provision shall be made in the panel for earthing the panels and mountings.

4.0 **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 furnished and the wiring shall be carried out internally.

4.2 All wiring shall be carried out with 1100V grade, single core, stranded copper conductor wires with PVC insulation and shall be FRLS type. The minimum size of the multi-stranded copper conductor used for internal wiring shall be as follows:

- All circuits except current transformer circuits and voltage transformer circuits – one 1.5mm sq. per lead.
- All current transformer circuits one 2.5 sq.mm lead.
- Voltage transformer circuit (for energy meters): Two 2.5 mm sq. per lead.

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 where necessary, while terminating wiring at equipment/terminal blocks the wiring shall be securely bunched so that the position of each individual connection wire does not get disturbed when disconnected from equipment terminals.

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 equipments.

4.8 The control scheme shall incorporate necessary isolating device for easy testing and isolation of faults in the control and signaling circuits.

4.9 The colour coding for wiring inside the panel shall be as follows:

a) Earth: Green
b) Neutral: Black
c) Phases: Red, Yellow, Blue

5.0 TERMINAL BLOCKS

5.1 All internal wiring to be connected to external equipment shall terminate on terminal blocks. Terminal blocks shall be 1100 V grade and have 10 Amps. Continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.

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 earthling facilities.

5.3 Terminal blocks shall be fully enclosed with easily removable covers and made of moulded non-inflammable plastic material. The terminal block shall have marking strips and all terminals shall be clearly marked with identification number or letters to facilitate

connection to the external wiring.

5.4 At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

5.5 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.
- All other circuits: minimum of one of 2.5mm Sq. Copper.

5.6 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.

5.7 Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallel and close proximity along each side of the wiring-duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the Owner's external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.

5.8 The number and sizes of the Owner's multi core incoming external cables will be furnished to the Contractor after placement of the order. All necessary cable terminating accessories such as gland plates, supporting clamps & brackets, wiring troughs and gutters etc. (except glands & lugs) for external cables shall be included the scope of supply.

6.0 PAINTING

6.1 All sheet steel work shall be phosphated in accordance with the IS: 6005 "Code of practice for phosphating iron and steel".

6.2 Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.

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

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

6.5 The phosphate coating shall be sealed with application of two coats of ready mixed, stoved type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

6.6 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting. The exterior colour of paint shall be of a slightly different shade to enable inspection of the painting.

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

6.8 The finished painted surface of panels shall present aesthetically pleasing appearance free from dents and even surface.

6.9 In case the bidder proposes to follow any other established painting procedure like electrostatic painting, the procedure shall be submitted for DTL's review and approval.

7.0 NAME PLATES AND MARKINGS

7.1 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.

7.2 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.

7.3 All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.

7.4 Name Plates shall be made of non-rusting metal or 3 ply lamicoid. Name plates shall have white engraving letters on black or dark blue background. The labels designation and the size of the lettering the labels shall be subject to approval of the purchaser.

7.5 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.

7.6 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.

8.0 MISCELLANEOUS ACCESSORIES

8.1 **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.

8.2 **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.

8.3 **Switches and Fuses**: Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breakers (MCB). Selection of the main and sub-circuit MCB rating shall be such as to ensure selective clearance of sub-circuit faults. MCBs shall confirm to IS: 13947. Each MCB shall be provided with one potential free contact and the same shall be wired for annunciation purpose. MCBs shall have imprints of the 'rating' and 'voltage'.

8.4 **Space Heater:** Each panel shall be provided with a space heater rated for 240V, single phase, 50 Hz AC supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit.

8.5 **ENERGY METERS: -** ABT meters (Microprocessor-based 3 Phase, 4 wire bi directional TriVector meter) of 0.2 accuracy class with open communication protocol (DLMS) of reputed make shall be supplied for each line protection panel and transformer panel for metering purpose. They shall be type tested as per IS / IEC. Details of the same shall be submitted to the Employer.

9.0 EARTHING

9.1 All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq. mm perforated copper with threaded holes at a gap of 50mm with a provision of bolts and nuts for 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.

9.2 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.

9.3 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. Earthing wire shall be connected on terminals with suitable clamp connectors and soldering shall not be permitted.

9.4 Looping of earth connections which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. Earthing may be done in such a manner that no circulating current shall flow in the panel.

9.5 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.

9.6 An electrostatic discharge point shall be provided in each panel connected to earth bus via 1 Mega Ohm resistor.

10.0 RELAYS

10.1 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.

10.2 All main protective relays shall be of numerical type and communication protocol shall be as per IEC 61850. Further, the test levels of EMI as indicated in IEC 61850 shall be applicable to these. All the relays shall be directly connected to the inter bay bus using fiber optic cables and shall support peer to peer communication. The relay shall generate GOOSE message as per IEC 61850 standards for interlocking and shall also ensure interoperability with 3rd Party relays. Each relay shall also generate an ICD file in XML format for engineering / integration to a vendor independent SCADA System. The relays should have a port for local communication for relay settings, modifications etc.

10.3 All the relays should have time synchronization facility and shall be connected with existing time synchronizing equipment available with DTL, with the available signals like

PPS, PPM, IRIG-B, potential free contact etc.

10.4 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.

10.5 All A C operated relays shall be suitable for operation at 50 Hz. A C 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.

10.6 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. Relay case size shall be chosen so as not to introduce any limitation on the use of available contacts of the relay.

10.7 All protective relays, auxiliary relays and timers except the lock out relays, master relay and interlocking relays specified shall be provided with self-reset type contacts. All protective relays and timers shall be provided with externally hand reset positive action operation indicators with inscription. All protective relays which do not have built-in hand-reset operation indicators shall have additional auxiliary relays with operating indicators (Flag relays) for this purpose. Similarly, separate operating indicator (auxiliary relays) shall also be provided in the trip circuits of protections located outside the board such as Buchholz relays, oil and winding temperature protection, sudden pressure devices, fire protection etc.

10.8 Timers shall be electronic/digital or software base timer. Time delay in terms of milliseconds obtained by the external capacitor resistor combination is not preferred and shall be avoided .

10.9 No control relay which shall trip the power circuit breaker when the relay is de-energised shall be employed in the circuits.

10.10 Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

10.11 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).

10.12 All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

10.13 Any alternative/additional protections or relays considered necessary for providing complete effective and reliable protection shall also be offered separately. The acceptance of this alternative/ additional equipment shall lie with the DTL.

10.14 The bidder shall include in his bid a list of installations where the relays quoted have been in satisfactory operation.

10.15 All devices required for correct operation of each relay shall be provided. The supplier shall ensure that all terminals and the contacts of the relays are readily brought out for connections as required in the final approval scheme. The type of the relay case size offered shall not create any restriction on the availability of contact terminals for wiring connections.

10.16 All relays and their drawings shall have phase indications as R-Red, Y-Yellow, B-blue.

10.17 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. The copy of software (2 Nos.) is to be supplied to protection department & substation under execution.

b) The relay shall have suitable communication facility for future connectivity to SCADA. The relay shall be capable of supporting IEC 61850 protocol.

c) Manuals for all relays (both Soft & Hard copy) and Computer manuals are to be supplied at every sub-station and 4 copies in Protection department and one copy each in Planning

department and C&MM department. 2 nos. copies of complete system files after testing & commissioning is to be supplied to protection department & substation under execution.

11.0 TRANSMISSION LINE PROTECTION

11.1 The line protection relays are required to protect the line and clear the faults on line within shortest possible time with reliability, selectivity and full sensitivity to all type of faults on lines. The general concept is to have two fast operating distance protection scheme preferably with two different make for 400 kV system. In case of 220 kV system, one fast operating distance & one fast operating current differential protection scheme be adopted. The Main-I and Main-II will generally be operated from signal from different cores of line VT. In case line VT is out due to any reason manual selection for Bus VT will be made. The Main-I and Main-II protections having equal performance requirement specially in respect of time as called for Main-I and Main-II for 400 & 220KV transmission lines. In case of 220KV O/H lines and XLPE cables Distance protection will be used as Main-I whereas the current differential protection will be used as Main-II protection. For 220 kV XLPE cable auto reclosing feature is not required whereas for 220 kV O/H lines auto reclosing feature is required. For current differential protection, the current differential relay at both ends should match with each other. The general concept is to have Main (distance protection) and back up protection for 66 kV & 33 kV line feeders. The supply of remote end differential relay is in the scope of bidder. The installation and integration of relay of existing remote end in panel/SAS shall be in the scope of bidder.
Communication is direct relay to relay communication through single mode FO cable. FO cable inside the substation and FODB alongwith patch chord at local end remote ends are in bidder's scope.

11.2 The Transmission system for which the line protection equipment are required is shown in the reference drawing/document(s). The length of lines and the line parameters (Electrical Constants) shall be provided during detailed engineering.

11.3 The maximum fault current could be as high as 40 kA for 400 kV and 220 kV system and 31.5 KV for 66 KV and 33 kV, 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.

11.4 The protective relays shall be suitable for use with capacitor voltage transformers having non-electronic damping and transient response as per IEC.

11.5 Disturbance Recorder, Distance to fault Locator and Over voltage relay (stage -1) functions if offered as an integral part of line protection relay, shall be acceptable provided these meet the technical requirements as specified in the respective clauses.

11.6 Auto reclose relay function if offered as an integral part of line distance protection relay, shall be acceptable provided the auto reclose relay feature meets the technical requirements as specified in the respective clause.

11.7 The following protections shall be provided for each of the Transmission lines:

For 400 KV

Main-I: Numerical distance protection scheme (with back up IDMT earth fault protection)

Main-II: Numerical distance protection scheme (with back up IDMT earth fault protection) of a different make from that of Main-I

For 220KV

Main-I: Numerical distance protection scheme (with back up IDMT earth fault protection)

Main-II: Line current differential protection scheme

For 66KV & 33 KV

Main: Numerical distance protection scheme

Back up: Directional over current and Earth fault Protection

11.8 The detailed description of the above line protections is given here under:

11.8.1 **Numerical Distance Protection scheme:**

(a) Shall be numerical type and 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 five independent zones.

(d) Shall have quadrilateral or Polygonal shaped characteristics.

(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 400 KV & 220 KV lines:

Descriptions	For 400kV & 220 kV
Source to Impedance ratio	4
Relay setting (Ohms)	10 or 20
Fault Locations (as % of relay setting)	50
Fault resistance (Ohms)	0
Maximum operating time (Milliseconds)	40 for all faults

ii) for 66 kV & 33 kV lines:
For 66 kV & 33 kV lines maximum operating time is 45 ms for 3 ph. Faults & 60 ms for all other faults

(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 independent time setting range of 0-5 sec for all five zones.

(h) Shall have resetting time of less than 55 milli-seconds (including the resetting time of trip relays).

(i) Shall have variable residual compensation.

(j) Shall have memory circuits with defined characteristics in all three phases to ensure correct operation during close-up 3 -phase faults and other adverse conditions and shall operate instantaneously when circuit breaker is closed to zero-volt 3 phase fault.

(k) Shall have weak end in-feed feature.

(l) Shall be suitable for single and three phase tripping.

(m) Shall have a continuous current rating of two times of rated current. The voltage circuit shall be capable of operation at 1.2 times rated voltage. The relay shall also be capable of carrying a high short time current of 70 times rated current without damage for a period of 1 sec.

(n) Shall be provided with necessary self reset type trip duty contacts for completion of the scheme (Minimum number of these trip duty contacts shall be four per

phase) through built in high speed trip relays. Making capacity of these trip contacts shall be 30 Amp for 0.2 seconds with an inductive load of L/R > 10 mill seconds.

(o) Shall be suitable for use in permissive under reach / over reach /blocking communication mode.

(p) Shall have suitable number of potential free contacts for Inter Tripping, Auto reclosing, CB failure, Event Logger, Disturbance recorder & Data acquisition system.

(q) Include power swing blocking protection which shall
- Have suitable setting range to encircle the distance protection described above.
- Block tripping during power swing conditions.
- Release blocking in the event of actual fault

(r) Include fuse failure protection which shall
- Monitor all the three fuses of V.T. and associated cable against open circuit.
- Inhibit trip circuits on operation and initiate annunciation.
- Have an operating time less than 7 milliseconds
- Remain inoperative for system earth faults

(s) Include a directional back up Inverse Definite Minimum Time (IDMT) earth fault relay with normal inverse characteristics as per IEC 60255-3 as a built in feature

(t) Must have a current reversal guard feature. Must also have module for Tx and Rx for interconnection with other end relay through fibre optic cable. Relay must be able to send and receive three independent codes.

(u) Must have SOTF (Switch on to Fault) feature

11.8.2 **Numerical Line Current Differential Scheme:**

(a) Shall be phase segregated current line differential protection scheme.

(b) For overhead lines and cables for short length for primary ckt.

(c) Shall have high sensitivity for differential current below the minimum line loading of 20%.

(d) Suitable for single and three phase tripping.

(e) Shall be suitable for different CT ratio of the CTs provided at the terminals of the line.

(f) Shall be non-operative for transient cable/line charging current without affecting the sensitivity of the relay.

(g) Shall have high stability for high through fault currents.

(h) Shall have measurement of delay time to remote line terminals for dynamic compensation of delay in differential measurement.

(i) Shall have CT Secondary current supervision.

(j) Shall have Continuous self monitoring and diagnostic feature.

(k) Potential free binary contacts shall be wired as per requirement for Inter Tripping, Auto reclosing, direct trip, CB failure, Disturbance recorder & Data acquisition system (These contacts are included in the total no of contacts).

(l) Shall have facility for selecting synchronizing or dead line charging features.

(m) Shall be based on IEC 61850 and should be communicable through direct fiber optic as well as through multiplexers.

(n) Shall be suitable for Direct inter tripping.

(o) Measurement:

The relay shall have the following measurements:
Local and remote phase current
Local neutral current
Phase bias and differential currents.
Sequence currents.
Thermal state.

The relay shall provide protection signaling supervision indicating the following parameters:

Channel propagation delay.
Channel status.
Number of valid and error messages.

(p) In Case of communication failure, relay shall work as Numerical Distance Protection scheme with all features mentioned in Distance relay specifications.

11.8.3 **Numerical Back-up directional 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 100-2000 % of rated current.
- Have a characteristic angle of 30/45 degree .
- Include self / electrical 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 10-1000 % of rated current.
- Have a characteristic angle of 45/60 degree lag.
- Include self/ electrical reset flag indicators or LEDs.
- Have internal feature in the relay for open delta voltage to the relay.

11.8.4 All trip relays used in transmission line protection scheme shall be of self/electrical reset type depending on application requirement.

12.0 Circuit Breaker Protection

This shall include following function:

12.1 **AUTO RE CLOSING RE LAY** shall be separate from Main-I and Main-II protection. However, auto reclose as inbuilt function of bay controller unit (BCU) provided for substation automation is acceptable. The auto reclose shall

(a) Have single phase or/and three phase reclosing facilities.

(b) Have a continuously variable single phase dead time range of 0.1-2 seconds.

(c) Have a continuously variable three phase dead time range of 0.1-2 seconds.
(d) Have a continuously variable reclaim time range of 5-25 seconds.

(e) Have facilities for selecting check synchronizing or dead line charging features. It shall be possible at any time to change the required feature by reconnection of links.

(f) Have priority circuit to closing of both circuit breakers in case one and half/double breaker arrangements for 400 kV to allow sequential closing of breakers

(g) Include check synchronizing relay which shall

- Have a time setting continuously variable between 0.5 -5 seconds with a facility of additional 10 seconds.
- Have a response time within 200 milli seconds with the timer disconnected.
- Have a phase angle setting not exceeding 35 degree
- Have a voltage difference setting not exceeding 10%

(h) Include dead line charging relay which shall

- Have two sets of relays and each set shall be able to monitor the three phase voltage where one set shall be connected to the line CVTs with a fixed setting of 20% of rated voltage and the other set shall be connected to the bus CVTs with a fixed setting of 80% of rated voltage.
- Incorporate necessary auxiliary relays and timers to give comprehensive scheme.

12.2 **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 initiation is 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 suitable for 220 V DC supply.

12.3 **TRIP CIRCUIT SUPERVISION RELAY**

(a) The relay shall be capable of monitoring the healthiness of each 'phase' trip-coil and associated circuit of circuit breaker during 'ON' and 'OFF' conditions.

(b) The relay shall have adequate contacts for providing connection to alarm and event logger.

(c) The relay shall have time delay on drop-off of not less than 200 milli seconds and be provided with operation indications for each phase.

13.0 LINE OVER VOLTAGE PROTECTION RELAY shall

(a) monitor all three phases

(b) have two independent stages and stage- 1 & II relay are acceptable as built in with line distance relays Main I & II respectively .

(c) have an adjustable setting range of 100-170% of rated voltage with an adjustable time delay range of 1 to 60 seconds for the first stage.

(d) Have an adjustable setting range of 100-170% of rated voltage with a time delay of 100-200 milliseconds for the second stage.

(e) be tuned to power frequency

(f) Provided with separate operation indicators (flag target) for each stage relays.

(g) Have a drop-off to pick-up ratio greater than 95%.

(h) provide separate output contacts for each 'Phase' and stage for breaker trip relays, event logger and other scheme requirements.

14.0 TRANSFORMER PROTECTION

14.1 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) shall be numerical type and shall have continuous self monitoring and diagnostic feature.

(j) have a disturbance recording feature to record graphic form of instantaneous values of current in all three windings in nine analogue channels in case of 400kv class and above transformers and 6 analogue channels for lower voltage transformers , during faults and disturbances for the pre fault and post fault period. The disturbance recorder shall have the facility to record the following external digital channel signals apart from the digital signals pertaining to differential relay.

i. REF protection operated
ii. HV breaker status
iii. LV breaker status
iv. Buchholz /OLTC Buchholz alarm / trip
v. WTI/OTI/PRD alarm/trip of transformer

Necessary hardware and software for down loading the data captured by disturbance recorder to the personal computer or work station available in the substation shall be included in the scope.

14.2 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.

(h) Be acceptable as a built in feature of numerical transformer differential relay

14.3 Numerical Restricted Earth Fault Protection shall

(a) Be single pole type

(b) Be of current/voltage operated high impedance type

(c) Have a current setting range of 10 -40% of 1 Amp./ have a suitable voltage setting range.

(d) Be tuned to the system frequency

(e) have suitable non-linear resistor to limit the peak voltage to 1000 Volts.

14.4 Numerical Back-up Over Current and Earth fault protection scheme with high set feature

(a) Shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s).

(b) The scheme shall include necessary VT fuse failure relays for alarm purposes

(c) Over current relay shall

- have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current
- have low transient, over reach high set instantaneous unit of continuously variable setting range 500-2000 % of rated current
- have a characteristic angle of 30/45 degree lead
- include self/ electrical 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 self/ electrical reset flag indicators or LEDs
- include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay.

14.5 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%.

(f) be acceptable as built in feature of numerical transformer differential relay

15.0 TRIPPING RELAY

High Speed Tripping Relay shall

(a) Be instantaneous (operating time not to exceed 10 milliseconds).

(b) Reset within 20 milliseconds

(c) Be D.C. operated

(d) have adequate contacts to meet the requirement of scheme, other functions like auto-reclose relay, LBB relay as well as cater to associated equipment like event logger, Disturbance recorder, fault Locator, etc.

(e) Be provided with operation indicators for each element/coil.

16.0 FLAG RELAYS

These shall have

(a) self/ electrical reset flag indication

(b) have minimum 4NO and 1 NC or combination as required for each relay.

17.0 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 milliseconds and be provided with operation indicator/flag.

18.0 BUS BAR PROTECTION (For New & Replacement of Whole Scheme)

18.1 Redundant (1+1) numerical Bus Bar protection scheme for each bus system (Bus1 +Bus2) for 400kV shall be provided**.** The scheme shall be engineered so as to ensure that operation of any one out of two schemes connected to main faulty bus shall result in tripping of the same.

18.2 Single bus bar protection scheme shall be provided for each bus for 220KV voltage level.

18.3 Distributed/ Decentralized bus-bar protection shall be provided. Local Breaker Backup Protection as inbuilt feature of Bus Bar Protection Relay is acceptable.

18.4 Each Bus Bar protection scheme shall

(a) Have maximum operating time up to trip impulse to trip relay for all types of faults of 25 milliseconds at 5 times setting value.

(b) Operate selectively for each bus bar

(c) Give hundred percent securities up to 40 KA fault level for 400KV and 220KV

(d) Incorporate continuous supervision for CT secondary against any possible open

circuit and if it occurs, shall render the relevant zone of protection inoperative and initiate an alarm

(e) Not give false operation during normal load flow in bus bars.

(f) Incorporate clear zone indication.

(g) Be of phase segregated and triple pole type

(h) Provide independent zones of protection (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. Separate relays for separate bus-bar protection scheme so as to achieve independent protection scheme.

(i) include individual high speed electrically reset tripping relays for each feeder.

(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. Bidder 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 required to provide a Bus-bar protection scheme for the complete bus arrangement i.e. for all the bay or breakers under this specification as well as for the future bays as per the Single line diagram for new substations. However for extension of bus bar protection scheme (if specified) in existing substations, scope shall be limited to the bay or breakers covered under this specification. Suitable panels to mount these are also included in the scope of the work.

(p) Shall have disturbance recorder.

Built-in Local Breaker Backup protection feature as a part of bus bar protection scheme shall also be acceptable.

18.5 At existing substations, Bus-bar protection scheme with independent zones for each bus will be available. All necessary co-ordination for 'AC' and 'DC' interconnections between existing schemes (Panels) and the bays proposed under the scope of this contract shall be fully covered by the bidder. Any auxiliary relay, trip relay, flag relay and multi tap auxiliary CTs (in case of biased differential protection) required to facilitate the operation of the bays covered under this contract shall be fully covered in the scope of the bidder.

(a) The test terminal blocks (TTB) to be provided shall be fully enclosed with removable covers and made of moulded, non-inflammable plastic material with boxes and barriers moulded integrally. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring. Terminal block shall have shorting, disconnecting and testing facilities for CT circuits.

18.6 The Bus-bar protection scheme shall be of low impedance and distributed type scheme.

19.0 DISTURBANCE RECORDER

19.1 Disturbance recorder shall be microprocessor based and shall be used to record the graphic form of instantaneous values of voltage and current in all three phases, open delta voltage & neutral current, open or closed position of relay contacts and breakers during the system disturbances and built in feature of line distance/ line current differential/ transformer current differential / Bus bar protection relay is acceptable provided the requirements of following clauses are met.

19.2 The disturbance recorder shall consist of individual acquisition units, one for each feeder and an Evaluation unit which is common for the entire Substation. Whenever, more than one acquisition units are connected to an Evaluation unit, necessary hardware and software shall also be supplied for on line transfer of data from all acquisition units to Evaluation unit. If there are any constraints for one Evaluation unit to accept the data from number of acquisition units under the present scope, adequate number of Evaluation units shall be supplied. In case of extension of existing substation(s), one set of Evaluation unit shall be supplied for each substation where ever disturbance recorders are specified.

19.3 Disturbance recorder shall have 8 analog and 16 digital channels for each feeder.

19.4 Acquisition units shall acquire the fault data for the pre fault and post fault period and transfer them to Evaluation unit automatically to store in the hard disk. The acquisition units shall be located in the protection panels of the respective feeders.

19.5 The acquisition unit shall be suitable for inputs from current transformers with 1A rated secondary and capacitive voltage transformers with 63.5V (phase to neutral voltage) rated secondary. Any device required for processing of input signals in order to make the signals compatible to the Disturbance recorder equipment shall form an integral part of it. However, such processing of input signals shall in no way distort its waveform.

19.6 The equipment shall be carefully screened, shielded, earthed and protected as may be required for its safe functioning. Also, the disturbance 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.

19.7 The Evaluation unit shall consist of a desktop personal computer (including TFT colour monitor, mouse and keyboard) and printer. The desktop PC shall be of latest configuration.

19.8 Necessary software for transferring the data automatically from local evaluation unit to a remote station and receiving the same at the remote station through owner's PLCC/VSAT/LEASED LINE shall be provided.

19.9 Evaluation software shall be provided for the analysis and evaluation of the recorded data made available in the PC under DOS/WINDOWS environment. The Software features shall include repositioning of analog and digital signals, selection and amplification of time and amplitude scales of each analog and digital channel, calculation of MAX/MIN frequency, phase difference values, recording of MAX/MIN values etc. of analog channel, group of signal to be drawn on the same axis etc, listing and numbering of all analog and digital channels and current, voltage, frequency and phase difference values at the time of fault/tripping. Also, the software should be capable of carrying out Fourier /Harmonic analysis of the current and voltage wave forms. The disturbance records shall also be available in COMTRADE format (IEEE standard-

Common Format for Transient data Exchange for Power System)

19.10 The Evaluation unit shall be connected to the printer to obtain the graphic form of disturbances whenever desired by the operator.

19.11 Disturbance recorder acquisition units shall be suitable to operate from 220V DC as available at sub-station. Evaluation unit along with the printer shall normally be connected to 240V, 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.

19.12 The acquisition unit shall have the following features

(a) Facility shall exist to alarm operator in case of any internal faults in the acquisition units such as power supply fail, processor / memory fail etc and same shall be wired to annunciation system.

(b) The frequency response shall be 5 Hz on lower side and 250 Hz or better on upper side.

(c) Scan rate shall be 1000 Hz/channel or better.

(d) Pre-fault time shall not be less than 100 milliseconds and the post fault time shall not be less than 2 seconds (adjustable). If another system disturbance occurs during one post-fault run time, the recorder shall also be able to record the same. However, the total memory of acquisition unit shall not be less than 5.0 seconds.

(e) The open delta voltage and neutral current shall be derived either through software or externally by 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 Auto reclosed operated
7. Over Voltage -Stage-1 /2 operated
8. Stub/ 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 circuit breaker

(g) In case the disturbance recorder is in-built part of line distance/ line current differential/ transformer current differential / Bus bar 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.

19.13 The printer shall be compatible with the desktop PC and shall use Plain paper. The print out shall contain the Feeder identity, Date and time (in hour, minute and second up to 100th of a second), identity of trigger source and Graphic form of analogue and digital signals of all the channels. Two packets of paper (500 sheets in each packet) suitable for

printer shall be supplied.

19.14 Each Disturbance recorder shall have its own time generator and the clock of the time generator shall be such that the drift is limited to ±0.5 seconds/day, if allowed to run without synchronization. Further, Disturbance recorder shall have facility to synchronies its time generator from Time Synchronisation Equipment having out put generator from Time Synchronization Equipment/ GPS 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
- RJ-45/Ethernet

20.0 DISTANCE TO FAULT LOCATOR

(a) Be electronic or microprocessor based type.

(b) Be 'On-line' type

(c) Be suitable for breaker operating time of 2 cycles

(d) Have built-in display unit

(e) The display shall be directly in percent of line length or kilometers without requiring any further calculations

(f) have an accuracy of 3% or better for the typical conditions defined for operating timings measurement of distance relays.

(g) The above accuracy should not be impaired under the following conditions:

- presence of remote end infeed
- predominant D.C. component in fault current
- high fault arc resistance
- severe CVT transients

(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.

21.0 TIME SYNCHRONISATION EQUPMENT (if applicable)

21.1 The Time synchronisation equipment shall receive the coordinated Universal Time (UTC) transmitted through Geo Positioning Satellite System (GPS) and synchronise equipments to the Indian Standard Time in a substation. For new substation, supply of GPS time synchronizing equipment is in bidder's scope.

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

21.3 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.

21.4 Equipment shall operate up to the ambient temperature of 50 degree centigrade and 100% humidity.

21.5 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).

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

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

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

21.9 The equipment offered shall have six (6) output ports. Various combinations of output ports shall be selected by the customer, during detailed engineering, from the following:

- Voltage signal : Normally 0-5V with 50 milliseconds minimum pulse duration. In case any other voltage signal required, it shall be decided during detailed engineering.
- Potential free contact (Minimum pulse duration of 50 milli Seconds.)
- IRIG-B
- RS232C

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

21.11 Time synchronization equipment shall be suitable to operate from 220V DC as available at Substation.

21.12 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.

22.0 RELAY TEST KIT (If specified in BOQ)

One automatic relay test kit suitable for both steady state and dynamic testing of all types of relay (voltage, current, frequency, distance and differential) electromechanical/static/numerical/along with inbuilt HMI/ separate laptop all accessories, test leads, carrying case etc. shall be supplied by bidder. The make of the test set shall be approved by DTL before placement of order. It should be suitable for testing of relay supplied.

23.0 TYPE TESTS

23.1 All equipment and components shall be subjected to routine tests and type tests according to relevant standards and such other tests as may be required to ensure that all equipment and component are satisfactory and in accordance with the specification. Any modification required in the testing procedure shall be made as directed by the purchaser at no additional cost to the purchaser. No equipment shall be dispatched from the manufacture works before the relevant tests reports have been approved by the purchaser.

23.2 The reports for following type tests shall be submitted by the bidder for the Protective relays, Fault locator, Disturbance recorder and Event Logger.

(a) Insulation tests as per IEC 60255-5

(b) High frequency disturbance test as per IEC 60255-4 (Appendix -E) Class III (not

applicable for electromechanical relays)

(c) Fast transient test as per IEC 1000-4, Level III (not a pplicable for electromechanical relays)

(d) Relay characteristics, performance and accuracy test as per IEC 60255

- Steady state Characteristics and operating time
- Dynamic C haracteristics a nd ope rating t ime f or di stance pr otection r elays and current differential protection relays
- For D isturbance r ecorder and Event l ogger onl y performance t ests ar e intended under this item.

(e) Tests for thermal and mechanical requirements as per IEC 60255-6

(f) Tests for rated burden as per IEC 60255-6

(g) Contact p erformance test as per I EC 60255 -0-20 (not applicable for E vent logger, Distance to fault locator and Disturbance recorder).

23.3 Steady s tate & D ynamic cha racteristics t est r eports o n the di stance pro tection relays, as type test, shall be based o n test programme spe cified in Appendix A on simulator/network ana lyzer/PTL. Alternatively, the files g enerated using E lectromagnetic transient P rogramme (EMTP) can also be us ed for carrying out t he ab ove t ests. Single source dy namic t ests on transformer di fferential relay sha ll b e/ s hould have be en 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.

24.0 CONFIGURATION OF RELAY & PROTECTION PANELS

The following is the general criteria for the selection of the equipments to be provided in each type of panel.

LINE PROTECTION PANEL

The L ine P rotection pa nel for t ransmission l ines sh all consist o f f ollowing r elays and protection schemes.

S.No.	Description	400 kV	220kV	66 kV	33 kV
1	Main-1 N umerical D istance pr otection scheme	1 No.	1 No.	1 No.	1 No.
2	Main-2 N umerical D istance pr otection scheme	1 No.	NIL	NIL	NIL
3	Main-2 N umerical C urrent D ifferential protection scheme	NIL	2 Nos.*	NIL	NIL
4	Over Voltage Protection Scheme	1 No.	1 No.	NIL	NIL
5	Disturbance Recorder	1 No.	1 No.	1 No.	1 No.
6	Distance to fault Locator	1 No.	1 No.	1 No.	1 No.
7	3 phase Trip Relays	2 Nos	2 Nos	2 Nos	2 Nos
8	Flag relays , carrier receive relays, aux. Relays timers e tc as pe r scheme Requirements	Lot	Lot	Lot	Lot
9	Under V oltage r elay f or i solator/earth switch	2 Nos	2 Nos	2 Nos	2 Nos
10	ABT m eters (Microprocessor-based 3	1 No.	1 No.	1 No.	1 No.

	Phase, 4 wire b i d irectional TriVector meter) of 0.2 accuracy cl ass w ith open communication pr otocol (DLMS) - 02 nos. (one main & one check meter) along with TTB				
11	Teed protection for 5 CT scheme in one & half breaker schemes	2 Nos	NIL	NIL	NIL
12	Directional back up O ver current and E/F protection scheme	1 No.	NIL	1 No.	1 No.

In a substation where 400kV and 220 KV lines are under the scope of the contract, bidder is required to give identical Main 1 and main 2 distance/current differential protection scheme for both voltage levels.

NOTE: The configuration of control and relay panel may be reviewed by the bidder considering requirements of the different clauses of the NIT document.

* 02 Nos. current differential relays of same make & type, one for local & other for remote end.

TRANSFORMER PROTECTION PANEL

The protection panel for Auto transformer/Transformer shall consists of the following equipments:

S. No.	**Description**	**HV side**	**MV/LV side**
1	Transformer Differential Protection scheme	1 Nos.	Nil
2	Restricted Earth fault protection scheme 1 Nos. 1 no@ @ Not applicable for autotransformer		
3	Directional back up O/C and E/F relay with non directional high set feature	1 No.	1 No.
4	Over Fluxing Protection scheme 1 Nos. 1 no.$ $ applicable only for 400/220kV Transformer		
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	Flag relays, aux relays, timers etc as per scheme requirement including transformer alarms and trip functions	Lot	Lot
9	ABT meters (Microprocessor-based 3 Phase, 4 wire bi directional TriVector meter) of 0.2 accuracy class with ope n c ommunication pr otocol (DLMS) along with TTB	1 No.	2 Nos.

Bus Coupler Protection Panel

A Protection Panel for Bus Coupler shall consist of following equipments:

S. No.	Description	400 KV	220 KV	66 KV	33 KV
1	IDMT over current & earth fault relays	1 set	1 set	1 set	1 set
2	DC Supply Supervision Relays	2 Nos.	2 Nos.	2 Nos.	2 Nos.
3	CT Switching Relays (if applicable)	1 set	1 set	1 set	1 set
4	Trip Circuit Supervision Relay	6 nos.	6 nos.	3 nos.	3 nos.
5	Flag R elays, Auxiliary R elays, Timers, Trip Relays etc. as per scheme requirement	Lot	Lot	Lot	Lot
6	PT Fuse Failure Relays	1 set	1 set	1 set	1 set

BREAKER RELAY PANEL

For 66 & 33 kV system, separate breaker relay panel is not required. However, relay from serial no. 2 to 5 should be installed on main protection panel (Line/ Transformer). The breaker relay panel for 400 & 220 kV 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 with check synchronizing and dead line charging relay	1 Nos.	NIL
5	Flag relays, aux relays, timers, trip relays as per scheme requirements.	Lot	Lot

Trip supervision relays shall be 2 numbers for each 66 KV & 33 KV Circuit Breaker

25.0 ERECTION AND MAINTENANCE TOOL EQUIPMENTS

All special testing equipment/ tools required for the installation and maintenance of the apparatus, instruments devices shall be furnished in relevant schedule.

26.0 TROPICALISATION

Control room will be normally air-cooled/air- conditioned. All equipments shall however be suitable for installation in a tropical monsoon area having hot, humid climate and dry and dusty seasons with ambient conditions specified in the specification. All control wiring, equipment and accessories shall be protected against fungus growth, condensation, vermin and other harmful effects due to tropical environment.

APPENDIX-A

TEST PROGRAMME FOR DISTANCE RELAYS

General Comments:

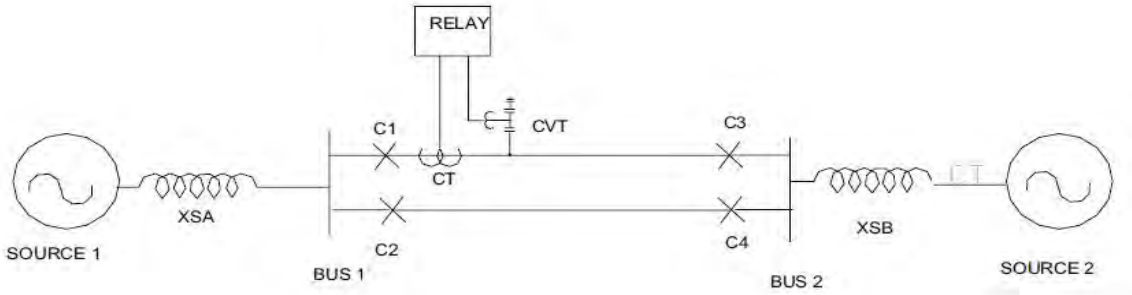
1. These test cases are evolved from the report of working group 04 of study committee 34 (Protection) on evaluation of characteristics and performance of power system protection relays and protective systems. For any further guidelines required for carrying out the tests, reference may be made to the above document.
2. The test shall be carried out using network configuration and system parameters as shown in the figure-1
3. All denotations regarding fault location, breakers etc are referred in figure –1
4. The fault inception angles are referred to R- N voltage for all types of faults
5. The fault inception angle is zero degree unless otherwise specified.
6. Where not stated specifically, the fault resistance (Rf) shall be zero or minimum as possible in simulator
7. Single pole circuit breakers are to be used
8. The power flow 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)



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	3.630 μ mho

succeptance (b1)	

Type of line	Short		Long
Secondary l ine impedance	2 Ω		20 Ω*
Length of l ine in Kms	23.57		235.7
SIR	4	15	4
Source i mpedance (pry) (at a Time constant of 50 ms)	29.09 Ω (5500 MVA)	109.09 Ω (1467 MVA)	290.9 Ω (550 MVA

* Alternatively, the tests can be done with 10 Ω secondary impedance and source impedance may accordingly be modified.

CVT Model

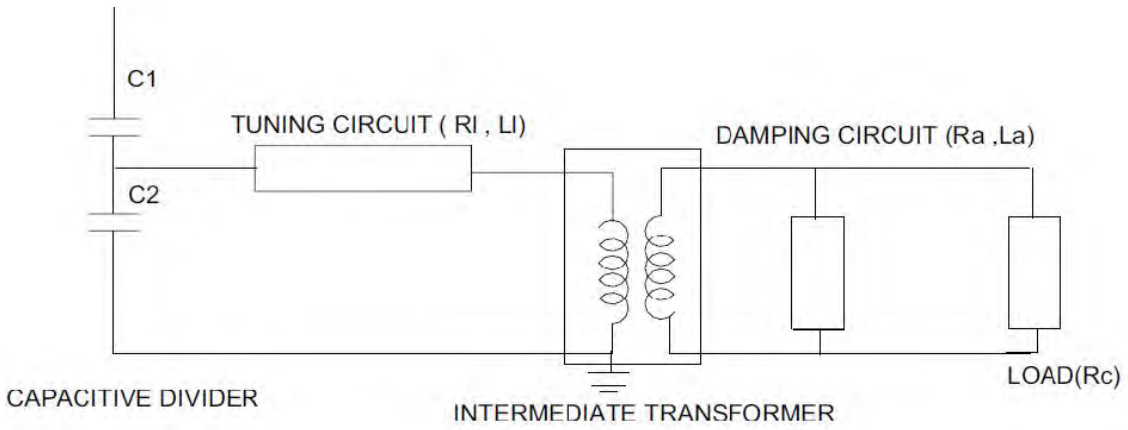


Figure-2

XC1	1.455 μ mho
XC2	27.646 μ mho
Rl	320 Ω
XLl	34243 Ω
Ra	4.200 Ω
Xla	197.92 Ω
Rc	14.00 Ω
Transformation ratio of Intermediate transformer	181.8

DETAILS OF FAULT CASES TO BE DONE

Sl No	Description	Single source with short line(2 Ω)		Single source long	Double source with short double line (2 Ω)	Double source with long single line (20 Ω)□
		CLOSE C1, OPEN C2,C3,C4		CLOSE C1, OPEN C2,C3,C4	CLOSE C1, C2,C3,C4	CLOSE C1,C3 OPEN C2,C4
		SIR=4	SIR=15	SIR =4	SIR = 4	SIR=4
1	Dynamic accuracy for zone 1	Tests to be done at 2 locations (84 % and 76 % of line length) X 4 faults (RN , YB, 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 % and76 % of line length) X 4 faults (RN , YB, YBN, RYB) X 2 Fault inception angle(0°,90°)= 16cases		Tests to be done at 2 locations (84%and 76% of line length) X4 faults (RN ,Y B, YBN,RYB) X 2f ault 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°) = 8	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 I I and Zone III	Tests to be done at 1 location (100 % of line length) X 1 faults (RN, YB, YBN, RYB) X 2 zones (II and III) = 2 cases	Tests to be done at 1 location (100 % of line length) X 1 faults (RN , YB, YBN, RYB) X 2 zones (II and III) = 2 cases	Tests to be done at 1 location (100 % of line length) X 1 faults (RN , YB, YBN, RYB) X 2 Zones (II and III) = 2 cases		

4	Switch on to fault feature			Tests to be done at 2 location (0 % and 32 %) X 1 faults (RYB) Any fault inception angle = 2 cases		
5	Operation during current reversal				Tests to be done at 2 location (0 % and 80 % of line length) X 1 faults (RN) X 1 fault inception angle (0 degrees)= 2 cases	
		CLOSE C1, OPEN C2,C3,C4		CLOSE C1, OPEN C2,C3,C4	CLOSE C1, C2,C3,C4	CLOSE C 1, C3, OPEN C2, C4
		SIR=4	SIR=15	SIR =4	SIR = 4	SIR=4
6	Operation at simultaneou s 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	Directiona l sensitivity					Tests to be done at 1 location (0% reverse) X 6 faults (RN,YB, YBN , RYB,RN with Rf=13.75 ohm(sec) and RYN wi th Rf= 13.75 Ohm (sec) X 2

						fault inception angle (0° ,90°)= 12 cases
8	Limit for fault resistance					Tests to be done at 2 location (0% and 68 % of line le ngth) 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% o f 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 f or all cas es 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 1ocation for all cases unde r 2, 7 and 9

SECTION-XV

POWER & CONTROL CABLE

SECTION : 15

POWER & CONTROL CABLES

1.0 1.1 KV GRADE POWER & CONTROL CABLES

1.1. CRITERIA FOR SELECTION OF POWER & CONTROL CABLES

1.1.1. Aluminium conductor XLPE insulated armored cables shall be used for main power supply purpose from LT Aux. Transformers to control room.

1.1.2 Aluminium conductor PVC insulated armored power cables shall be used for various other applications in switchyard area/control room except for control/protection purposes.

1.1.3 For all control/protection/instrumentation purposes PVC insulated armored control cables of minimum 2.5 sq.mm. size with stranded Copper conductors shall be used.

1.1.4 Bidders are to estimate the quantity of cables and quote accordingly. The sizes of power cables to be used per feeder in different application shall be as follows:

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	Air Conditioning Board	1-3½C X 300 mm^2	XLPE
4	Main Switch Board	Oil Filtration Unit	1-3½C X 300 mm^2	XLPE
5	AC Distribution Board	D.G. Set AMF Panel	2-3½C X 300 mm^2	XLPE
6	Main Switch Board	Lighting transformer	1-3½C X 70 mm^2	XLPE
7	Lighting transformer	Main Lighting DB	1-3½C X 70 mm^2	XLPE
8	AC Distribution Board	Emergency Lighting Transformer	1-3½C X 70 mm^2	PVC
9	Emergency Lighting transformer	Emergency Lighting DB	1-3½C X 70 mm^2	PVC
10	AC distribution Board	ICT MB	1-3½C X 70 mm^2	PVC
11	AC Distribution Board	Bay MB/LCC	1-3½C X 35 mm^2	PVC
12	AC Distribution Board	Battery Charger	Charger1-3½C X 70mm^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	1-2C X 6 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/ Sub-lighting panels	Lighting fixtures (outdoor)	1-2C X 6 mm^2	PVC
22	Bay MB	Equipments	1-4C X 16 mm^2 / 1-4C X 6 mm^2 / 1-2C X 6 mm^2	PVC
23	Air Conditioning Board	A/C unit panel	1-3½C X 70 mm^2	PVC
24	Air Conditioning Board	AHU	1-3½C X 35 mm^2	PVC
25	Air Conditioning Board	Heater	1-3½C X 35 mm^2	PVC
26	Air Conditioning Board	Chiller Pump	1-3½C X 35 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 purchaser's approval.

1.1.6 Cables shall be laid conforming to IS: 1255.

1.1.7 While preparing cable schedules for control/protection purpose following shall be ensured:

1.1.7.1 Separate cables shall be used for AC & DC.

1.1.7.2 Separate cables shall be used for DC1 & DC2.

1.1.8 For different cores of CT & CVT separate cable shall be used

1.1.9 Atleast one (1) cores shall be kept as spare in each copper control cable of 4C, 5C or 7C size whereas minimum no. of spare cores shall be two (2) for control cables of 10 core or higher size.

1.1.10 For control cabling, including CT/VT circuits, 2.5 sq.mm. size copper cables shall be used per connection. However, if required from voltage drop/VA burden consideration additional cores shall be used. Further for potential circuits of energy meters separate connections by 2 cores of 2.5 sq.mm. size shall be provided.

1.2. **TECHNICAL REQUIREMENTS**

1.2.1. **General**

1.2.1.1.The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

1.2.1.2. They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions. The XLPE /PVC insulated L.T. power cables of sizes 240 sq. mm. and above shall withstand without damage a 3 phase fault current of at least 45 kA for at least 0.12 second, with an initial peak of 105 kA in one of the phases. The armour for these power cables shall be capable of carrying 45 kA for at least 0.12 seconds without exceeding the maximum allowable temperature of PVC outer sheath.

1.2.1.3. The XLPE insulated cables shall be capable of withstanding a conductor temperature of 250°C during a short circuit without any damage. The PVC insulated cables shall be capable of withstanding a conductor temperature of 160°C during a short circuit.

1.2.1.4. The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects. All aluminium used in the cables shall be of H2 grade.

1.2.1.5. The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable.

1.2.1.6. Progressive sequential marking of the length of cable in meters at every one meter shall be provided on the outer sheath of all cables.

1.2.1.7. Strip wire armouring method (a) mentioned in Table 5, Page-6 of IS: 1554 (Part-1) 1988 shall not be accepted for any of the cables. For control cables only round wire armouring shall be used.

1.2.1.8. The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.

1.2.1.9. All the cables shall pass fire resistance test as per IS: 1554 (Part-I)

1.2.1.10. The normal current rating of all PVC insulated cables shall be as per IS: 3961.

1.2.1.11. Repaired cables shall not be accepted.

1.2.1.12. Allowable tolerance on the overall diameter of the cables shall be plus or minus 2mm.

1.2.2. **XLPE Power Cables**

1.2.2.1. The XLPE insulated cables shall be of category "C2" and type 'FR-LSH' as per IS:1554 and its amendments read alongwith this specification. The conductor shall be stranded aluminium circular/sector shaped and compacted. In multicore cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multicore cables. For XLPE cables, the inner sheath shall be of extruded PVC to type ST-2 of IS:5831. When armouring is specified for single core cables, the same shall consist of aluminium wires/strips. The outer sheath shall be extruded PVC to Type ST-2 of IS:5831 for all XLPE cables.

1.2.3. **PVC Power Cables**

1.2.3.1. The PVC (70°C) insulated 1100V grade power cables shall be of category "C2" and type 'FR-LSH' as per IS:1554 and its amendments, read alongwith this specification and shall be suitable for a steady conductor temperature of 70°C. The conductor shall be stranded aluminium. The Insulation shall be extruded PVC to type-C of IS: 5831. A distinct inner sheath shall be provided in all multicore cables.

For multicore armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-2 of IS: 5831 for all cables.

1.2.4. **PVC Control Cables**

1.2.4.1. The 1100V grade control cables shall be of category "C2" and type 'FR-LSH' as per IS:1554 and its amendments, read alongwith this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type C of IS 5831. A distinct inner sheath shall be provided in all cables whether armoured or not. The over sheath shall be extruded PVC to type ST-2 of IS: 5831 and shall be grey in colour except where specifically advised by the Owner to be black.

1.2.4.2. Cores shall be identified as per IS:1554 (Part-1) for the cables up to five (5) cores and for cables with more than five (5) cores the identification of cores shall be

done by printing legible Hindu Arabic Numerals on all cores as per clause 10.3 of IS 554 (Part-1).

2.0 HT CABLE FOR AUXILIARY POWER SUPPLY

2.1. The HT cable of 1Cx185 mm^2 (Aluminium Conductor) or 1Cx120mm^2 (Copper Conductor) of voltage class as specified for 400 kVA LT transformer for interconnecting 400kVA LT transformer shall be, XLPE insulated, armoured cable conforming to IS: 7098 (Part-II) and IEC 60502-2 1998. Terminating accessories shall conform to IEC 61442 1997/IEC 60502-4 1998.

2.2. Only overhead connection has been foreseen for interconnecting 400 kVA, LT transformer to the tertiary of the Power Transformer. However, HT cable connections in place of overhead connection, if necessary shall also be in the scope of contractor. In this case contractor shall provide 1C x 185 mm^2 (Aluminium Conductor) or 1Cx120mm^2 (Copper Conductor), 38/66kV HT cable alongwith necessary terminating accessories. The construction of XLPE insulated, armoured HT cable shall be generally conforming to IS 7098 (Part-III). Terminating accessories shall conform to IEC 60840 1999.

2.3. Bidder may offer sizes other than the sizes specified in clause 2.1 and 2.2. In such case sizing of power cables shall be done keeping in view continuous current, voltage drop & short-circuit consideration of the system. Relevant calculations shall be submitted by bidder during detailed engineering for purchaser's approval.

3.0 CABLE DRUMS

3.1. Cables shall be supplied non-returnable wooden or steel drums of heavy construction. Wooden drum shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum.

3.2. Standard lengths for each size of power and control cables shall be 500/1000 meters. The cable length per drum shall be subject to a tolerance of plus or minus 5% of the standard drum length. The owner shall have the option of rejecting cable drums with shorter lengths. However, the total quantity of cables after taking into consideration of all cable drums for each size shall be within the tolerance of ± 2%.

3.3. A layer of 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 drums shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stencilled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

3.6. Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage.

Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

4.0 TYPE TESTS

4.1. All cables shall conform to all type, routine and acceptance tests listed in the relevant IS.

4.2. The type tests on cables shall be conducted on each type and size of cables offered.

4.3. Following type tests as per IS: 7098 (Part 1) – 1988 including its amendments and additional type tests shall be carried out on 1.1 KV grade XLPE insulated cables:

a) Tests on conductor

i) Annealing test (for Copper)
ii) Tensile test (for aluminium)
iii) Wrapping test (for aluminium)
iv) Resistance test

b) Test for armouring wires/strips
c) Test for thickness of insulation and sheath
d) Physical tests for insulation
i) Tensile strength and elongation at break
ii) Ageing in air oven
iii) Hot set test
iv) Shrinkage test
e) Physical tests for outer sheath
i) Tensile strength and elongation at break
ii) Ageing in air oven
iii) Loss of mass in air oven
iv) Shrinkage test
v) Hot deformation
vi) Heat shock test
vii) Thermal stability
f) Insulation resistance (volume resistivity test)
g) High voltage test
h) Flammability test
i) Oxygen index and temperature index test on outer sheath
j) Short time current test on power cables of sizes 240 sq.mm and above.
1) On conductor(s).
2) On armours.

4.4.1 Following type tests as per IS: 1554(Part-1) including its amendments and additional type tests shall be carried out on 1.1 KV grade PVC insulated cables:

1) Tests on conductor
a) Annealing test
b) Conductor resistance test
2) Test for thickness of insulation and sheath.
3) Physical tests for insulation and outer sheath:
a) Tensile strength and elongation at break.
b) Ageing in air oven.
c) Shrinkage test.
d) Hot deformation.
e) Loss of mass in air oven.
f) Heat shock test.
g) Thermal stability
4) Insulation resistance test.
5) High voltage test (water immersion test)
6) High voltage test at room temp
7) Flammability test.
8) Tests for round steel wire armour:
a) Dimensions
b) Physical tests on round wire:
i.) Tensile strength
ii.) Elongation at break
iii.) Torsion test for round wires
iv.) Uniformity of zinc coating
v.) Mass of zinc coating

vi.) Resistivity

9) Tests for proving FR-LSH Properties of cable.
   a) Oxygen Index Test
   b) Flame Retardant Test on single cable.
   c) Flame Retardant Test on bunched cables.
   d) Test for halogen acid gas evolution
   e) Temperature Index

4.4.2 Following acceptance tests as per IS: 1554(Part-1) including its amendments and additional type tests shall be carried out on 1.1 KV grade PVC insulated cables.
   1) Annealing test
   2) Conductor resistance test
   3) Test for thickness of insulation and sheath
   4) Tensile strength and elongation at break of insulation and sheath
   5) Insulation resistance test
   6) High voltage test at room temp
   7) Oxygen Index Test
   8) Flame Retardant Test on single cable
   9) Test for halogen acid gas evolution

4.4.3 Following routine tests as per IS: 1554(Part-1) including its amendments and additional type tests shall be carried out on 1.1 KV grade PVC insulated cables.
   1) Conductor resistance test
   2) High voltage test at room temp

4.5. Following type tests as per IS: 7098 (Part 2) - 1988 including its amendments and additional type tests shall be carried out on XLPE insulated HT cable up to and including 220 KV

a) Tests on conductor
   i) Annealing test (for Copper)
   ii) Resistance test
   iii) Tensile test (for aluminium)
   iv) Wrapping test (for aluminium)

b) Physical tests for insulation
   i) Test for thickness and dimensions of insulation
   ii) Tensile strength and elongation at break
   iii) Thermal Ageing in air oven
   iv) Hot set test
   v) Shrinkage test

c) Resistivity test for semi-conducting layers

d) Test for concentric metallic screen:
   i) Test for concentric copper wire
   ii) Test for concentric copper tape

e) Thickness of metallic sheath

f) Test for armouring material:

g) Dimensions

h) Physical tests for outer sheath:
   1. Measurement of thickness
   2. PVC sheath
      i) Tensile strength and elongation at break
      ii) Ageing in air oven
      iii) Loss of mass in air oven only for PVC sheath
      iv) Heat shock test

v) Hot deformation test
vi) Shrinkage test
vii) Thermal stability

3. PE sheath
i) Carbon black content
ii) Tensile strength and elongation at break before and after ageing
iii) Hot-deformation

i) Flammability test (for PVC outer sheathed cables only)
j) Water tightness test
k) 1) Thermal ageing on complete cable sample
2) Tensile strength and elongation at break for insulation and outer sheath
3) Resistivity test for semi-conducting layer
l) Bending test followed by P.D. test
m) Dielectric power factor and capacitance measurement at ambient temperature
n) Dielectric power factor measurement at elevated temperature
o) Impulse withstand test followed by HV test
p) Oxygen index and temperature index test on outer sheath

4.6. Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for which test conducted once are acceptable (i.e. The requirement of test conducted within last five years shall not be applicable) for the following:

4.6.1. 1.1 kV grade PVC insulated cables
High voltage test (water immersion d.c. test as per clause no. 16.3.2 of IS: 1554 (Part 1) - 1988)

4.6.2. 1.1 kV grade XLPE insulated cables
Water absorption (gravimetric) test as per IS: 7098 (Part 1) –1988

4.6.3. XLPE insulated HT cable from 66kV up to and including 220KV
Load cycle test followed by P.D. measurement as per IS: 7098(Part 3)

4.6.4. Terminating/jointing accessories as per IEC 60840:1999
a) Partial discharge test at ambient temperature;
b) Heating cycle voltage test
c) Partial discharge tests
-At ambient temperature
-At high temperature
d) Impulse voltage test followed by power frequency test
e) Test of outer protection for buried joints

SECTION –II : TECHNICAL SPECIFICATIONS FOR UNARMORED U/G FIBER OPTIC CABLE

This section describes the functional requirements, major technical parameters, Type and Factory Acceptance Testing requirements for underground fiber optic cable. Marking, packaging and transportation requirements have also been described.

2.1 General

The underground fiber optic cable shall be unarmored and shall be suitable for underground installation in pipes. The cable should be of low weight, small volume and high flexibility. The mechanical design and construction of each unit shall be inherently robust and rigid under all condition of operation, adjustment, replacement, storage and transport.

2.2 Applicable Standards

The cable shall conform to the standards named below and the technical specifications described in the following sections.
ITU-T Recommendations G-652.
Electronic Industries Association, EIA/TIA 455-78A, 455-3A, 455-62A, 455-164A/ 167A/174. 455-168A/ 169A/ 175A, 455-176, 455-59, EIA/TIA 598, EIA 455-104.
International Electro technical Commission standards, IEC 60304, IEC 60794-1-2, IEC 60811-5-1.
Bell core GR-20.

2.3 Fiber Type(s) and Counts

The cable shall contain 12 Dual Window Single Mode (DWSM) fibers conforming to G.652 as per the bill of the Quantity and the Technical parameters stipulated in the following sections. The BOQ for each type of cable has been provided in the appendices.

2.4 Optical Characteristics

The attenuation coefficient for wavelength between 1525nm and 1575nm shall not exceed the attenuation coefficient at 1550nm by more than 0.05dB/km. The attenuation coefficient between 1285nm and 1330nm shall not exceed the attenuation coefficient at 1310nm by more than 0.05dB/km. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.1dB. The fibre attenuation characteristics specified in table 2-1 shall be "guaranteed" fibre attenuation of any & every fibre reel. Further the average cabled fibre attenuation, averaged over 100kms of cabled fibre, (as measured during the factory acceptance testing) shall be as specified in 2-1.

DWSM fibres shall conform to the requirements specified in Table 2-1 below.

Table 2-1

DWSM Optical Fibre Characteristics

Fibre Description:	**Dual Window Single-Mode**
Mode Field Diameter:	8.6 to 9.5nm um(± 10% of the nominal value)
Cladding Diameter:	125.0 um ± 2um

Mode field Concentricity Error:	≤ 1.0 um
Cladding non-circularity	≤2%
Cable Cut off Wavelength	≤1260nm
1550 loss performance	As per G.652
Proof Test Level	≥0.35Gpa
Attenuation coefficient	@ 310nm ≤0.35 dB/Km @1550nm ≤ 0.23 dB/Km
Chromatic Dispersion : Maximum: Zero Dispersion Wavelength: Zero Dispersion Slope:	20 ps/(nm x km) 1550 nm 3.5 ps/ (nm x km) 1288-1339nm 5.3 ps/ (nm x km) 1271-1360nm 1300 to 1324 nm -0.093 ps/(nm² x km) maximum
Polarization mode dispersion coefficient	≤ 0.5 ps/km^ ½
Temperature Dependence:	Induced attenuation ≤0.05 dB (-60 ºC + 85 ºC)
Bend performance:	@1310nm(75n±2nmdia Mandrel), 100 turns: Attenuation rise <0.05 dB/km @1550nm(75±2nmdia Mandrel), 100 turns: Attenuation rise <0.10 dB/km @1550nm(32±0.5 dia Mandrel), 1 turn: Attenuation rise <0.50 dB/km
End of Table	

2.5 General Construction

The optical cable shall consist of a central fibre optic unit protected by one or more layers of helically wound anti-hygroscopic tape or yarn. The central fibre optic unit shall be designed to house and protect the fibres from damage due to forces such as crushing, bending, twisting, tensile stress and moisture, wide temperature variations, hydrogen evolution etc. The fibre shall be of loose tube construction. The inner polyethylene jacket and outer sheath jackets shall be free from pinholes, joints, spilts or any other defects,. All fibre optic cable shall have a minimum service life span of 25 years.

2.5.1 Colour Coding & Fibre Identification

Individual optical fibres within a fibre unit, and fibre units shall be identifiable in accordance with EIA/TIA598 or IEC 60304 or Bellcore GR-20 colour –coding scheme. The colour coding system shall be discernible throughout the design life of the cable. Colouring utilized for colour coding optical fibres shall be integrated into the fibre coating and shall be homogeneous. The colour shall not bleed from one fibre to another and shall not fade during fibre preparation for termination or splicing. Each cable shall have tracibility of each fibre back to the original fibre manufacturer's fibre number and parameters of the fibre. If more than the specified number of fibres included in any cable, the spare fibres shall be tested by the cable manufacturer and any defective fibre shall be suitably bundled, tagged and identified at the factory by the vendor.

2.5.2 Strength Members

The central fibre optic unit should include a central strength member of Fibre Reinforced Plastic (FRP) or other suitable material. Peripheral strength members and aramid yarns are also acceptable. The central FRP strength member may be of slotted type with SZ lay (reverse oscillation lay) of fibre units or it may be cylindrical type with helical lay of fibre units.

2.5.3 Filling Compound

The interstices of the central fibre optic unit and cable shall be filled with a suitable compound to prohibit any moisture ingress or any longitudinal water migration within fibre optic unit or along the fibre optic cable. The water tightness of the cable shall meet or exceed the test performance criteria as per IEC60794-1-2-F5. The filling compound used shall be a non-toxic homogeneous water proofing compound that is free of dirt and foreign matter, anti-hygroscopic, electrically nonconductive and non-nutritive to fungus. The compound shall also be fully compatible with all cable components it may come in contact with and shall inhibit the generation of hydrogen within the cable. The filling compound shall remain stable for ambient temperature up to +70 ºC and shall not drip, flow or leak with age or at change of temperatures. Reference method to measure drip point shall be as per IEC60811-5-1 and drip point shall not be less than 70 ºC.

2.5.4 The Sheath/Inner Jacket

The sheath shall be black, smooth, concentric, and shall be free from holes, splits, blisters and other surface flaws. The sheath shall be extruded directly over the central fibre optic unit and shall also be non-hygroscopic. The cable sheath design shall permit easy removal without damage to the optical fibres or fibre units. The sheath shall be made from good quality of weather resistant polyethylene compound (Black High Density Polyethylene-HDPE) and thickness shall be $\geq$ 1.8mm.

2.5.5 The Outer Jacket/Termite protection

A circular jacket of not less than 0.65mm Polymide-12(Orange Nylone-12) material should be applied over the sheath as an outer jacket. The outer jacket shall have smooth finish and shall be termite resistant.

RIP Cord: Suitable rip cord(s) shall be provided to open the outer sheath of the cable. The rip cord(s) shall be properly waxed to prevent wicking action and shall not work as a water carrier.

2.6 Mechanical Parameters & Tests

(A) **Tensile Strength**: The cable shall be of sufficient strength to withstand a load of value T (N) = 9.81 x 2.5 x W Newton or 2670 N whichever is higher (where W is the mass in Kg of 1 Km cable). The load shall be sustained for 10 minutes and the strain of the fiber monitored. The load shall not produce a strain exceeding 0.25% in the fiber and shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the rated tensile load in accordance with IEC 60794-1-2-EI procedure shall not exceed 0.05dB/Km both for 1310 nm and 1550 nm wavelength. The attenuation shall be noted before strain, and after release of strain for all the fibers.

(B) **Crush test** (Compressive Strength): The cable shall withstand a compressive force of at least 2000 N. applied for at least 60 seconds between two plates of 100mm x 100mm in accordance with IEC60 794-1-2-E3 procedure. This compressive load applied in accordance with IEC60794-1-2-E3 shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the compressive load shall not exceed 0.05dB/Km both 1310nm and 1550nm wavelength. The attenuation shall be noted before and after the test for all the fibers.

(C) **Bend Radius**: The cable bend radius under no load shall be less than or equal to 20 times the cable diameter. The test method shall be according to the IEC60794-1-2-E11 (procedure-I). The fibers and component parts of the cable shall not suffer permanent damage when the cable is repeatedly wrapped and unwrapped 4 complete turns of 10 complete cycles around a mandrel of 20 times to the cable diameter. The change in optical attenuation after the test shall not exceed 0.05dB/Km both for 1310nm and 1550nm wavelength. The attenuation shall be noted before and after the test for all the fibers. Outer Jacket shall not show any cracks visible to the naked eye when examined whilst still wrapped on the mandrel.

(D) **Cable Bending test** (Repeated bending): The cable shall withstand repeated bending when tested in accordance with EIA-455-104 and shall not cause any permanent damage to any constituent part of the cable. The cable sample shall be at least 5 meters or more. The change in optical attenuation during or after the application of the repeated bending test shall not exceed 0.05dB/Km for all the fibers. The attenuation shall be noted before and after the test for all the fibres. The test requirement shall be as mentioned below:-

Weight	5Kg
Minimum distance from pulley centre to holding device	216 mm
Minimum distance from weight to pulley centre	457mm
Pulley diameter	20 times to the cable dia
Angle of turning	90º
No. of cycles	30
Time required for 30 cycles	2 min.

(E) **Impact Test**: The cable shall withstand at least 10 impacts of 50N load from a 0.5 meter height with impacting surface radius of 300mm. This impact load applied at the same place in accordance with IEC60794-1-2-E4 shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the impact load shall not exceed 0.05dB/Km. The attenuation shall be noted before and after the test for all the fibres.

(F) **Torsion test**: The cable shall withstand 10 cycles of ±180º torsion with 100N load applied on a 2m sample. This load cycle applied in accordance with IEC60794-1-2-E7 shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation during or after the application of the torsion load shall not exceed 0.05dB/km for all the fibres. The attenuation shall be noted before and after the test.

(G) **Kink test** (Resistance): When a cable of sample length 10 times the minimum bend radius as defined above is subjected to kinking,it shall not result in any fibre breakage and the kink shall disappear after normalizing the cable. The change in optical attenuation after the application of the kink in accordance with IEC60794-1-2-E10 shall not exceed 0.05dB/km for all the fibres.

(H) **Water penetration test**(Resistance to water ingress): The resistance to water ingress of the cable shall meet or exceed the test performance criteria as as per IEC60794-1-2-F5 method F5B. Before applying the water tight sleeve at one end the outer jacket shall be stripped. A water soluble fluorescent dye shall be used for testing.The duration of test shall be 7 days. In addition after the test the cable shall be ripped open and distance up to which water has seeped shall be noted.

(I) **Drip Test**(Seepage of Filling Compound): For testing, a sample of 30cm length of the cable with one end sealed by the end cap will be taken and outer jacket, sheath, binder tapes shall be removed by 5cms from open end of the sample. The filling compound will be wiped thoroughly and the sample be kept vertically with open end down ward in the oven for 24 hours at 70 ºC. temperature with a filter paper under the sample. The filter paper should not indicate any sign of drip or oily impression. The reference test specification shall be as per IEC60811-5-1 to measure drip point.

(J) **Environmental Test**: Temperature cycling test shall be carried out on one drum length of the cable to ensure stability of attenuation parameter of the cable when subjected to temperature change which may occur during storage, transportation, and operation. The permissible temperature range for storage and operation will be from -20ºC to +70ºC. The rate of change of temperature during test shall be 1ºC per minute. The cable shall be kept for 12 hours at each of the following temperature and should follow the specification IEC60794-1-2-F1. Two cycles shall be performed.

TA2	: -20ºC
TA1	: -10-ºC
TB1	: +60ºC
TB2	: +70ºC

The attenuation shall be measured at the end of each temperature range both at 1310nm & 1550nm. The change of attenuation of fibre used shall be ≤ 0.05 dB both for 1310 & 1550nm for entire range of temperature for all the fibres in each cycle.

(K) **Termite Resistance Test**: The outer jacket shall be demonstrated to be termite resistant. The exact procedure for the test shall be mutually agreed between the Contractor and the Purchaser and shall generally be in line with test procedures followed by reputed test laboratories.

(L) **Abrasion Test**: To be conducted as per IEC 60794-1-E2 or equivalent international test method.

(M) **Flexure Rigidity Test**: To be conducted as per ASTM D-790. The test shall not cause any permanent damage to any constituent part of the cable. The change in optical attenuation after the test shall not exceed 0.05 dB/km. The attenuation shall be noted before and after the test for all the fibres.

(N) **Figure of Eight Test**: 1000m of cable shall be uncoiled from the drum and arranged in figure of eight, each loop having a maximum, dimension of 2m. It shall be possible to arrange cable in figure of 8 with relative ease and the cable shall not show any visible damages.

(O) **Cable A geing Test**: After Environmental test the cable shall be subjected to a temperature of 85 ±2 ºC for 168 hours. Cable shall then be brought to ambient temperature and stabilized for 24hours. The change in optical attenuation after the test shall not exceed 0.05dB/km. For 1310 as well as 1550nm wavelengths. The attenuation shall be noted before and after the test for all the fibres.

(P) **Embitterment Test of Loose tube**: The minimum length of the test sample depend on the outside diameter of the loose tube and should be 85mm for tubes upto 2.5mm outside dia. The length of the bigger tubes should be calculated by using the following equation:

$Lo > 100 \times ((D^2 + d^2)/4)^{½}$

Where

Lo = Length of tube under test
D = Outside dia of loose tube
d = inside dia of loose tube

Both the ends of a buffer tube test sample may be mounted in a tool which is clamped in jaws of a tensile machine which exert a constant rate of movement. The movable jaw may move at a rate if 50mm per minute toward the fixed jaw. Under load the tube will bend, so that the tube is subjected to tensile and compressive stresses. The fixture for holding the tube should be designed in a manner that the tube might bend in all directions without further loading. The tube should not get embrittled. No ink should appear on the tube up to the safe bend dia of tube (20D) where D is the outside diameter of the loose tube. There should not be any physical damage or mark on the tube surface.

(Q) **Kink Resistance test on the loose tube**: A longer length of The loose tube is taken(with fibre and gel), a loop is made and loop is reduced to the minimum bend radius of loose tube i.e. 20 D.(where D is the outside dia of the loose tube). This test is to be repeated 4 times on the same sample length of the loose tube. No damage or kink should appear on the surface of the tube.

(R) **Drainage test for loose tube**: A tube length to 40cm shall Be cut and filled with filling gel ensuring there are no air bubbles and the tube is completely full. The filled tube is placed in a horizontal position on a clean worktop and cut 5cm from each end so that the finished length of the sample is 30cm. The filled tube shall be left in a horizontal position at an ambient temperature for 24 hrs. The sample tube is then suspended vertically in an environment heat oven over a weighed beaker. It is left in the oven at a temperature of 70 ºC for a period of 24 hrs. At the end of the 24hrs. period the beaker is checked and weighed to see if there is any gel in beaker. There shall be no gel or oil in the beaker.

(S) **Check of easy removal of sheath**: The sheath shall be Cut in circular way using a sheath removal tool and the about 300mm length of the sheath should be removed in one operation. It should be observed during sheath removal process that no undue extra force is applied and no component part of the cable is damaged. It shall be possible to remove the sheath easily. Easy removal of both the outer jacket and the inner sheath shall be checked separately.

(T) **Effect of aggressive media on the cable surface**(Acidic and alkaline behaviour) : The test shall be conducted as per method no.ISO175. The two test samples of the finished cable each of 600mm in length are taken and the ends of the samples shall be sealed. These test samples are put in the PH4 and PH10 solutions separately. After 30days these samples are taken out from the solutions and examined for any corrosion etc. on the sheath and other markings of the cables. The sample should not show any effect of these solution on the sheath and other marking of the cable.

2.7 Optical fibre cable marking

A suitable marking shall be applied in order to identify this cable from the other cables. Marking on the cable shall be indelible, of durable quality, shall last long and shall be applied at regular interval of one-meter length. Marking shall be imprinted and must clearly contrast with the surface and colors used must withstand the environmental influences experienced in the field,

The accuracy of the sequential marking must be within ±0.5% of the actual measured length. The sequential length marking must not rub off during normal installation. In case laser printing is used the marking shall not exceed 0.15mm depth. The optical fibre cable shall have the following markings in every metre.

Type of Cable
Running metre length
No. of fibres
Type of fibre
Laser symbol & caution notice
Year of manufacture and batch no.
Manufacturer's name
D T L

2.8 Operating Instructions

Complete technical literature in English with detailed cable construction diagram of various sub-component with dimensions and test data of the cable shall be provided. All aspects of installation shall also be covered in the handbook.

2.9 TEST AND INSPECTION:

The general conditions for Type and Factory Acceptance Testing shall be as follows:-

2.9.1 TYPE TEST

Type testing shall be carried out as per IEC for fiber optic cable & the tests listed in table 2-2 shall be carried out as type tests for fibers.

Table 2-2

Type test for Fibres

S. No.	Test Name	Acceptance Criteria	Test procedure
1.	Attenuation	TS Table 2-1	EIA/TIA 455-78A
2.	Attenuation Variation with wavelength	TS Table 2-1	EIA/TIA 455-78A
3.	Attenuation at Water Peak	TS Table 2-1	EIA/TIA 455-78A
4.	Temp.Cycling (Temp. dependence of Attenuation)		EIA/TIA 455-3A, 2 cycles
5	Attenuation with Bending (Bend performance)		
6.	Mode Field dia.		EIA/TIA 455-164A/167A/174
7.	Chromatic Dispersion		EIA/TIA455-168A/

			169A/175A
8	Cladding Diameter		EIA/TIA 455-176
9	Point Discontinuities of attenuation		EIA/TIA 455-59
10	Core-Clad concentricity error		EIA/TIA 455-176
	-- End of Table---		

2.9.2 Factory Acceptance Testing

The tests listed in Table 2-3 shall be carried out as Factory Acceptance Test for Underground fibre optic cable.

Table 2-3

Factory Acceptance Tests on Underground Fibre Optic Cable

S.No.	Factory Acceptance Test
1.	Attenuation Co-efficient (1310,1550, and Water Peak)
2.	Point discontinuities of attenuation
3.	Chromatic Dispersion
4.	Visual Material verification and dimensional checks as per approved drawings
5.	Resistance to Water Ingress test
6.	Tensile strength test/Strain test
7.	Impact test
8.	Kink test

SECTION-III : <u>QUALITY ASSURANCE PROGRAMME</u>

To ensure that the equipment and services under the scope of contract, whether manufactured or performed within the contractors work or at his sub contractors premises or at the owners site or at the other place of the work are in accordance with the specifications, the contractors shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programme shall be outlined by the contractor and finally accepted by the owner/authorize representative after discussion before the award of contract. The QA programme shall be in line with ISO 9001/IS-14001.

GENERAL REQUIREMENTS QUALITY ASSURANCE

All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all stages, as per comprehensive quality assurance programme. An indicated programme of the inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specifications. This is however, not intended to form a comprehensive programme as it is the contractor responsibility to draw up and implement such programme duly approved by the owner. The detailed quality plans for manufacturing and field activities should be drawn by the bidder and will be submitted to owner for approval. Schedule of finalization of such quality plans will be finalized before award.

Manufacturing quality plan will detail out for all the components and equipments, various tests/inspection, to be carried out as per the requirement of this specification and standards mentioned therein and quality practices and procedure followed by contractors quality control organization, the relevant reference document and standards, acceptance norms,

inspection documents raised etc. during all stages of material procurement, manufacturer, assembly and final testing performance testing.

Field quality plans will detail out for all the equipment the quality practices and procedures etc. to be followed by the contractors site quality control organization, during various stages of site activities from receipt of materials/equipment at site.

The Contractor shall also furnish copies of the reference documents/plant standards/ acceptance norms/tests and inspection procedure etc., as referred in quality plans alongwith quality plans. These quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans Owner shall identify Customer Hold Points (CHP), i.e. test/checks which shall be carried out in presence of the Owner's engineer or his authorized representative and beyond which the work will not proceed without consent of Owner/authorized representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner alongwith technical justification for approval and disposition.

No material shall be dispatched from the manufacture's work before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspection by Owner's engineer/authorized representative, and duly authorized for dispatch issuance of MDCC.

All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

SECTION-XVI

CCTV

Section-16

Visual monitoring system for Remote monitoring of unmanned new S/stn equipment

Visual monitoring system (VMS) for effective watch and ward of sub-station premises covering the areas of entire switchyard, Control Room cum Administrative building, Fire lighting pump house, stores and main gate, shall be provided. The contractor shall design, supply, erect, test and commission the complete system including cameras, Network video recorder system, mounting arrangement for cameras, cables, LAN Switches, UPS and any other items accessories required to complete the system. To provide all the necessary licenses to run the system successfully shall be in the scope of contractor.

System with Color IP cameras for VMS surveillance would be located at various locations including indoor areas and out doors switchyard and as per the direction of Engineer-In-charge. The VMS data partly / completely shall be recorded (minimum for 15 days) and stored on network video recorder.

The number of cameras and their locations shall be decided in such a way that any location covered in the area can be scanned. The cameras shall be located in such a way to monitor at least: The operation of each and every isolator pole of the complete yard (including future scope).

1. All the Transformer and Reactors (including future scope).
2. All the Entrance doors of Control Room Building and Fire-fighting Pump House and Switchyard Panel Room.
3. All the gates of switchyard.
4. Main entrance Gate.
5. All other Major Equipments (such as CB, CT, CVT, LA etc. for present and future)

The cameras can be mounted on structures, buildings or any other suitable mounting arrangement to be provided by the contractor.

1.1 Technical requirements of major equipment of Visual Monitoring System.

1.1.1 The Video Monitoring system shall be an integrated system with IP network centric functional and management architecture aimed at providing high-speed manual / automatic operation for best performance.

1.1.2 The system should facilitate viewing of live and recorded images and controlling of all cameras by the authorized users.

1.1.3 The system shall use video signals from various types of indoor/outdoor Charge Couple Device (CCD) color cameras installed at different locations, process them for viewing on workstations/monitors in the control Room and simultaneously record all the cameras after compression **H 264 /** MPEG 4 or better standard. Mouse/joystick-keyboard controllers shall be used for Pan, Tilt, Zoom, and other functions of desired cameras.

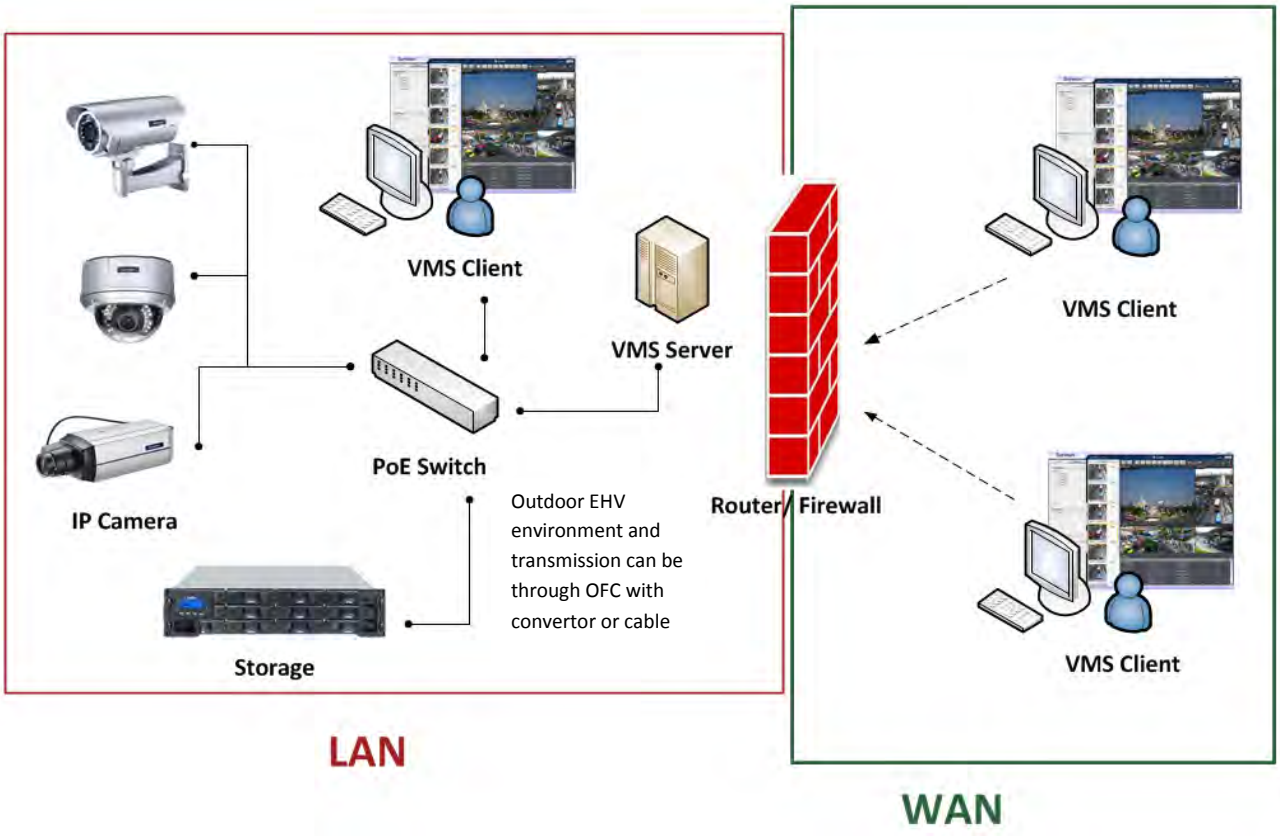
1.1.4 The system shall provide sufficient storage of all the cameras recordings for a period of 15 days or more @ 25 FPS (Frame Per Second), at 4 CIF (Common Intermediate Format) or better quality using necessary compression techniques for all cameras. It

shall be ens ured that d ata onc e recorded shall n ot be al tered by any m eans. T he recording resolution and frame rate for each camera shall be user programmable.

1.1.5 The s urveillance V MS S ystem s hall ope rate on 240 V , 50 H z s ingle-phase pow er supply. System shall have back up UPS power supply meeting the power supply need of al l t he cam eras i n the s tations i ncluding t hose w hich a re i nstalled a t g ate f or a period of 2 hour s. T he bi dder s hall s ubmit t he s izing c alculation f or t he U PS considering the total load requirement of Video Monitoring System.

1.2 System Architecture

The con ceptual s ystem architecture o f the vi sual moni toring s ystem is de scribed below:



1.3 System requirements:

a) System mus t pr ovide bu ilt-in facility of watermarking or D igital c ertificate to ensure tamperproof recording.

b) All cam eras m ay be con nected through a s uitable LAN w hich shall be abl e t o perform in 400 / 220kV class sub-station environment without fail.

c) All camera recordings shall have Camera ID & location/area of recording as well as da te/time stamp. Camera ID, location/Area of r ecording & da te/time s hall be programmable by the system administrator with User ID & Password.

d) Facility of camera recording in real-time mode (25 FPS)/15/12.5/10 or lower FPS as well as in any desired combination must be available in the system.

e) Facility of Camera recording in HD (1280X720p), D1, 4CIF, CIF, VGA, as well as in any combination i.e. any camera can be recorded in any quality.

f) System to have facility of 100% additional camera installation beyond the original planned capacity.

g) In order to optimize the memory, while recording, video shall be compressed using H 264 / MPEG-4 or better standard and streamed over the IP network.

h) System shall be triplex i.e. it should provide facility of Viewing, Recording & Replay simultaneously.

i) The offered system shall have facility to export the desired portion of clipping (from a specific date/time to another specific date/time) on CD or DVD. Viewing of this recording shall be possible on standard PC using standard software like windows media player etc.

j) System shall have provision of WAN connectivity for remote monitoring. The client can log into WAN and then monitor the live video / recorded video of the substation.

k) The contractor shall provide the Software Development Kit (SDK) and Application Program Interface (API) for all the system software's including NVR / Cameras installed under the CCTV system.

The Software Development Kit (SDK) / Application programming interface (API) for the NVR and the cameras shall be supplied including for the future integration of the following functions with visual monitoring system

(i) Camera- Network device discovery, live video streaming, video capture configuration, video compression configuration, event and metadata configuration, storage recording.

(ii) NVR- Network device discovery, video capture configuration, video compression configuration, video recording control, video recording search, video replay control.

l) The equipment should generally conform to Electro magnetic compatibility requirements for out door equipment in EHV switchyards. The major EC required for Cameras and other equipment shall be as under:

Technical Specification for Visual Monitoring System

1.	Electrical Fast Transient (Level 4)	- As per IEC 61000-4-4
2.	Damped Oscillatory (1 MHZ and 100 K HZ) (Level 3)	- As per IEC 61000-4-12
3.	AC Voltage Dips & Interruption/Variation (Level 4)	- As per IEC 61000-4-12
4.	Electrostatic Discharge (Level4)	- As per IEC 61000-4-2
5.	Power Frequency Magnetic Field (Level 4)	- As per IEC 61000-4-8
6.	Ripple on DC Power Supply (Level 4)	- As per IEC 61000-4-17

Type test reports to establish compliance with the above requirement shall be submitted during detailed engineering.

1.3.1 Video Surveillance Application Software

a) Digital video surveillance software control software should be capable to display and manage the entire surveillance system. It should be capable of supporting variety of devices such as cameras, video encoder, servers, NAS boxes/Raid back up device etc.
b) The software should have inbuilt facility to store configuration of encoders and cameras.
c) The software should support flexible 1/2/4/8/16/32 window split screen display mode and scroll mode on the PC monitor.
d) The software should be able to control all cameras i.e. PTZ control, Iris control, auto / manual focus, and color balance of camera, selection of presets, video tour selection etc.
e) The software should have user access authority configurable on per device or per device group basis. The system shall provide user activity log with user ID, time stamp, action performed etc.
f) The users should be on a hierarchical basis as assigned by the administrator. The higher priority person can take control of cameras, which are already being controlled by a lower priority user.
g) It should have recording modes, viz. continuous, manual, or programmed modes on date, time and camera-wise. All modes should be disables or enabled using scheduled configuration. It should also be possible to search and replay the recorded images on date, time and camera-wise. It should provide onscreen controls for remote operation of PTZ cameras. It should have a facility for scheduled recording. Different recordings speeds (Fps) and resolution for each recording mode for each camera should be possible.
h) The software for clients should also be working on a browser based system to remote users. This will allow any authorized user to display the video of any desired camera on the monitor with full PTZ and associated controls.
i) Retrieval: The VMS application should allow retrieval of data instantaneously or any date/time interval chosen through search functionality of the application software. In case data is older than 15 days and available, then the retrieval should be possible. The system should also allow for backup of specified data on any drive like DVD's or any other device in a format which can be replayed through standard PC based software. Log of any such activity should be maintained by the system.
j) VMS shall provide the full functionality reporting tool which can provide reports for user login/logoff, camera accessibility report, server health check reports etc.

1.3.2 Network video recorder

The Network recorder shall include at least Server (min 3.0 Ghz, 4GB RAM, 3000GB HDD (min)), RAID 5 with suitable configuration along with colored TFT 22" High resolution monitor and internal DVD writer. Windows XP/7 Prof. or VMS compatible operating system latest version with hardware like graphic cards, licensed anti virus etc.

Further the digital video recorder shall conform to the following requirements:

1.	Server Spec	Intel Quad core (or better) 3.0 Ghz (min.), 8MB cache, 4GB RAM with suitable NVIDIA graphics card, 3TB HDD, Raid 5.
2.	Recording and display Frame rate	Real time 25 frames per second per channel, manual select.
3.	Recording Resolution	PAL: 1280 X 720, 704(H) X 586 (V). It should be possible to select lower resolutions.
4.	Compression Method	H.264 / MPEG-4 or better and latest.
5.	Video Motion Detection Capable	Standard and built-in (selectable in menu).
6.	Monitoring Options	Split Screen 1, 2, 4, 8, 16, 32 or more cameras.
7.	Playback options	Search, still image capture.
8.	Alarm / Event Recording Capable	To be provided with built-in external alarm input / output ports minimum (8 in, 2 out)
9.	Network Operation Capable	To be provided by using WAN or LAN router.
10.	Remote internet viewing Capable	Using WAN or LAN router.
11.	HDD storage consumption	1GB ~ per hour /channel variable based on frame speed and resolution setting, as well as compression
12.	Operation	Triplex operation (simultaneous recording, playback, network operation)
13.	Number of Video Channel	32
14.	Audio Recording Capable	32
15.	Input Voltage	230V AC or equivalent with UPS as a back up of 30mins.

1.3.3 VMS camera

a) The color IP camera for substation shall have PAN, TILT and ZOOM facilities so that it can be focused to the required location from the remote station through a controller. Whereas wireless IP cameras with PTZ controls are required for installation at gates of the DELHI TRANSCO premises as per the direction of Engineer-In-Charge

b) The IP Camera at the main gate can be fixed or PTZ based and shall be used for monitoring entry and exit

c) The cameras must be of Day and Night type. The cameras must be controllable for use in black & white mode when needed. The cameras shall have provision to operate with enhanced sensitivity in the darkest conditions.

d) The cameras must be operative in automatic mode for switching from day mode to night mode depending on the ambient natural light intensity without having to manually operate. All cameras shall be operative in color in day and black & white mode in low illumination condition.

e) It should have sufficient range for viewing all the poles of isolators and other equipments with high degree of clarity.
f) The VMS cameras shall be suitable for wall mounting, ceiling mounting and switchyard structure mounting.
g) Cameras shall be connected through cable and / or optical fiber cable to visual monitoring system. If OFC interface is not available in the camera suitable media converters placed in weather proof outdoor cubicle should be supplied. Camera should also have the provision for wireless connection.
h) The camera shall meet the following requirement:
    - Build in surge and lighting protection
    - Communication: RS232, RS485, TCP/IP
    - UL certified.
i) It shall be possible to define at 128 selectable preset locations so that the cameras get automatically focused on the selection of the location for viewing a predefined location.
j) The camera should be able to detect motion in day & night environment having light intensity of color: 0.5 Lux; B&W: 0.05 Lux.
k) Housing of cameras meant for indoor use shall be of IP 42 or better rating whereas outdoor camera housing shall be of IP 66 or better rating. Weather resistant sunshields shall be provided in the camera housing for all cameras required to be installed outdoors. Enclosure shall have provision to avoid fogging during high humidity conditions. Housing shall be robust and not have effect of electromagnetic induction in 400 / 220 KV switchyard.
l) All camera recording shall have Camera ID & location / Area of recording as well as date / time stamp. Camera ID , Location / Area of recording & date / time shall be programmable by the system administrator with user ID & password.
m) Facility of camera recording in real time mode (25 FPS)/ 15 / 12.5 / 10 or lower FPS as well as in any desired combination must be available in the system.

A. Outdoor IP Fixed Megapixel Camera Specifications (for Main Gate)

1.	Image sensor	2 Megapixel Progressive , 1/3" CMOS/CCD sensor, minimum illumination 0.1 lux
2.	Min Luminous	0.5 Lux (Color), 0.05 lux (Black)
3.	Camera enclosure	IP 66 Grade
4.	Iris/Focus	Auto/Manual
5.	Video Compression	Dual Stream H.264 and MPEG user selectable
6.	Support Dual-Stream	Primary/secondary stream, H.264 and MPEG 4 optional
7.	Video Definition	Primary stream 1600 X 1200, 1280 X 960, 1280 X 720, Secondary stream 800X 600, 400 X 288, 192 X 144
8.	Video Parameters	Brightness, Hue, Contrast, Saturation and image Quality

9.	Video Frame Rate	PAL:1-25 frames/sec NTSC: 1-30 frames/second
10.	Video C ompression BR	32Kbit / S – 6Mbit / S
11.	Video Output	One Channel Composite Streaming
12.	Supported Protocols	TCP, UDP, IP, HTTP, FTP, SMTP, DHCP, DNS, ARP, ICMP, POP3, NTP, IPSec, UpnP, RTP, RTCP.
13.	Operating Temperature	-5 ~ +50^{o} C
14.	Operating Humidity	10 ~ 90 %

B. Outdoor IP66 PTZ HD Camera Specifications (For Switch Yards)

1.	Image sensor	1/3 t ype S olid S tate P rogressive Scan CCD, WDR (High Definition)
2.	Security	Multiple user access with password protection
3.	Effective Pixels	(PAL): M ain S tream: 1280x 720, S ub S tream : 640x360, 320x280 selectable
4.	Compression	Dual Stream H.264 and MPEG 4 user selectable
5.	Signal System	50 Hz
6.	S/N (signal to noise) ratio	Better than 50 dB
7.	Electronic Shutter	1/60 ~ 1/10,000 sec. automatic or better
8.	Scanning System	Progressive / interlace.
9.	Low Li ght Sensitivity (Lux)	Color: 0.5 Lux; B&W : 0.02 Lux
10.	Lens	Min. 10x (minimum) op tical in high Definition **(The system s hall b e ab le t o z oom t he i mages on t he monitor w ithout an y d istortion t o t he maximum level of optical zoom)**
11.	Lens size	Minimun 4.1 ~ 73.8 mm
12.	PTZ D ata T ransfer Baud / Bit R ates Supported	Selectable 2400 bps / 4800 bps / 9600 bps
13.	Lens Aperture	F1.6 (wide) ~ F2.8(tele), f= 4.1 ~ 41.0mm, 10X zoom, Video A uto F ocus, A ngle o f vi ew H orizontal : 52 ^{o} (wide), 2.8^{o} (tele)
14.	Panning range	Complete 360 degrees (horizontal)
15.	Pan Speed	Adjustable, 0.1 degree / second ~ 250 degrees / second
16.	Tilting Range	Minimum 180^{o} Tilt Rotation
17.	Tilt Speed	Adjustable, 0.1 degree / second ~ 150 degrees / second
18.	In Build Storage	Camera s hould ha ve i nbuilt s torage T F or S D f ormat for recording and storing pictures
19.	IP Class	IP 66 Standard
20.	Working Temperature	-0^{o}C ~ +50^{o}C
21.	Working Humidity	10 ~ 90 %

1.3.4 PTZ- Keyboards

The features of PTZ shall include

- Fully functional dynamic keyboard / joystick controllers
- Controls all pan, tilt, zoom, iris, preset functions
- Control up to 255 units from a single keyboard
- Many preset options and advanced tour programming
- Compatible with all connected cameras

1.	Key Application	Wired keyboard control operation of PTZ functions for weatherproof dome cameras
2.	Pan / Tilt / Zoom Protocol Languages Supported	Selectable
3.	PTZ Data Transfer Baud Rates Supported	Selectable 1200 bps / 2400 bps / 4800 bps / 9600 bps
4.	Additional Features	Dynamic joystick for smooth camera movements, preset location option for quick access to frequently monitored areas.

2.0 Future Integration

In future the system should able to integrate at central control location. Hence the system should be based on open platform. Otherwise the contractor must provide the Software Development Kit(SDK) and Application Program Interface (API) for all the system software ' s including NVR / Cameras installed under the project. These solution shall provide a unified device interface to devices, including different kinds of third party devices as follows defined by ONVIF standards. The contractor shall assist for future intergration.

3.0 Cable and Other Accessories

Any optical fiber cable used in the project shall be suitable for transmitting the video signal from camera to media converter and further to server without any loss to signal. The copper cable being used shall be suitable for 1100 V rating and shall confirm to respective IS standards. The media converters and switches should be suitable for continuous operation. The outdoor rack shall be suitable for all weather conditions with locking arrangement.

Location of cable laid directly under ground shall be indicated clearly by cable marker made of galvanized iron plate. These markers shall be spaced at an interval of 30 meters and at every change of direction in the cable laid area.

4.0 Training

The training for configuration of camera, software shall be offered at respective sites by contractor.

SECTION-XVII

FIBRE OPTIC TERMINAL EQUIPMENT (FOTE)

Section-17

Technical Specification of Fibre Optic Terminal Equipment (FOTE)

1.1. Introduction of Scope and General Requirement of FOTE

This document describes the technical specifications of FOTE equipment to be installed in Fiber Optic communication system for terminating optical cable.

The FOTE equipment shall be designed to operate in electrical high-voltage networks and shall be suitable for installations in substations with harsh environment and high electromagnetic interference conditions. It shall be highly reliable and provide secure communications for real time signals such as DATA, VOICE, IP/ETHERNET, SCADA, TELE-PROTECTION and Line Current Differential Relay Communication including status/control signals. The equipment offered shall already be working successfully in telecommunication networks operated by power utilities. It shall comply with the latest ITU-T recommendations and ETSI standards and be able to be interconnected with legacy multiplexers and other telecommunication equipment.

For each location, the supplier is required to assess the environmental conditions for the equipment to be installed under this specification. The supplier shall be responsible for all necessary enclosure, rack or equipment upgrades etc. to ensure the proper operation of the installed equipment.

The equipment shall be in line with current practice as followed by Department of Telecommunication (Govt. of India) or by internationally accepted practices for communication system.

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 supplier.

Equipment supplied shall be supported for its maintenance and availability of spares by its OEM for minimum 7 years from the date of its supply.

Integration: bidder / supplier should be responsible to integrate the entire supplied equipment with the existing communication system (PLCC, OLTE, OFC, MUX, EPAX and RTU etc.).The supplier should supply any necessary hardware, cards, cables, connectors etc. Required in supplied & existing system for integration without any additional cost.

1.2. General Characteristics

1.2.1.Description - FOTE communication system

The proposed FOTE communication system shall be fiber optic based SDH Transmission equipment and PDH Terminal Equipment. SDH shall be used for transmission and PDH equipment for termination of voice, data and Tele-protection interfaces, Distance relays / Line current differential relay communication.

SDH equipment shall be a separate Terminal, which shall support to STM-4 capacity network interfaces with minimum 3 MSP (Multiplex Section Protection) directions which shall be field upgradeable by simply changing the required SFPs.

PDH Equipment shall support the Voice & Data communication requirements of RTUs, SCADA / EMS system, PABX and other Power system interfaces such as Distance Relays, Line Differential Current Relay communication, Tele-protection signalling.

The FOTE system, comprising of SDH and PDH equipment shall meet all the communications requirements of the substation and shall provide data & voice connectivity across the various locations or connectivity of RTUs with Control Centre.

The RTUs located at various locations will report to Control Centre using IEC 60870-5-101 or IEC 60870-5-104 / IEC-61850 Protocol. The proposed communication system shall provide connectivity of some RTUs over TCP/IP protocol using Ethernet interface and other RTUs over serial interface.

1.3. Functional Requirement

The primary function of the FOTE is to provide a highly reliable voice and data communication with support of the SCADA/EMS and tele-protection signalling.
A brief summary of the communication system requirements is as follows:

(a) Ethernet over SDH
(b) The connectivity envisaged between RTUs and Control Centre is Wide Area Network (WAN) on TCP-IP using IEC 60870-5-104
(c) High speed E1 channel support
(d) 64kbps & Nx64kbps data channel support
(e) Low speed (300 -19200 bps) data channel support
(f) Voice (2 wires / 4 wires) channel support.
(g) C37.94 optical interface supports for Distance Relay Communication / Tele-protection signalling and Line Current Differential Protection Relay Communication.
(h) Data transport supporting Network Management channels

1.3.1. General Systems Requirements

Required characteristics are defined and specified herein at the system level, subsystem level, and equipment level to provide 1:1 redundancy at all critical levels and to ensure maximum uptime and system availability.

1.3.2. System Upgradeability and Expandability

Equipment supplied shall be sized (though not necessarily equipped) to support system / subsystem expansion to full capacity as required for specified aggregate transmission rates. Equipment units provisioned for equipped subunits shall be terminated at appropriate patching facilities or termination blocks. Power supplies shall be appropriately sized for maximum equipped system capacity.

1.3.3. General Physical Characteristics

All supplied equipment shall be new and of the finest production quality. The Employer will not accept modules or printed-circuit boards that are modified by appending wires or components. Wired strapping options shall be incorporated in the board design to meet the above requirement.

1.3.4. Redundancy Requirements and Protection Schemes

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

FOTE 1:1 Redundancy Requirements - SDH

Power Supply ---------- Common control* cards---------- * = Common control card which must provide 1:1 Redundancy and are required for operation of the equipment and include: (a) Processor (b) Cross-Connect (c) Timing (d) SDH Network Interfaces	1:1 APS or distributed power supply 1:1 APS

FOTE 1:1 Redundancy Requirements – PDH

Power Supply ---------- Common control* cards---------- * = Common control card which must provide 1:1 Redundancy and are required for operation of the equipment and include: (e) Processor (f) Cross-Connect (g) Timing (h) E1 Network Interfaces	1:1 APS or distributed power supply 1:1 APS

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 Supplier.

1.3.5. Lost Signal Recovery
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.

1.4. Functional Description

1.4.1.FOTE Requirements

The Supplier shall be required to provide a FOTE package that shall include SDH and PDH (E1 Drop & Insert Multiplexer) FOTE Equipment in compliance with the electrical input-output characteristics provided in Table 2&3.

The SDH transmission network node should be equipped with minimum three ports of STM-1/4 for optical interface 16xE1 and 8xFastEthernet interface (L2). For clarity, the basic functions accomplished at the network nodal points, are described briefly as follows:

The E1 Primary Rate PDH multiplexer shall connect to the E1 interface provided by the SDH Transmission Equipment and used to accomplish Digital Access Cross-Connect (DACS) as well as subscriber connectivity to the Digital Communication Network. Subscriber Line Units shall provide analog to digital and direct digital conversion to 64Kbps digital channel in the Conference of European Postal and Telecommunications Administration (CEPT) standard hierarchy, thirty (30) such 64 Kbps digital channels shall be Time-Division Multiplexed (TDM) resulting in a single 2.048 Mbps (E1) digital bit stream totalling up to sixty (60) such 64 Kbps analog / digital channels to be accommodated in a single chassis.

Digital Drop-Insert and Branching Equipment shall be used to digitally interface a small number of channels at spur locations without requiring successive D/A and A/D conversions of the throughput channels.

The Digital Cross Connect Equipment (DACS) must be an intergraded part of the primary (E1) Multiplexer stream to support Digital Access Cross-Connect (DACS), Drop-Insert as well as PDH Primary Rate Terminal Equipment functions.

The equipment shall also have an interface for external 2048 kHz synchronization signal according to ITU-T Recommendation G.703.

1.4.2. Drop & Insert Multiplexing

Drop & Insert multiplexing in conformance with CEPT E1 characteristics shall be required at locations where the subscriber requirement is minimal. The drop and insertion of up to 60 x 64 Kbps channels supporting subscriber line units (SLU) shall be required at intermediate locations. The Drop & Insert Muxes supplied shall be performance and card compatible with

the C hannel B ank E quipment pr ovided so that a ll S ubscriber L ine I nterface c ards a re interchangeable.

SDH Transmission and Multiplexing Equipment
(Table-2)

Network Interfaces: Field Upgradeable between STM-1, STM-4, by changing the SFP
Cross connect Capacity: 20G
Optical Wavelength NOTE (1) : 1310/1550nm
Optical Source NOTE (2) : Laser
Optical Source Life Span: Better than **$5x10^5$hours**
Optical Fibre Type: G.652 D
Optical Connectors: Type LC
Transmission Quality: Per ITU-T G.821, G.823, G.826
Source Primary Power -48 Vdc
Equipment Specifications: Per ITU-T G.783
Tributary, Electrical Interface: Per ITU-T G.703, 75 _
Ethernet Interface: 10/100 Mbps
SDH Bit Rates: Per ITU-T G.703
Optical Interfaces: Per ITU-T G.957, G.958
Frame and Multiplexing Structure for SDH: Per ITU-T G.707
Synchronization: Per ITU-T G.813
Management Functions: Per ITU-T G.774, G.784
Protection Architectures: Per ITU-T G.841
Built In Testing and Alarms: Per ITU-T G.774, G.783, G.784

NOTE (1) O ptical w avelength shall be se lected considering t he characteristics of t he op tical fibre and the link budget.

NOTE (2) Eye Safety for Laser Equipment: To avoid eye damage, when a receiver detects a line interruption, it is required that the optical power of the laser shall be reduced to Safe limits on the transmitter in the opposite direction as per ITU-T G.958.

NOTE (3) In case other than FC-PC connector is provided in the equipment, suitable patch cord with matching connector are to be provided to connect with FODP

PDH, E1 Primary Rate Multiplexing Equipment
(Table-3)

Applicable Standards:	PDH per CCITT Recommendation G.703, G.704,G.711 and G.712
Total Number of Tributaries:	Up to 60 X 64 Kbps
Alternative S ub-rate Tributaries:	n X 64 Kbps V.36 64Kb/s V.11/V.36
Output Aggregate Rate: Interface Code: Impedance: Peak Level @ 120 ohm: Peak Level @ 75 ohm: Maximum Insertion Loss:	2.048 Mb/s ± 50 ppm HDB3 75 ohm unbalanced 3.0 volts ± 10% 2.37 volts ± 10% 6 dB
Signal Waveform: Frame Structure: Jitter Performance:	Per CCITT G.703 Per CCITT G.742 Per CCITT G.823
Primary P ower S upply Voltage:	-48 Vdc

1.4.3. Mux and Drop / Insert Functions

The offered FOTE package must be capable of providing up to at least 60, 64 Kbps channels voice, data and C37.94 Optical Tele-protection c oupler channels interfacing requirements which a re de fined a t t he subscriber line l evel. P rimary m ultiplexing i n c onformance w ith CEPT E -1 c haracteristics shall be us ed t o p rovide first o rder m ultiplexing of up t o 60 Subscriber Line Units (SLUs).

1.4.4. Subscriber Line Units / Subscriber Line Interface Cards

The terms Subscriber Line Interface Cards and Subscriber Line Units (SLU) have been used interchangeably throughout the specification. Multiple configurations of SLUs shall be required to provide subscriber to primary multiplexer bank interfacing for a variety of voice and data communications. In case there are changes in number or type of cards because of changes in channel requirements, the contract price shall be adjusted accordingly.

The SLU interface requirements are discussed in the following subparagraphs:

(a) Voice Channels

The voice channel requirement is for (I) 4-Wire E&M trunking in support of PABX trunks & PLC VF and (II) 2-Wire telephonic interfaces. 2 wire SLUs shall be DTMF/TP optioned for 2-wire loop start or 2-wire GND start. The voice cards shall utilize ITU.T A - law commanded PCM G.711, 64 Kbits/s encoding.

(b) Sub-Channel Data Multiplexing

For this Project, the RTU data interface to the wideband telecommunications network node shall be defined at the DTE level at low-speed rates of 300, 600 and 1200 baud. The port shall be compatible with RS232C interface. The Supplier shall be required to furnish 64 Kbps SLU asynchronous data taplexing for at least 4 selectable low speeds DTE interfaces whenever multiple asynchronous data circuits are required.

(c) Synchronous Data

The Supplier shall provide a direct DTE interface for synchronous communications at speed of 64 Kbps and compatible with CCITT G.703 Kbit/s, V.35 and X.21 interfaces. Data rate selection shall be switch selectable or programmable.

(d) Nx64 kbps Synchronous Data

There is also a requirement for N x 64 kbps V.35, X.21 interfaces. The tentative quantities have been identified in the appendices. However the final BoQ shall be worked out during detailed design.

C37.94 Optical Interfaces for connecting to Digital Protection Couplers to provide Distance Tele-protection

There is a requirement to connect to Digital Protection Couplers to provide Distance Relay / Line current differential relay communication& Tele-protection using C 37.94 channels. Necessary interfaces required to in the FOTE need to be provided for successful transmission of data/commands of Current Differential relay/Tele-protection signalling equipment/ inbuilt Tele-protection of Distance relay.

1.4.5. Drop-Insert and Cross-Connect Functions and Capability

The FOTE shall be fully capable of implementing standard applications such as “Groom and Fill", Drop & Insert/Bypass, Broadcast Routing at 64Kps, Primary Rate Channel Level.

1.5. MDF, DDF and Cabling

For the purposes of the specification, the supplier shall provide cabling, wiring and MDFs interfacing to the wideband telecommunications system. Equipment and material components for MDF and cabling are also part of this procurement. It shall be the supplier's responsibility to provide all cable support required for full supplied equipment interconnection with the MDF and shall be in accordance with communications industry standard practices and the requirements mentioned in the technical specifications.

1.5.1. MDF Patching Facilities

The Supplier shall supply and install all cabling, wiring, connectors, cross connects, Main Distribution Frames (MDF) associated with the installation and interconnection of equipment procured under this package as follows:

(a) Cabling (including connectors) for E1 level connections from SDHDDF to new PDH equipment. To the extent possible, existing cable at site shall be used.

(b) MDF for termination of all the subscriber channels at new PDH node

(c) Cabling and connectors required to enable subscriber-to-subscriber circuits over the telecom network. The Line side of the MDF shall be cabled to the Primary Multiplex and the equipment side shall be cabled to the MDF of the assigned subscriber (PLCC, PABX, Telephone at wideband locations etc.)

(d) Any other cables, connections etc. required for a fully functional, integrated telecom system.

The connections amongst various equipment such as termination equipment and subscriber MDF set shall always be routed through DDF and MDF to provide maintenance access.

1.5.2. Main Distribution Frames

The Supplier shall make provision for cross connection of subscriber services to the subscribers utilizing Krone or equivalent and shall provide full connectivity up to and terminated on the equipment side of the appropriate DDFs and line side of MDFs. The Supplier shall terminate on the equipment side of patching facilities provided by other contracts and shall provide DSX type patching facilities supporting aggregate bit streams (i.e. dataplexers and E-1 Channel Banks). Separate patch panels or MDFs shall be provided for Data and Voice. All cross connects shall be accomplished utilizing one, two or three pair patch cords. Patch plugs are permissible for direct one-to-one circuit "cut-thru".

1.6. Craft Terminal

Each equipment (Drop/Insert Multiplexer and DACS etc.) on the fibre optic communication network shall include provision for connecting a portable personal computer (PC) to be known as craft terminal to support local commissioning and maintenance activities. Through the use of this PC and local displays/controls, the operator shall be able to:

(a) Change the configuration of the station & the connected NEs.

(b) Perform tests

(c) Get detailed fault information

The craft terminal shall be connected to the interface available in the communication equipment. Portable (Laptop) computers (craft terminal) complete with necessary system and latest application software to support the functions listed above.

1.6.1. Hardware Requirements Craft Terminal configuration

The Craft Terminal shall be a Laptop PC having minimum configuration of Intel i5 Processor, 14 -15" Display, 4GB RAM, DVD-RW Drive, 1TB Hard Disk Drive, WiFi, Keyboard with Touchpad, USB ports, latest MS Windows OS, 2.5 -3 hours battery back-up capacity.

1.6.2 Patch Cables & accessories

All patch cords, screws and accessories etc for successful installation & commissioning

1.7. Minimum Base Configuration

This configuration may be increased appropriately during detailed engineering process to meet the communication requirement and for making the system fully operational. Following is the minimum base configuration for FOTE equipment to be supplied by the contractor.

S.No	Description	Qty	Remark
1	STM-4 SDH with 3MSP Protected Directions		
1.1	Base Equipment (with all common cards, cross-connect /control cards, optical base cards, power supply cards, power cabling, other necessary hardware accessories including sub -rack, patch cords etc.)	01 No	
1.2	Optical Interfaces / SFPs (SFPs as per optical link budget)	06 Nos.	
1.3	Tributary Cards		
1.3(a)	E1 Interfaces	16 E1	
1.3(b)	Ethernet Interface 10/100 Mbps with L2 Switching	08 Interfaces	
1.3(c)	Digital Distribution Frame	01 No	

2	PDH Terminal Equipment	
2.1	Base E quipment (Common c ards, c ontrol cards, optical ba se car ds, power sup ply cards, pow er c abling, ot her ne cessary hardware accessories including sub-rack)	
2.2	Subscriber Line Interface Cards	
2.2(a)	2 wire (sub/sub) voice channel card	8 voice channels
2.2(b)	4 wire (E&M) voice channel card	8 voice channels
2.2 (c)	Asynchronous sub c hannel d ata c ard (V.24/V.28)	4 data channels
2.3	Main Distribution Frame (M DF) for 1 00 pairs	1 No.
2.4	C37.94 O ptical C ouplers f or D ifferential Relays & Tele-protection*	Qty as per requirement
	*To be d ecided dur ing de tailed e ngineering in consultation with Protection Division	

3	Equipment Cabinet	
3.1	For SDH and PDH equipment (Additional cabinet to be supplied, if more equipment space is required for supplied equipment.)	1 Nos.
4	Craft Terminal	
4.1	Laptop P C w ith latest M S W indows O S a nd application software for management of SDH & PDH	1 No.
5	Patch Cables & acces sories (All p atch cords, screws and accessories et c f or successful installation & commissioning)	1 set

1.8. Tests

The tests sh all conform t o all Type, routine and acceptance t ests as per applicable relevant standards like IS, IEC, ITU standards etc. issued from time to time.

1.9. GUARANTEE TECHNICAL PARTICULARS FOR FOTE

Name of Manufacturer: Model: Type:		(To be filled up by lder)
GENERAL:		
Type of multiplexer	SDH: ADM	
Complying to ITU-T	Yes/NO	
Transmission Capacity: STM-4:622Mbit/s STM-1:155Mbit/s	 Yes/NO Yes/NO	
Access capacity on 2Mbit/s	Min. channels Max. channels	
Access capacity on 64kbit/s	Min. channels Max. channels	
Redundant Central Processor Available	YES/NO	
Digital Cross Connect Function (Fully on- blocking)	YES/NO	
PDH cross connect capacity	Min. N x 2Mbit/s Max. N x 2Mbit/s	N=
SDH cross connect capacity, high order	Minimum x VC4	
Tele-protection interface:		
Integrated distance tele-protection interface	YES/NO	
Integrated optical tele-protection interface	YES/NO	
Addressing of protection commands	YES/NO	
Loop test for measuring delay time	YES/NO	
1+1 switch-over less than 10ms	YES/NO	
Time for switch-over		
USER interfaces		
Voice interfaces for trunk lines:		
Integrated tele-protection		
Interface for Commands:		
Number of independent commands		
Transmission time max.	6 ms	
Signal voltage	Max VDC	

1+ 1 com path protection	YES/NO	
Data: interfaces per module		
V.24/V.28(RS-232)	Number 'N'	N=
V.11/X.24(RS-432)	Number 'N'	N=
V.35	Number 'N'	N=
Integrated LAN port available on DATA Interface	YES/NO	
Software programmable board available	YES/NO	
Functions available for individual configuration: - 1+1 path protection - point-multipoint - performance monitoring - sub rate multiplexing available for all data interface	 YES/NO YES/NO YES/NO YES/NO	
Ethernet interface		
Ethernet A & Ethernet B (Two Independent Ethernet path for Redundancy) 10/100BaseT ports 1000Base LX/ SX ports L2 switching function WAN capacity Mbit/s Logical WAN ports Routing Protocol	8 x RJ45 electrical 2 x optical YES/NO NXVC12 or NXVC3 Min N''= IP Routing	 N= N''=
Integrated Ethernet Hub10/100BaseT ports	Min.6x RJ45	
Integrated alarm gathering module:		
Number of external alarms per module	Min.8Nos.	
Auxiliary power supply for ext. contacts		
Ambient Conditions:		
Operating Temperature	oc	
Storage Temperature	oc	
Relative Humidity	% hum	
Power Supply		
Nominal Supply voltage	AC volts	
	DC volts	
Operation	DC (-48) volts	
Fully redundant power supply	YES/NO	
Dual power feeding	YES/NO	

List of Abbreviations

AAL	ATM Adaptation Layer
ADM	Add-drop multiplexed
ATM	Asynchronous Transfer Mode
ALS	Automatic Laser Shutdown
BIP	Bitter leaved Parity
CAS	Channel Associated Signalling
CAP	Carrier-less Amplitude and Phase
CRC	Cyclic Redundancy Check
DACS	Digital Access Cross-Connect
DCN	Data Communication Network
DTMF	Dual Tone Multi-Frequency
EN	European Norm
EOW	Engineering Order Wire
ETS	European Telecommunications Standards
FOTE	Fiber Optic Terminal Equipment
GPS	Global Positioning System
GPF	General framing Procedure
HDLC	High Level data Link Control
HDSL	High Density Subscriber Line
IEC	International Electrical Commission
ITU	International Telecommunication Union
IP	Internet Protocol
ISDN	Integrated Services Digital Network
MCMI	Multi Coded Mark Inversion
MDF	Main Distribution Frames
MS	Multiplex Section
NE	Network Element
NMS	Network Management System
LAN	Local Area Network
LCAS	Link capacity Adjustment Scheme
OS	Optical Section
OSI	Open System Interconnection
OSPF	Open Shortest Path First
PDH	Plesiochronous Digital Hierarchy
PPP	Point-to-Point Protocol
RS	Regenerator Section
SDH	Synchronous Digital Hierarchy
SNMP	Simple Network Management Protocol
SOH	Section Overhead
SSM	Synchronization Status Messaging
STM	Synchronous Transport Module
TCP	Transmission Control Protocol
TDM	Time Division Multiplexed
TMN	Telecommunications Management Network.
TTI	Trail Trace Identifier
VC	Virtual Container
VCAT	Virtual Concatenation
VF	Voice Frequency

SECTION-XVIII

LA

SECTION: 18
Technical Specification of Lightning Arrestor for 220 kV, 66 kV & 33 kV systems

1.0 GENERAL

1.1 The Surge Arrestor shall consist of Zinc Oxide Elements and should be designed in accordance with the relevant IS/IEC. The Surge Arrestor shall be provided with hermetically sealed discharge counter to indicate the number of discharges through the surge diverter. A leakage current detector as an integral part of the discharge counter shall be supplied.

2.0 STANDARDS

2.1 The design, manufacture and performance of metal oxide arrestor shall comply with latest addition of the following IS/IEC specification:-

i) IS-3070 : Lightning Arrestors for alternating current system.
ii) IS-4004 : Application Guide for Surge Arresters for alternating current systems
iii)IEC- 99-5 : IEC on metal oxide Arrestors without gaps for A.C. systems.

2.2 Equipment complying with any other authorized standard can also be offered if it ensures performance equivalent to and better than Indian standards specifications detailed above.

3.0 CONSTRUCTIONAL FEATURES

3.1 The Surge Arrestor furnished shall be single phase unit suitable for outdoor installation.

3.2 The non-linear blocks shall be of metal oxide and these shall be provided in such a manner as to obtain robust construction with excellent mechanical and electrical properties which should not get affected even after repeated operations.

3.3 The arrestor shall be fitted with a pressure relief device suitable to prevent shuttering of the porcelain housing and providing a path for venting out the excess pressure. In the event of the explosion and the shattering of the porcelain housing, the particles/pieces of the porcelain housing after the explosion shall fall within the radius stipulated in the relevant IEC specifications.

3.4 The arrestor should be provided with a suitable arrestor disconnector so as to disconnect the arrestor from the system in the event of failure of the arrestor and also providing an indication of the arrestor failure.

3.5 The sealing of the arrestor shall be done in such a manner that all seals are effectively maintained even while discharging max lightning current.

3.6 The porcelain housing of the arrestor shall be coordinated with the arrester protective characteristics so that external flash-over will not occur due to application of impulse or switching surge voltage before the maximum design value of the arrestor. The porcelain bushing shall conform to IS 2099 and the total creepage distance of the bushing shall not be less than 25mm per KV. The fittings shall be made of hot dip galvanized mild steel castings.

4.0 ACCESSORIES

4.1 The arrestor shall be complete with insulating base and have necessary provision for belting to the flat surface of the structure.

4.2 The Arrestor should be provided with discharge counter suitably enclosed for outdoor and the counter should not require any battery or other supply for its operation. The cylometri counter shall be visible through an inspection window. The counter terminal shall be robust and of adequate size and so located that incoming and outgoing connections are made with minimum possible bends. A milli amp meter as a leakage current detector should form an integral part of the arrester and shall be in built. The value of the leakage current beyond which the operation of the arrestor is not desired shall be clearly marked in red colour on the scale of the milli amp. meter.

5.0 TERMINAL CONNECTOR

The surge arrestor shall be supplied complete with universal type terminal connectors suitable for connecting with ACSR zebra / goat conductor as per requirement shall form an integral part of the supply.

6.0 MOUNTING ARRANGEMENT

The drawing for recommended mounting arrangement of the Lightning Arrestor along with detailed drawing of the structure thereof shall be enclosed with the tender offer.

7.0 SYSTEM PARAMETERS

7.1 The Surge Arrester are to be installed on 220 kV, 66 kV & 33KV substations/ switchyard.

7.2 The brief particulars of 220 kV, 66 kV & 33KV system parameters are given as under:-

S.NO	Technical Parameters	33 kV	66 kV	220 kV
i)	Rated System Voltage	36 KV	72.5 KV	245 KV
ii)	System frequency	50 Hz		
iii)	System Earthing	Effectively grounded		
iv)	System fault level and	31.5 KA	31.5 KA	40 KA for 1 sec

	its duration	for 1 sec	for 1 sec	
v)	Basic Insulation level of equipment a) Impulse withstand voltage for 1.25/50 micro sec b) One Minute power frequency withstand voltage	 170 KVp 70 KVrms	 325 KVp 140 KVrms	 1050 KVp 460 KVrms
vi)	Rated arrester voltage	30KV	60KV	198KV
vii)	Max. continuous operating voltage	25KVrms	50KVrms	168 KVrms
viii)	Current through arresters at operating voltage	Not more than 1 mA	Not more than 1 mA	Not more than 1 mA
ix)	Nominal discharge current	10KA of 8/20 Micro Seconds wave	10KA of 8/20 Micro Seconds wave	10KA of 8/20 Micro Seconds wave
xi	Step current impulse residual voltage	110KVp	220KVp	730KVp
xii	Residual voltage at: a) 10KA discharge current b) 20KA discharge current	 85KVp 90 KVp	 170KVp 200 KVp	 550KVp 630 KVp
xiii	Long duration discharge class	Class III	Class III	Class III
xiv	High current short duration test value (4/10 micro sec. Wave)	100KA	100KA	100KA
xv	Pressure Relieve device	Class A	Class A	Class A

7.3 The surge arrester shall be heavy duty type, station class and gapless type.

7.4 The Surge Arrestor shall be capable of discharging over voltages occurring in the system during lighting, switching of unloaded transformers and reactors.

7.5 The arrester shall be capable of discharging voltage equivalent to the long duration discharge class as defined in IEC specifications.

7.6 The Surge Arrestor shall have an inbuilt capability to withstand against dynamic over-voltages. The manufacturer with furnish the date for duration and per unit over voltage factors which the offered arrestor can withstand after initial specified discharge.

7.7 The leakage current of the Surge Arrestor shall be adequate to eliminate the influence of grading and static capacitance on measured reference voltage.

7.8 The Surge Arrestor should be suitable for protecting the station equipment of the basic insulation levels specified above:-

8.0 TESTS

8.1 The arrestor offered shall be type tested in accordance with the latest IEC/IS. All the type test reports shall be enclosed with the offer:-

i) Insulation withstand test.
ii) Residual Voltage Test.
iii) Current Impulse withstand test.
iv) Operating duty test.
v) Pressure Relieve Test.

8.2 The following acceptance tests shall definitely be carried out on the arrestors:-

i) Measurement of capacitive and resistive current continuous operating voltage.
ii) Measurement of power frequency reference voltage.
iii) Lightning Impulse residual voltage.
iv) Radio Interference voltage.

8.3 The arrestor shall be subjected to all routine tests as prescribed in the relevant IEC/IS to ensure satisfactory performance of the arrestor before dispatch.

DELHI TRANSCO LTD

(A Government of NCT of Delhi Undertaking)

Bidding Documents

For

A. Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B. Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C. Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

Volume – III

Bid Form, Attachments, GTP & Price Schedules

Tender No: T20R220201

VOLUME-III

Bid Form, Attachments, GTP & Price Schedules

SECTION 1: BID FORM

SECTION 2: ATTACHMENTS

SECTION 3: GUARATNTEED TECHNICAL PARTICULARS

SECTION 4: PRICE SCHEDULES

SECTION-I

BID FORM

BID FORMS

Bid Proposal Ref. No…… Date: ……

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

To,

Delhi Transco Limited
Shakti Sadan, Kotla Road
New Delhi – 110002

Ladies and Gentlemen,

1.0 Having examined the Bidding Documents, including Amendment Nos. _____*(Insert Numbers)* dated …… the receipt of which is hereby acknowledged, we _____,offer to design, test, deliver, install and commission (including carrying out Performance & Guarantee Test) the Facilities under the above-named package in full Conformity with the said Bidding Documents for the sum of:

(_____)
(Amount in Words)
(_____)
(Amount in Figures)

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

"Note: Being a Two Part tender, bidders are required to submit the Bid Forms in Part –I as well as in Part-II. However, the prices shall be quoted only in the Bid Form to be submitted with Price Bid Part -II."

2.0 ATTACHMENTS TO THE BID FORM

In line with the requirement of the Bidding Documents, we enclose herewith the following Attachments to the Bid Form:

(a) Attachment 1 : Bid Security in the form of ……* for a sum of ……. (amount in words and figures) initially valid for a period of two hundred forty (240) days from the date set for opening of bids.

*Please fill in the alternative chosen in line with 23.3 Section-ITB, Vol.-I, of the Bidding Documents.

(b) Attachment 2 : A power of attorney duly authorized by a Notary Public indicating that the person(s) signing the bid have the authority to sign the bid and thus that the bid is binding upon us during the full period of its validity in accordance with the ITB Clause 24.

(c) Attachment 3 : The documentary evidence that we are eligible to bid in accordance with Clause 10.3 (c) & (d) of ITB are qualified to perform the contract if our bid is accepted. The qualification data has been furnished as per your format enclosed with the bidding documents.

(d) Attachment 4 : The details of all major items of services or supply which we propose subcontractor in case of award, giving details of the name and nationality of the proposed subcontractor/ sub-vendor for each item.

(e) Attachment 5 : The variation and deviations from the requirements of the Conditions of Contract as per ITB and other commercial conditions, in your format enclosed with the Bidding Documents, including, inter alia, the cost of withdrawal of the variations and deviations indicated therein.

(f) Attachment 6 : The variation and deviations from the

requirements of the Important Conditions of Contract as per ITB, in your format enclosed with the Bidding Documents, including, inter alia, the cost of withdrawal of the variations and deviations indicated therein.

(g) Attachment 7 : The variation and deviations from the requirements of the Technical Deviation clauses mentioned in Volume-II, in your format enclosed with the Bidding Documents, including, inter alia, the cost of withdrawal of the variations and deviations indicated therein.

(h) Attachment 8 : Additional information submitted by the bidder, in your format enclosed with the Bidding Documents, including, inter alia, indicated therein, if any.

(i) Attachment 9 : Bought-out & Sub-contracted item listed with bidding documents.

(j) Attachment 10 : Work Completion Schedule.

(k) Attachment 11 : List of special tools & tackles listed with bidding documents.

(l) Attachment 12 : Information regarding ex-employees of DTL in our firm.

(m) Attachment 13 : Deleted

(n) Attachment 14 : Price Adjustment Data

(o) Attachment 15 : Guarantee Declaration (If applicable)

(p) Attachment 16 : Integrity Pact, in a separate envelope duly signed on each page by the person signing the bid.

(q) Attachment 17 : Deleted

(r) Attachment 18 : Checklist (Bidder shall submit the information regarding documents submitted by them in the offer as per the checklist provided in Attachment-

18 of Sec: Attachments, Vol-III of bidding document. It shall be sole responsibility of bidder to provide the information based on the documents submitted by them.)

(s) Attachment 19 : Affidavit of Self certification regarding Local Content in line with PPP-MII order (submission of Hard Copy in 'Original'), to be submitted on a non-judicial stamp paper of Rs. 100/-.

(t) Attachment 20 : Certificate from statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of Local Content, in line with PPP-MII orders and MoP orders, *(submission of Hard Copy in 'Original') to be submitted on the letter head of the auditor/cost accountant/chartered accountant.*

(u) Attachment 21 : Undertaking for not indulging in Corrupt & Fraudulent practice

(v) Attachment 22 : Certificate regarding compliance of Ministry of Finance order no- F.No.6/18/2019-PPD dt 23.07.2020

3.0 Price Schedules

3.1 Schedule 1 **:** Price break-up Plant and Equipment (including Mandatory Spares) to be supplied

Schedule 2 **:** Break-up of Local Transportation, Insurance and other Incidental Services

Schedule 3 **:** Price Breakup of Installation Charges

Schedule 4 **:** Grand summary of the quoted bid price.

3.2 We are aware that the Price Schedules do not generally give a full description of the Work to be performed under each item and we shall be deemed to have read the Technical Specifications and other sections of the Bidding Documents and Drawings to ascertain the full scope of Work included in each item while filling-in the rates and prices. We agree that the entered rates and prices shall be deemed to include for the full scope as aforesaid, including overheads and profit.

3.3 We declare that as specified in the clause 11.2 CC of the Bidding Documents prices quoted by us in the Price Schedules shall be Fixed and Firm during the execution of Contract.

3.4 We understand that in the price schedules, where there are errors between the total of the amounts given under the column for the price Breakdown and the amount given under the Total Price, the former shall prevail and the latter will be corrected accordingly. We further understand that where there are discrepancies between amounts stated in figures and amounts stated in words, the amount stated in words shall prevail. Similarly, any discrepancy in the total bid price and that of the summation of Schedule price (price indicated in a Schedule indicating the total of that schedule), the total bid price shall be corrected to reflect the actual summation of the Schedule prices.

3.5 We declare that items left blank in the Schedules will be deemed to have been included in other items. The TOTAL for each Schedule and the TOTAL of Grand Summary shall be deemed to be the total price for executing the Facilities and sections thereof in complete accordance with the Contract, whether or not each individual item has been priced.

4.0 We confirm that except as otherwise specifically provided our Bid Prices include all taxes, duties, levies and charges as may be assessed on us, our Sub Contractor/Sub-Vendor or their employees by all municipal, state or national government authorities in connection with the Facilities, in and outside of India.

4.1 Deleted

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, Taxes, Duties and Levies as per GST rules in respect of transaction between you and us, imposed on the Plant & Equipment including Mandatory Spare Parts specified in Price Schedule to be incorporated into the Facilities; by the Indian Laws.

4.3 Deleted.

4.4 We confirm that we shall also get registered with the concerned Tax Authorities as per GST rules, in all the states where the project is located.

4.5 Deleted.

4.6 We confirm that TDS under the applicable laws shall be deducted by the Employer from the payments made to us and Employer shall issue TDS certificates in lieu of deductions so made.

5.0 CONSTRUCTION OF THE CONTRACT

5.1 We declare that we are making this offer on the basis of divisible Supply-cum-Erection Contract on a single source responsibility basis. The supply portion of

the Contract will relate to the Supply of equipment and materials on the ex-works basis and the Erection portion will relate to transportation, storage, insurance, erection, testing and commissioning etc. of equipment/ materials as specified in the bidding documents. However, we have no objection in case Owner decides to split the above mentioned package into two separate Contracts-one Contract for Supply of all equipment on ex-works basis and second Contract for all services such as transportation & insurance, handling at site, storage, insurance, installation, testing and commissioning etc of equipment/materials as specified in the bidding documents.

We hereby declare that the award of two separate Contracts, will not, in any way, dilute our responsibility for successful completion of work 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 considered as a breach of the other Contract which will confer on the Owner the right to terminate the other Contract at our risk and cost and/or recover damages under any or both the Contracts.

6.0 PERFORMANCE GUARANTEE

We declare that the ratings and performance figures of the equipment to be furnished and erected by us are guaranteed. The Guaranteed particulars of different equipment are enclosed in Technical Data Sheets.

7.0 QUALIFICATION DATA

We confirm having submitted the Qualification Data in two Copies, as required by you in your Conditions of Contract in a separate envelope along with this Bid. Further we have filled in the information for qualification requirements in Attachment-3. In case you require any further information in this regard, we agree to furnish the same.

8.0 DEVIATIONS

8.1 We declare that the contract shall be executed strictly in accordance with the specifications and documents except for the variations and deviations, all of which have been detailed out exhaustively in the following Attachments, irrespective of whatsoever has been stated to the contrary elsewhere in our proposal.

(a)	Commercial Deviations Attachment	:	Attachment-5
(b)	Cost of withdrawal of deviation on Important/critical conditions Attachment	:	Attachment-6
(c)	Technical Deviations Attachment	:	Attachment-7

8.2 We confirm having noted Clause 11.2 of Section-ITB, Conditions of Contract, Volume-I, as per which Bid containing deviations from following provision

relating to following critical clauses will be treated as non-responsive, as stated therein :

(i) Governing Laws, Clause 5, CC
(ii) Settlement of Disputes, Clause 6, CC
(iii) Taxes and Duties, Clause 14, CC
(iv) Appendix 2 to the Form of Contract Agreement (Price Adjustment): Clause No. 15 ITB
(v) Bid Security: Clause 23.0, Section ITB Volume-I, conditions of contract
(vi) Contract Performance Guarantee: Clause 43.0, Section ITB, Volume-I, Conditions of Contract.
(vii) Liquidated Damages & (Functional Guarantee): Clause 28 & 28.5 CC
(viii) Defect Liability: Clause No. 27 CC
(ix) Price Basis and Payment: Clause No.12 CC and Clause 14 Section ITB
(x) Completion Time : Section F&P Appendix-4
(xi) Patent Indemnity, Clause No.29, CC

8.2.1 We confirm that we have not taken any deviations / exceptions to above clauses.

8.3 Further, we agree that additional conditions, deviations, if any, found in the proposal documents other than those stated in attached Deviation Attachments (i.e., Attachment 5, 6 & 7), save that pertaining to any rebates offered, shall not be given effect to.

9.0 ADDITIONAL INFORMATION

We have included with this proposal additional information as listed in Attachment-8, We further confirm that such additional information do not imply any additional deviation beyond those covered in Attachment- 5, 6 & 7 and in case of any contradiction between these additional information and other provisions of Bid, the latter will prevail.

10.0 GUARANTEE DECLARATION

We guarantee that the equipment offered shall meet the rating and performance requirements stipulated in the specifications.

11.0 BOUGHT-OUT AND SUB-CONTRACTED ITEMS

We are furnishing herewith at Attachment-9, the detail of all major items of supply amounting to more than 10% of our bid price, which we propose subcontract giving detail of the name of sub-contractor / sub-vendor and quantity for each item.

12.0 WORK SCHEDULE

If this proposal is accepted by you, we agree to complete the entire scope of work as per the bidding documents, in accordance with schedule indicated in the proposal. We fully understand that the work completion schedule stipulated in this proposal is the essence of the Contract, if awarded. The completion schedule of the various major key phases of the work is indicated in Attachment-10.

13.0 SPECIAL TOOLS AND TACKLES

We have given a list of Special Tools and Tackles in Attachment-11 and prices thereof are included in his lumpsum bid price. We further agree that any items of special tools and tackles, though not included in the aforesaid list, but required for effective erection, testing and commissioning & operation of the equipment for subject Package shall also be furnished by us at no extra cost to you.

14.0 CONTRACT PERFORMANCE GUARANTEE

The successful Bidder shall be required to furnish to DTL a Contract Performance Guarantee (CPG) for the value of ten percent (10%) of total Contract Price as per conditions stipulated in Clause 43.0, Section-ITB and Clause 13.0, Section-CC, Conditions of Contract, Volume-I of the Bidding Documents, which shall be extended from time to time beyond the actual date of successful completion of warranty/ defect liability period, as may be required under the Contract. The Bid Security/ guarantee shall be kept valid by the successful Bidder till the CPG is accepted by DTL

15.0 INFORMATION REGARDING EX-EMPLOYEES OF DTL

We have furnished the details of Ex-employees of DTL, who had retired/resigned at the level of General Manager and above from DTL and subsequently have been employed by us, in Attachment-12.

16.0 CHECK LIST

We have included a checklist duly filled in Attachment-18

17.0 Deleted

18.0 We undertake, if our bid is accepted, to commence the work on Facilities immediately upon your Notification of Award to us, and to achieve Completion within the time stated in the Bidding Documents.

We agree to abide by this bid for a period of 180 days from the date fixed for 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.

19.0 We, hereby, declare that only the persons or firms interested in this proposal as principals are named herein and that no company, persons or firms other than mentioned herein have any interest in this proposal or in the Contract to be entered into, if we are awarded the Contract, and this proposal is made without any connection with any other persons, firm or party likewise submitting a proposal and that this proposal is in all respect for and in good faith, without collusion or fraud.

Dated this ..... day of ..... 20.....

Thanking you, we remain

Yours faithfully

…….....
(Signature of the authorized signatory[@])
(Printed Name).....
(Designation) .....
(Common Seal) .....

Date:……

Place.....

Business Address:

Name and Address of Principal Officer
([@] Written Power of Attorney of all signatories of bid to commit the bidder must be enclosed with the bid.)

SECTION-II

ATTACHMENTS

ATTACHMENT-3

Tender No. T20R220201

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

(QUALIFYING REQUIREMENT (QR) DATA)

Bidder's Name and Address:

To: Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

In support of the Qualification Requirements (QR) for bidders, stipulated in Annexure-A, BDS Section-III , Volume-I of the Bidding Documents, we furnish herewith our QR data/details along with other information, as follows herewith, however, in case of any discrepancy the QR as given in Annexure-A, BDS Section-III shall prevail.

I. We have submitted bid as Individual Firm* through route 1.1/1.2/1.3/1.4* of QR as given in Annexure-A, BDS Section-III, Volume-I of the Bidding Documents.

II. We have submitted bid as Joint Venture* of following firms:
Lead Partner: …….
Other Partners:…….
:…….

[*Strike off whoever is not applicable.)

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).
d) Joint Venture Agreement.

B. Attached original & copies of the following documents :

a) Written power of attorney of the signatory of the Bid to commit the bidder.

GENERAL INFORMATION

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.

a. Bidder is required to provide general information as per the following format. [Where the Bidder proposes to use named subcontractor(s) for critical components of the works or for work contents in excess of ten (10) percent of the bid price, the following information should also be supplied 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 Firm				
2.	Head Office / Registered Office Address				
3.	Telephone				
4.	Fax				
5.	Contact Person				
6.	Place of Incorporation/ Registration				
7.	Year of Incorporation/ Registration				
8.	Nationality of Owner(i)				
9	Nationality of Owner(ii)				
10	Nationality of Owner(iii)				

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

Name of Person	Professional Qualification	Experience	Designation

c. Litigation History: Information regarding any current litigation in which the bidder is involved, the parties concerned and disputed amount; As per ITB, the information is to be completed for individual bidder and each Partner of a Joint venture

S. No.	**Name of Parties concerned**	**Cause of litigation and matter in dispute**	**Disputed amount**

1.0 TECHNICAL REQUIREMENTS

{Reference Clause 1.0 of Annexure-A, Section BDS}

Route-1:

1.1 The Bidder/Manufacturer must have designed, manufactured, type tested (as per IEC or equivalent standard), supplied, supervised erection and commissioning of at least two (2) nos. GIS circuit breaker bays***** of 66 kV or above voltage class in one (1) GIS substation or Switchyard during last seven (7) years and these bays must be in satisfactory operation**#** for at least two (2) years as on the originally scheduled date of bid opening.

OR

The Bidder/Manufacturer must have designed, manufactured, type tested (as per IEC or equivalent standard), supplied, erected and commissioned of at least two (2) nos. GIS circuit breaker bays* of 66 kV or above voltage class in one (1) GIS substation or Switchyard during last seven (7) years and these bays must be in satisfactory operation# for at least two (2) years as on the originally scheduled date of bid opening.

Route-2:

1.2 In case, the Bidder not meeting the requirement stipulated in para 1.1 above, he shall also be considered, provided he meets the following requirements:

The bidder/manufacturer must have established manufacturing and testing facilities in India for 66 kV or above voltage class GIS and must have manufactured at least one (1) no. 66 kV or above voltage Class GIS Circuit Breaker bay* based on the technological support of the Collaborator(s). Further the bidder must have either supplied or type tested the above GIS bay* as per IEC as on the originally scheduled date of bid opening, provided further that the collaborator(s) of the bidder meets qualifying requirements as per para 1.1 mentioned above.

Further, the bidder shall also submit the following along with the bid:

i) A legally enforceable undertaking (jointly with the Collaborator(s)) to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s);

ii) A confirmation letter from the Collaborator(s) stating that the Collaborator(s) shall furnish performance guarantee for an amount of 10 % of the ex-works cost of such equipment(s). This performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder

iii) A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 66 kV or above voltage class GIS equipment in India.

Route-3:

1.3 In case, the Bidder is established as Subsidiary/JVC/ Group company by its parent/principal, he shall also be considered, provided he meets the following requirements:

The bidder must have established manufacturing and testing facilities in India for 66 kV or above voltage class GIS and must have manufactured at least one (1) no. 66 kV or above voltage Class GIS Circuit Breaker bay* based on the technological support of the parent/principal company. Further, the bidder must have either supplied or type tested the above GIS bay* as per IEC as on the originally scheduled date of bid opening, provided further that the parent/principal company of the bidder meets qualifying requirements as per para 1.1 mentioned above.

Further, the bidder shall also submit the following along with the bid:

i) A legally enforceable undertaking (jointly with the parent/principal company) to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s);

ii) A confirmation letter from the Bidder stating that they shall furnish performance guarantee for an amount of 10 % of the ex-works cost of such equipment(s). This performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder.

iii) A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 66 kV or above voltage class GIS equipment in India.

OR

Route-4:

1.4 EPC Contractor:

In Case, the bidder is not a GIS Manufacture he shall also be considered, provided the bidder have designed, supplied, constructed, erected, tested (as per IEC standard) and commissioned, including CIVIL works of at least two (2) nos. GIS circuit breaker bays* of 66 kV or above voltage class in one (1) NEW GIS substation or Switchyard during last seven (7) years and these Sub-Stations/ bays must be in satisfactory operation# for at least two (2) years as on the originally scheduled date of bid opening.

In such case, GIS equipments should be offered from Indian manufactures who meets the clause no. 1.1 or 1.2 or 1.3, while fulfilling all additional requirements as per respective clauses no. 1.1 or 1.2 or 1.3.

Further, the bidder shall also submit the following along with the bid:

i) The bid shall include consent letter (as per format Annexure-D2) from the proposed GIS manufacturer.
ii) A legally enforceable undertaking (jointly with GIS manufacturer) to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s);
iii) A confirmation letter from the GIS manufacturer/ GIS Collaborator/ Parent/ Subsidiary/ JVC/ Group company etc. as applicable that they shall furnish performance guarantee for an amount of 10 % of the ex-works cost of such equipment(s). This performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder.

Note :-

i) Manufacturer of GIS (Route1,2,& 3) may propose a GIS erector as sub-contractor who has erected, tested (as per IEC standard) and commissioned, including CIVIL works of at least two (2) nos. GIS circuit breaker bays of 66 kV or above voltage class in one (1) 66 kV GIS substation during last seven (7) years and these Sub-Stations/ bays must be in satisfactory operation# for at least two (2) years as on the originally scheduled date of bid opening. The bid shall include consent letter (as per format Annexure-D1) from the proposed Erector.
ii) (#) Satisfactory operation means certificate issued by the Employer certifying the operation without any adverse remark.
iii) * For the purpose of qualifying requirement, one no. of circuit breaker bay shall be considered as a bay used for controlling a line or a transformer or a 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.
iv) In case bidder is a holding company, the technical experience referred to in Route-1, 2 and 3 above as the case may be, shall be of that holding company only (i.e. excluding its subsidiary/group companies). In case bidder is a subsidiary of a holding company, the technical experience referred to in in Route-1, 2 and 3 above as the case may be, shall be of that subsidiary company only (i.e. excluding its holding company)

1.5 Using the following format, each Bidder (individual firms or partners of a joint venture) is requested to list the experience as detailed above, on the basis of which the Bidder wishes to qualify. The information is to be summarized using following format for each experience of the Bidder or of each Partner of a Joint Venture.

(The bidder shall attach documentary evidence, such as copies of utility certificates for completed contracts and copies of award letters etc. for ongoing contracts in support of his experience as listed in the following proforma for each Contract)

Format-A

Format for the Bidder/ Lead Partner/ Partners of JV in case of Joint Venture in support of meeting the requirement of Clause 1.1, Annexure-A, BDS Section-III , Volume-I of the Bidding Documents

S. No	Description	Details
1.	Bidder's Name	
2.	Single Firm/Lead Partner/Other Partners	

Format-A **Format for the Bidder/ Lead Partner/ Partners of JV in case of Joint Venture in support of meeting the requirement of Clause 1.1, Annexure-A, BDS Section-III , Volume-I of the Bidding Documents**		
S. No	**Description**	**Details**
	of a JV	
3.	Name of Contract Undertaken	
4.	Contract Reference No. & Date of Award	
5.	Name and Address of the Employer/Utility for whom the Contract was executed by the firm/Partner of a JV: Email: Telephone: Fax:	
6.	Voltage Level of GIS Substation or Switchyard commissioned under the Contract (Indicate 66 kV or above Voltage class)	
	a) No. of Circuit Breaker equipped bays under the contract ***(Indicate nos. of GIS Circuit Breaker equipped bays of 66 kV or above voltage level)***	
	b) Name of the substation or switchyard	
	c) No. of years, the above Substation / switchyard has been in Satisfactory operational as on originally scheduled date of bid opening.	
	d) Scope of work involved under the Contract: (*Strike off whichever is Not Applicable)*	i.Design ii.Manufactured iii.Type Tested (IEC or Equivalent Standard) iv.Supplied v.Erected *vi.*Commissioned *vii.*Supervised Erection and Commissioning
	e) Has the Contract under reference been executed as a Prime Contractor ?	
7.	Details of documents submitted along with the bid in support of the above stated experience.	

Format-B **Format for the Indian Entity/ Lead Partner/ Partners of JV in support of meeting the requirement of Clause 1.2 & 1.3 of Annexure-A, BDS Section-III , Volume-I of the Bidding Documents**		
S. No	**Description**	**Details**
1.	Name of the Indian Entity not meeting the requirement stipulated in clause 1.1 of Annexure-A, BDS Section-III , Volume-I, but has established manufacturing and	

Format-B

Format for the Indian Entity/ Lead Partner/ Partners of JV in support of meeting the requirement of Clause 1.2 & 1.3 of Annexure-A, BDS Section-III , Volume-I of the Bidding Documents

S. No	Description	Details
	testing facilities in India for 66 kV or above voltage level Gas Insulated Switchgear (GIS):	
2.	Name of Contract Undertaken	
3.	Contract Reference No. & Date of Award	
4.	Name and Address of the Employer/Utility for whom the Contract was executed by the bidder: Email: Telephone: Fax:	
5.	Voltage Level of GIS Circuit Breaker Bay Manufactured under the Contract *(Indicate 66 kV or above Voltage class)*	
	a) No. of GIS Circuit Breaker equipped bays manufactured. *(Indicate nos. of GIS Circuit Breaker equipped bays of 66 kV or above voltage level)*	
	b) Whether the above Circuit Breaker Bays have been supplied as on the originally scheduled date of bid opening.	
	c) Whether the above Circuit Breaker Bays have been Type Tested as per IEC as on the originally scheduled date of bid opening.	
	d) Whether 66 kV or above voltage level GIS Circuit breaker bays, as mentioned above, has been manufactured based on technological support of the Collaborator/parent/principal under the Contract.	
	e) If Yes, indicate the name of the Collaborator(s) /parent/principal	
6.	Details of documents submitted along with the bid in support of the above stated experience.	

Format-C

Format for Collaborator/ Subsidiary/JVC/Group company by its parent/principal of Indian Entity in support of meeting the requirement of Clause 1.2 & 1.3 of Annexure-A, BDS Section-III , Volume-I of the Bidding Documents

S. No	Description	Details
1.	Name of the Collaborator/parent/principal, if applicable	
2.	Name of Contract Undertaken	

Format-C **Format for Collaborator/ Subsidiary/JVC/Group company by its parent/principal of Indian Entity in support of meeting the requirement of Clause 1.2 & 1.3 of Annexure-A, BDS Section-III , Volume-I of the Bidding Documents**		
S. No	**Description**	**Details**
3.	Contract Reference No. & Date of Award	
4.	Name and Address of the Employer/Utility for whom the Contract was executed by the firm/Partner of a JV: Email: Telephone: Fax:	
5.	Voltage Level of GIS Substation or Switchyard commissioned under the Contract: (Indicate 66 kV or above Voltage class)	
	a) No. of Circuit Breaker equipped bays under the contract ***(Indicate nos. of GIS Circuit Breaker equipped bays of 66 kV or above voltage level)***	
	b) Name of the substation or switchyard	
	c) No. of years, the above Substation or switchyard has been in Satisfactory operational as on the originally scheduled date of bid opening.	
	d) Scope of work involved under the Contract as per IEC: (*Strike off whichever is Not Applicable)*	i. Design ii. Manufactured iii. Type Tested (IEC) iv. Supplied v. Erected *vi.* Commissioned *vii.* Supervised Erection and Commissioning
6.	Whether a legally enforceable undertaking (jointly with the parent company (Principals) or collaborator(s) or subsidiary company) to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s) has been enclosed with bid (in line with para 1.2 / 1.3 of Annexure-A, BDS Section-III **Volume-I of the Bidding Documents**.	
7.	Whether confirmation letter from the parent company (Principals) or collaborator(s) stating that the Collaborator(s) shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) has been enclosed with bid? (in line with para 1.2 of Annexure-A, BDS Section-III , **Volume-I of the Bidding Documents (if applicable)**	
8.	Whether confirmation letter from the parent company (Principals) or collaborator(s) stating that the Collaborator(s) shall furnish	

Format-C **Format for Collaborator/ Subsidiary/JVC/Group company by its parent/principal of Indian Entity in support of meeting the requirement of Clause 1.2 & 1.3 of Annexure-A, BDS Section-III , Volume-I of the Bidding Documents**		
S. No	**Description**	**Details**
	performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) has been enclosed with bid? (in line with para 1.3 of Annexure-A, BDS Section-III , **Volume-I of the Bidding Documents (if applicable)**	
9.	Whether valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 66 kV or above voltage level GIS equipment in India has been enclosed with bid (in line with para 1.2 / 1.3 of Annexure-A, BDS Section-III , **Volume-I of the Bidding Documents**.	
10.	Details of documents submitted along with the bid in support of the above stated experience.	

Format-D **Format for the Bidder/ Lead Partner/ Partners of JV in case of Joint Venture in support of meeting the requirement of Clause 1.4, Annexure-A, BDS Section-III , Volume-I of the Bidding Documents**		
S. No	**Description**	**Details**
1.	Bidder's Name	
2.	Single Firm/Lead Partner/Other Partners of a JV	
3.	Name of Contract Undertaken	
4.	Contract Reference No. & Date of Award	
5.	Name and Address of the Employer/Utility for whom the Contract was executed by the firm/Partner of a JV: Email: Telephone: Fax:	
6.	Voltage Level of GIS Substation or Switchyard commissioned under the Contract (Indicate 66 kV or above Voltage class)	
	a) No. of Circuit Breaker equipped bays under the contract ***(Indicate nos. of GIS Circuit Breaker equipped bays of 66 kV or above voltage level)***	
	b) Name of the substation or switchyard	
	c) No. of years, the above Substation / switchyard has been in Satisfactory operational as on originally scheduled date of bid opening.	
	d) Scope of work involved under the Contract:	i. Design ii.Manufactured

Format-D **Format for the Bidder/ Lead Partner/ Partners of JV in case of Joint Venture in support of meeting the requirement of Clause 1.4, Annexure-A, BDS Section-III , Volume-I of the Bidding Documents**		
S. No	**Description**	**Details**
	(*Strike off whichever is Not Applicable)*	iii.Type Tested (IEC or Equivalent Standard) iv.Supplied v.Erected *vi.*Commissioned *vii.*Supervised Erection and Commissioning
	e) Has the Contract under reference been executed as a Prime Contractor ?	
7.	Whether a confirmation letter from the GIS manufacturer/ GIS Collaborator/ Parent/ Subsidiary/ JVC/ Group company etc. as applicable that they shall furnish performance guarantee for an amount of 10 % of the ex-works cost of such equipment(s) has been enclosed with bid? (in line with para 1.4 of Annexure-A, BDS Section-III , **Volume-I of the Bidding Documents**	
8.	Details of documents submitted along with the bid in support of the above stated experience.	

Format-E **Format for Proposed Erector as Sub contractor for the Manufacturer of GIS (Route 1, 2 & 3) of Annexure-A, BDS Section-III , Volume-I of the Bidding Documents**		
S. No	**Description**	**Details**
1.	Name of the Proposed Erector	
2.	Name of Contract Undertaken	
3.	Contract Reference No. & Date of Award	
4.	Name and Address of the Employer/Utility for whom the Contract was executed by the firm/Partner of a JV: Email: Telephone: Fax:	
5.	Voltage Level of GIS Substation or Switchyard commissioned under the Contract: (Indicate 66 kV or above Voltage class)	
	a) No. of Circuit Breaker equipped bays under the contract ***(Indicate nos. of GIS Circuit Breaker equipped bays of 66 kV or above voltage level)***	
	b) Name of the substation or switchyard	
	c) No. of years, the above Substation or switchyard has been in Satisfactory operational as on the originally scheduled	

Format-E **Format for Proposed Erector as Sub contractor for the Manufacturer of GIS (Route 1, 2 & 3) of Annexure-A, BDS Section-III , Volume-I of the Bidding Documents**		
S. No	**Description**	**Details**
	date of bid opening.	
	d) Scope of work involved under the Contract as per IEC: (*Strike off whichever is Not Applicable)*	i. Erected *ii.* Tested *iii.* Commissioned including Civil works
6.	Whether a consent letter (as per format Annexure-D2) from the proposed GIS manufacturer.	
7.	Details of documents submitted along with the bid in support of the above stated experience.	

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 the best three years out of last five financial years as annualized should be not less than:

MAAT = (1.5 x Estimated Cost) / completion period in years

Package- A :- MAAT = Rs 73,35,22,990.5
Package- B:- MAAT = Rs 59,77,19,940/-
Package- C :- MAAT = Rs 14,81,85,760.5

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

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

LA = (3 x estimated cost) /completion period in months

Package-A:- LA = Rs. 12,22,53,831.75
Package-B:- LA = Rs. 9,96,19,990/-
Package-C:- LA = Rs. 2,46,97,626.75

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

d) Relaxation for Start-Ups^/ MSEs

Start-Ups^/ MSEs, meeting the specified requirements at Para 2.0 (a) above in Financial Position shall also be considered qualified if they meet Eighty (80) % of the requirement specified at Para 2.0 (b) & 2.0 (c) above in Financial Position.

^ Start-Ups as defined by DIPP, applicable as on the originally scheduled date of bid

opening.

Note:

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

ii) In case bidder has established manufacturing facility in India and yet to complete three (3) financial years, the Net Worth and average of the turnover as per financial statement for completed financial years shall be considered for the purpose of compliance to the specified Net Worth and MAAT requirements

iii) In case of bidder qualifying through Route-3 but not meeting the Financial Position requirement as per note (i) read along with note (ii) above, the following shall be applicable:

In case bidder is yet to complete five (5) years from the date of commercial production of such equipment(s) but no later than seven (7) years from the date of incorporation of the said company as on the originally scheduled date of bid opening as above, the financial position requirement as per para 2.0 (b) & (c) of parent/principal company providing collaboration for Technological Support shall be considered. However, once he meets the turnover requirement on their own or completes five (5) years from the date of commercial production of such equipment (s) in India but no later than seven (7) years from the date of incorporation as on the originally scheduled date of bid opening as above, the financial position requirements as specified at 2.0 (b) and (c) above shall also be required to be met by such bidder on their own as per note (i) above and not based on their Parent/Principal company. Further, in case the bidder is yet to complete one (1) financial year, the Net worth requirement as per para 2.0 (a) above of Parent/Principal shall be considered.

Format E

Data in support of meeting the Financial Position as per Clause 2.0 (a) Annexure-A, BDS Section-III , Volume-I of the Bidding Documents

Name of the Bidder:

S. No.	Financial Year	Net worth			Details of documentary evidence submitted in support of Qualification Data
		Net worth (in Millions) Currency	Equivalent US$ (in Millions)	Exchange Rate*	

*(Indicate the rate(s) of exchange against US Dollar at the end of each year, which have been used for arriving the amount at equivalent US Dollar.)

Format F

Data in support of meeting the Financial Position as per Clause 2.0 (b) Annexure-A, BDS Section-III , Volume-I of the Bidding Documents

Name of the Bidder:

S.	Financial	Turnover Details	Details of

No.	Year	Turnover (in Millions) Currency	Equivalent US$ (in Millions)	Exchange Rate*	documentary evidence submitted in support of Qualification Data
Average Annual Turnover for best Three Years is:					
*(Indicate the rate(s) of exchange against US Dollar at the end of each year, which have been used for arriving the amount at equivalent US Dollar.)					

Format G **Data in support of meeting the Financial Position as per Clause 2.0 (c) Annexure-A, BDS Section-III , Volume-I of the Bidding Documents**			
Name of the Bidder:			
Description	**Currency**	**LA**	**Equivalent US$ (in Millions)**
Details of evidence of having Liquid assets (LA)			
OR			
Details of evidence of access to or availability of credit facilities			

3.0 JOINT VENTURE BIDS:

a) In case a bid is submitted by a Joint Venture (JV) of two or more firms as partners, all the partners of Joint Venture shall meet collectively the complete requirements stipulated at para 1.0 and 2.0 (b) & (c) above. Further, the partner(s) of JV must also meet the following minimum criteria:

i) All the partners of the JV shall meet individually the Financial Position criteria given at 2.0 (a) above.
ii) The Lead Partner shall meet, not less than 40% of the minimum Financial Position[$] criteria given at para 2.0 (b) & (c)
iii) Each of the other partner(s) individually shall meet not less than 25% of the minimum Financial Position[$] criteria given at para 2.0 (b) & (c) above

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.

b) However, for a JV to be qualified, the partners of JV must also meet the following minimum criteria:

i) One of the partner(s) of JV must meet the Technical Experience criteria and the requirements stipulated under Route-1 or Route-2 or Route-3 as per para 1.0 above

ii) The remaining partner(s) of JV must meet the Technical Experience criteria and the requirements stipulated under Route-1 or Route-2 or Route-3 as per para 1.0 above

OR

Supplied, erected, tested and commissioned, including CIVIL works of at least Two (02) nos.GIS circuit breaker bays@ 66kV or above voltage class in one(1) NEW GIS substations or switchyard during last seven (7) years and these Sub-Stations/bays must be in satisfactory operation# for at least two (2) years as on the originally scheduled date of bid opening.

Note :

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

2. (@) For the purpose of qualifying requirement, one no. of circuit breaker bay shall be considered as a bay used for controlling a line or a transformer or a 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.

3. ($) In case of a JV bid involving an Indian Entity qualifying through Route-3 and its Parent/ Principal company as partner(s), the Indian Entity shall meet the applicable Financial Position criteria on its own and not based on its Parent/Principal company

The information as per Format A to Format G for cl. 3.0 Annexure-A, BDS Section-III , Volume-I of the Bidding Documents) is to be provided in respect of all partners (Lead Partner and Other Partners) of Joint venture/consortium Bidder. Use a separate sheet in each case.

4.0) Financial & Capacity Requirements

Bidder shall be financially sound.

i. Bidder shall submit a certificate from their Banker(s) as per format indicating various fund based/non fund based limits sanctioned to the bidder and the extent of utilization as on date. Such certificate should have been issued not earlier than three months prior to the originally scheduled date of bid opening.

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

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

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

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

i. Their statutory Auditor; or

ii. A Certified Public Accountant; or

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

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

i) Their statutory Auditor; or

ii) A Certified Public Accountant; or

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

5.0 Financial & Capacity Requirements: Refer Cl. 4.0 of, Annexure-A, BDS Section-III , Volume-I of the Bidding Documents

(A) Details of Banker:

Name of Banker	
Address of Banker	
Telephone No.	
Contact Name and Title	
Fax No.	
E-mail ID	

(B) Certificate of Fund Based and Non Fund Based Limits sanctioned to the bidder and extent of utilization as on date issued by the banker:

S. No.	Name of Bank	Date of Issue of Certificate

(C) The monthly cash flow projection for execution of the contract having regard to implementation schedule along with proposed means to meet funding gap in each month, if any, is given below :-

S. No	Month	Anticipated Cash Flow	Source	Funding Gap	Proposed means to meet the funding gap
1)					
2)					
3)					

S. No	Month	Anticipated Cash Flow	Source	Funding Gap	Proposed means to meet the funding gap
4)					
5)					
6)					
7)					
8)					
9)					
10)					
11)					
12)					
13)					
14)					
15)					
16)					
17)					
18)					

(D) Annual Report, summarized actual Assets And Liabilities in Indian Rupees or equivalent (at the rates of exchange current at the end of each year to be indicated) for the last five years and, Based upon known commitments, summarized projected assets and liabilities in Indian Rupees equivalent for the next three years.

Financial Information in Indian Rupees	**Details for last five years preceding to the date of Bid Opening**				
	1st Year	**2nd Year**	**3rd Year**	**4th Year**	**5th Year**
1. Total Assets					
2. Current Assets					
3. Total Liabilities					
4.Current Liabilities					
5.Profit before Taxes					
6. Profit after Taxes					

(* Indicate the rate of exchange used in calculating the equivalent Indian Rupees amount)

(E) Audited Balance Sheet and Income Statements for the last five years (for the individual bidder or each partner of a Joint venture/consortium), as stated below are attached:

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

6.0 General Requirements

1. The bidder shall furnish documentary evidence in support of the qualifying requirement stipulated as above along with the bid.
2. All the Bidders shall submit the proof of work executed by them along with the Performance Certificates in support of their qualification.
3. The bidder shall have a project manager with 15 years experience in executing such contract of comparable nature including not less than five years as manager.
4. The bidder should have adequate after sales support facility and shall ensure availability of technical support in India so as to attend warrantee provisions under this contract.
5. For the purpose of qualifying requirement, one no. of circuit breaker bay shall be considered as a bay, used for controlling a line or a transformer or a bus coupler and comprising of at least one circuit breaker, two disconnectors and three nos. of single phase CTs/ Bushing CTs.
6. A Bidder shall submit only one bid in the same tendering process, either individually as bidder or as a partner of a Joint Venture or GIS manufacturer or EPC contractor. A bidder who submits or participates in more than one bid will cause all of the proposals in which the bidder has participated to be disqualified.

Date :……..

Place :…….

Signature …….

(Printed Name) ……

(Designation) ……

(Common Seal) …….

ATTACHEMENT-4

Tender No: T20R220201

Name of Package:

A :- **Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).**

B :- **Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).**

C :- **Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).**

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

LIST OF APPROVED SUBCONTRACTORS

Prior to award of Contract, the following details shall be completed indicating those sub-contractors proposed by the Bidder by Attachment to its bid that are approved by the Employer for engagement by the Contractor during the performance of the contract.

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

Item of Facilities	Approved Subcontractors	Nationality

ATTACHEMENT-5

Tender No: T20R220201

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

(Commercial Deviations)

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

Dear Sir,

The following are the Commercial Deviations and variations from and exceptions to the specifications and documents for the subject package. These deviations and variations are exhaustive. Except for these deviations, the entire work shall be performed as per your specifications and documents.

S.No.	Volume/Clause No.	Ref./Page No.	Details of Deviation	Reason/ Justification of Deviation	Withdrawal Price in Rupees

Date : (Signature) .....

Place : (Printed Name) .....

(Designation) .....

(Common Seal) .....

Note : Continuation sheets of like size and format may be used as per Bidder's requirements and annexed to this Schedule.

ATTACHMENT-6

Tender No: T20R220201

Name of Package:

A :- **Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).**

B :- **Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).**

C :- **Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).**

(DEVIATIONS ON IMPORTANT CONDITIONS)

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

Dear Sirs,

Sub. : Deviation on Important Conditions along with their withdrawal price.

The following are the Deviations/variations/exceptions to the provisions of important conditions stipulated in Clause 11.2 of ITB, Conditions of Contract, Volume-I. We undertake to execute the contract in line with the provisions of bidding documents in respect of above said clauses in case DTL agree to pay us the withdrawal price indicated below against each such deviations/variations/exceptions.

Volume of bidding document	Section	Clause No.	Page No.	Statement of deviations/ variations/ exceptions	Withdrawal Price in Rupees

Date :

Place :

(Signature) .....

(Printed Name) .....

(Designation) .....

(Common Seal) .....

Note : Continuation sheets of like size and format may be used as per Bidder's requirements and annexed to this Schedule.

ATTACHMENT-7

Tender No: T20R220201

Name of Package:

A :- **Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).**

B :- **Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).**

C :- **Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).**

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

Dear Sir,

Sub. : Technical Deviations.

The following are the Technical Deviations and variations from and exceptions to the specifications and documents for the subject package. These deviations and variations are exhaustive. Except for these deviations, the entire work shall be performed as per your specifications and documents.

S.No.	Volume/Clause No	Ref./Page No	Details of Deviation	Reason/ Justification of Deviation	Withdrawal Price in Rupees

Date :
Place :

(Signature) .....
(Printed Name) .....
(Designation) .....
(Common Seal) .....

Note: 1. Continuation sheets of like size and format may be used as per Bidder's requirements and annexed to this Schedule.

2. The deviations and variations, if any, shall be brought out separately for each of the equipment.

ATTACHMENT-8

Tender No: T20R220201

Name of Package:

A :- **Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).**

B :- **Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).**

C :- **Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).**

(**Additional Information)**

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

We have enclosed with our proposal the following additional information for the subject package.

Sl. No.	Brief description of Information	Ref. & Page No.

Date :

Place :

(Signature) .....

(Printed Name) .....

(Designation) .....

(Common Seal) .....

Note: Continuation sheets of like size and format may be used as per Bidder's requirements and annexed to this Schedule.

ATTACHMENT-9

Tender No: T20R220201

Name of Package:

A :- **Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).**

B :- **Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).**

C :- **Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).**

(BOUGHT-OUT & SUB-CONTRACTED ITEMS)

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

We hereby furnish the details of the items/sub-assemblies; we propose to buy for the purpose of subject package.

Sl. No.	Item Description	Quantity Proposed be bought/Sub-contracted	Source of Supply

Date :

Place :

(Signature) .....

(Printed Name) .....

(Designation) .....

(Common Seal) .....

Note : Continuation sheets of like size and format may be used as per Bidder's requirements and annexed to this Schedule.

ATTACHMENT-10

Tender No: T20R220201

Name of Package:

A :- **Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).**

B :- **Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).**

C :- **Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).**

(WORK COMPLETION SCHEDULE)

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

We hereby declare that the following Work Completion Schedule shall be followed by us for the subject package.

Sl. No.	**Description of Work**	**Period in Months (from the date of Award of Contract)**
1.	Completion of detailed engineering a) Commencement b) Completion	
2.	Procurement of equipment & raw materials	
3.	Tests a) Commencement b) Completion	
4.	Manufacturing a) Commencement b) Completion	
5.	Shipments a) Commencement b) Completion	
6.	Establishment of site office	
7.	Receipt at final destination at site a) Commencement b) Completion	
8.	Erection a) Commencement b) Completion	
9.	Testing & Commissioning a) Commencement b) Completion	

Date :
Place :

(Signature) .....
(Printed Name) .....
(Designation) .....
(Common Seal) .....

Note: Continuation sheets of like size and format may be used as per Bidder's requirements and annexed to this Schedule.

ATTACHMENT-11

Tender No: T20R220201

Name of Package:

A :- **Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).**

B :- **Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).**

C :- **Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).**

(LIST OF SPECIAL TOOLS & TACKLES)

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in.

We hereby furnish below the list of special tools & tackles for erection and commissioning of equipment for the subject package. The prices for these tools & tackles are already included in the lumpsum bid price.

Sl. No.	For Equipment	Item Description	Unit	Quantity

Date :

Place :

(Signature) .....

(Printed Name) .....

(Designation) .....

(Common Seal) .....

Note: Continuation sheets of like size and format may be used as per Bidder's requirements and annexed to this Schedule.

ATTACHMENT-12

Tender No: T20R220201

Name of Package:

A :- **Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).**

B :- **Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).**

C :- **Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).**

(INFORMATION REGARDING EX-EMPLOYEES OF "DTL")

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in.

We hereby furnish the details of Ex-Employees of DTL who had retired/resigned at the level of General Manager and above from DTL and subsequently have been employed by us.

Sl. No.	Name of Person with designation in DTL	Date of Retirement/ resignation from DTL	Date of joining and designation in our Organisation

Date :

Place :

(Signature) .....

(Printed Name) .....

(Designation) .....

(Common Seal) .....

Note: Continuation sheets of like size and format may be used as per Bidder's requirements and annexed to this Schedule.

ATTACHMENT-14

Tender No: T20R220201

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

(PRICE ADJUSTMENT DATA)

Refer BDS

ATTACHMENT-15

Tender No: T20R220201

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

(GUARANTEE DECLARATION)

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

Dear Sirs,

We declare that the ratings and performance figures of 11/0.433 kV Auxiliary three phase LT Transformer furnished by us for subject Package covered under this specification are guaranteed. We further declare that in the event of any deficiencies in meeting the guarantees in respect of the characteristics mentioned below as established after conducting the factory test, you may at your discretion, reject or accept the equipment after assessing the liquidated damages as specified in the relevant clauses of Bid document.

Equipment	**Guaranteed Losses at rated output (kW) per unit**		
	Copper Loss at 75^0C	**Iron loss at rated voltage and frequency**	**Cooler loss at rated voltage and frequency**
For Package-A			
630kVA Auxiliary LT Transformer (170kVp, BIL)			
630kVA Auxiliary LT Transformer (95kVp, BIL)			
For Package-B			
400kVA Auxiliary LT Transformer (170kVp, BIL)			
400kVA Auxiliary LT Transformer (95kVp, BIL)			
For Package-C	Not Applicable		

Date:.....

Place:.....

(Signature).....…….....……..

(Printed Name).....…….

(Designation).....…….....

(Common Seal).…….....

ATTACHMENT-16

Tender No: T20R220201

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

(Integrity Pact)

(Signature of Bidder)……

(Designation)…….....

(Stamp)…….

ATTACHMENT-16

Tender No: T20R220201

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

INTEGRITY PACT

Between

Delhi Transco Limited

having its Registered Office at Shakti Sadan, Kotla Road, New Delhi -110 002

hereinafter referred to as

"DTL"

and

(Insert the name of the Sole Bidder/Lead Partner of Joint Venture)

having its Registered Office at _____

(Insert full Address)

_____

and

_____

(Insert the name of the Partner(s) of Joint Venture/agent, as applicable)

having its Registered Office at _____

(Insert full Address)

_____

(Signature)_____ (Signature) _____

(For & On behalf of DTL)

(For & On behalf of Bidder/Partner(s) of Joint Venture/Contractor)

(Office Seal)

(Office Seal)

hereinafter referred to as

"The Bidder/Contractor"

Preamble

DTL intends to award, under laid-down organisation procedures, contract(s) for _____ Package
(Insert the name of the package)

and Specification Number _____DTL values full compliance with all relevant
(Insert Specification Number of the Package)
laws and regulations, and the principles of economical use of resources,and of fairness and transparency in its relations with its Bidders/Contractors.

In order to achieve these goals, DTL and the above named Bidder/Contractor enter into this agreement called **'Integrity Pact'** which will form a part of the bid.

It is hereby agreed by and between the parties as under:-

Section I – Commitments of DTL

(1) DTL commits itself to take all measures necessary to prevent corruption and to observe the following principles:

(a) No employee of DTL, personally or through family members or relative(s), will in connection with the tender, or the execution of the contract, demand, take a promise for or accept, for him/herself or third person, any material or other benefit which he/she is not legally entitled to.

(b) DTL will, during the tender process treat all Bidder(s) with equity and fairness. DTL will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or for the execution of contract.

(c) DTL will exclude form evaluation of Bids its such employee(s) who has any personnel interest in the Companies/Agencies participating in the Bidding/Tendering process.

The action stipulated in this Integrity Pact is without prejudice to any other Legal action that may follow in accordance with the provisions of the relevant law in force relating to any civil or criminal proceedings.

(Signature)_____ (Signature) _____

(For & On behalf of DTL)

(For & On behalf of Bidder/Partner(s) of Joint Venture/Contractor)

(Office Seal)

(Office Seal)

(2) If Managing Director obtains information on the conduct of any employee of DTL which is a criminal offence under the relevant Anti-Corruption Laws of India or illegal under the Indian Contract Act or Indian Laws, or if there be a substantive suspicion in this regard, he will inform its Chief Vigilance Officer and in addition can initiate disciplinary actions under its Rules.

Section II – Commitments of the Bidder/Contractor

(1) The Bidder/Contractor commits himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the tender process and during the contract execution.

(a) The Bidder/Contractor will not, directly or through any other person or firm, offer, promise or give to DTL, or to any of DTL's employees involved in the tender process or the execution of the contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange an advantage during the tender process or the execution of the contract.

(b) The Bidder/Contractor will not enter into any illegal agreement or understanding, whether formal or informal with other Bidders/Contractors. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or actions to restrict competitiveness or to introduce cartelization in the bidding process.

(c) The Bidder/Contractor will not commit any criminal offence under the relevant Anti-Corruption Laws of India, further, the Bidder/Contractor will not use for illegitimate purposes or for purposes of restrictive competition or personal gain, or pass on to others, any information provided by DTL as part of the business relationship, regarding plans, technical proposals and business details, including information of any type contained or transmitted electronically.

(d) The Bidder/Contractor of foreign origin shall disclose the name and address of the Agents/representatives in India, if any, involved directly or indirectly in the Bidding. Similarly, the Bidder/Contractor of Indian Nationality shall furnish the name and address of the foreign principals, if any, involved directly or indirectly in the bidding.

(Signature)_____ (Signature) _____

(For & On behalf of DTL)

(For & On behalf of Bidder/Partner(s) of Joint Venture/Contractor)

(Office Seal)

(Office Seal)

(e) The Bidder/Contractor will, when presenting his bid, disclose any and all payments he has made, or committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract and/or with the execution of the contract.

(f) The Bidder/Contractor will not misrepresent facts or furnish false/forged documents/information in order to influence the bidding process or the execution of the contract to the detriment of DTL.

(2) The Bidder/Contractor will not instigate third persons to commit offences outlined above or be an accessory to such offences.

Section III – Disqualification from tender process and exclusion from future contracts

(1) If the bidder, before contract award, has committed a serious transgression through a violation of Section II or in any other form such as to put his reliability or credibility as Bidder into question, DTL may disqualify the Bidder from the tender process or terminate the contract, if already signed, for such reason.

(2) If the Bidder/Contractor has committed a serious transgression through a violation of Section II such as to put his reliability or credibility into question, DTL may after following due procedures also exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of the transgression. The severity will be determined by the circumstances of the case, in particular the number of transgressions, the position of the transgressors within the company hierarchy of the Bidder/Contractor and the amount of the damage. The exclusion will be imposed for a minimum of 12 months and maximum of 3 years and it has to be decided by the Competent authority.

(3) If the Bidder/Contractor can prove that he has restored/Recouped the damage caused by him and has installed a suitable corruption prevention system, DTL may revoke the exclusion prematurely with the approval of Competent Authority.

Section IV – Liability for violation of Integrity Pact

(1) If DTL has disqualified the Bidder from the tender process prior to the award under Section III, DTL may forfeit the Bank Guarantee under the Bid.

(2) If DTL has terminated the contract under Section III, DTL may forfeit the Contract Performance Guarantee of this contract besides resorting to other remedies under the contract.

Section V – Previous Transgression

(Signature)_____ (Signature) _____

(For & On behalf of DTL)

(For & On behalf of Bidder/Partner(s) of Joint Venture/Contractor)

(Office Seal)

(Office Seal)

(1) The Bidder shall declare in his Bid that no previous transgressions occurred in the last 3 years with any other Public Sector Undertaking or Government Department that could justify his exclusion from the tender process.

(2) If the bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

Section VI – Equal treatment to all Bidders/Contractors

(1) DTL will enter into agreements with identical conditions as this one with all Bidders.

(2) DTL will disqualify from the tender process any bidder who does not sign this Pact or violate its provisions.

Section VII – Punitive Action against violating Bidders/Contractors

If DTL obtains knowledge of conduct of a Bidder or a Contractor or his subcontractor or of an employee or a representative or an associate of a Bidder or Contractor or his Subcontractor which constitutes corruption, or if DTL has substantive suspicion in this regard, DTL will inform the Chief Vigilance Officer (CVO).

(*)Section VIII – Independent External Monitor/Monitors

(1) DTL has appointed a panel of Independent External Monitors (IEMs) for this Pact with the approval of Central Vigilance Commission (CVC), Government of India, out of which one of the IEMs has been indicated in the NIT.

(2) The IEM is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement. He has right of access to all project documentation. The IEM may examine any complaint received by him and submit a report to Managing Director, DTL at the earliest. He may also submit a report directly to the CVO and the CVC, in case of suspicion of serious irregularities attracting the provisions of the PC Act. However, for ensuring the desired transparency and objectivity in dealing with the complaints arising out of any tendering process, the matter shall be referred to the full panel of IEMs, who would examine the records, conduct the investigations and submit report to Managing Director, DTL, giving joint findings.

(3) The IEM is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the Managing Director, DTL.

(Signature)_____ (Signature) _____

(For & On behalf of DTL)

(For & On behalf of Bidder/Partner(s) of Joint Venture/Contractor)

(Office Seal)

(Office Seal)

(4) The Bidder(s)/Contractor(s) accepts that the IEM has the right to access without restriction to all documentation of DTL related to this contract including that provided by the Contractor/Bidder. The Bidder/Contractor will also grant the IEM, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his documentation. The same is applicable to Subcontractors. The IEM is under contractual obligation to treat the information and documents of the Bidder(s)/Contractor(s)/Sub-Contractor(s) with confidentiality.

(5) DTL will provide to the IEM information as sought by him which could have an impact on the contractual relations between DTL and the Bidder/Contractor related to this contract.

(6) As soon as the IEM notices, or believes to notice, a violation of this agreement, he will so inform the Managing director, DTL and request the Managing Director, DTL to discontinue or take corrective action, or to take other relevant action. The IEM can in this regard submit non-binding recommendations. Beyond this, the IEM has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action. However, the IEM shall give an opportunity to DTL and the Bidder/Contractor, as deemed fit, to present its case before making its recommendations to DTL.

(7) The IEM will submit a written report to the Managing Director, DTL within 8 to 10 weeks from the date of reference or intimation to him by DTL and should the occasion arise, submit proposals for correcting problematic situations.

(8) If the IEM has reported to the Managing Director, DTL a substantiated suspicion of an offence under relevant Anti-Corruption Laws of India, and the Managing Director, DTL has not, within the reasonable time taken visible action to proceed against such offence or reported it to the CVO, the Monitor may also transmit this information directly to the CVC, Government of India.

(9) Theword'**IEM**' would include both singular and plural.

(*) This Section shall be applicable for only those packages wherein the IEMs have been identified in Section – I: Invitation for Bids and/or Clause 9 in Section –III : Conditions of Contract, Volume-I of the bidding documents.

Section IX – Pact Duration

This Pact begins when both parties have legally signed it. It expires for the Contractor after the closure of the contract and for all other Bidder's six month after the contract has been awarded.

Section X – Other Provisions

(Signature)_____ (Signature) _____

(For & On behalf of DTL)

(For & On behalf of Bidder/Partner(s) of Joint Venture/Contractor)

(Office Seal)

(Office Seal)

(1) This agreement is subject to Indian Law. Place of performance and jurisdiction is the establishment of DTL. The Arbitration clause provided in the main tender document/contract shall not be applicable for any issue/dispute arising under Integrity Pact.

(2) Changes and supplements as well as termination notices need to be made in writing.

(3) If the Contractor is a partnership firm or a consortium or Joint Venture, this agreement must be signed by all partners, consortium members and Joint Venture partners.

(4) Nothing in this agreement shall affect the right of the parties available under the General conditions of Contract (CC/GCC) and Special Conditions of Contract (SCC).

(5) Views expressed or suggestions/submissions made by the parties and the recommendations of the CVO/IEM[#] in respect of the violation of this agreement, shall not be relied on or introduced as evidence in the arbitral or judicial proceedings (arising out of the arbitral proceedings) by the parties in connection with the disputes/differences arising out of the subject contract.

CVO shall be applicable for packages wherein IEM are not identified in Section IFB/BDS of Condition of Contract, Volume-I. IEM shall be applicable for packages wherein IEM are identified in Section IFB/BDSof Condition of Contract. Volume-I

(6) Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

(Signature)_____	(Signature) _____
(For & On behalf of DTL)	(For & On behalf of Bidder/Partner(s) of Joint Venture/Contractor)
(Office Seal)	(Office Seal)
Name :_____	Name : _____
Designation: _____	Designation: _____
Witness 1 :_____	Witness 1 :_____
(Name &Address)_____	(Name & Address)_____

(Signature)_____	(Signature) _____
(For & On behalf of DTL)	(For & On behalf of Bidder/Partner(s) of Joint Venture/Contractor)
(Office Seal)	(Office Seal)

_____	_____
_____	_____
Witness 2 :_____	Witness 2 :_____
(Name &Address)_____	(Name & Address)_____
_____	_____
_____	_____

(Signature)_____	(Signature) _____
(For & On behalf of DTL)	(For & On behalf of Bidder/Partner(s) of Joint Venture/Contractor)
(Office Seal)	(Office Seal)

ATTACHMENT-18

Tender No: T20R220201

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

(CHECK LIST)

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

We have enclosed with our proposal the following additional information for the subject package.

	Particulars	
Bid Validity	Whether Bid is valid is as stipulated in ITB from the date of bid opening.	Yes/No
Bid Security amount	Whether Bid security amount and form is enclosed as per ITB.	Yes/No
Bid Security Validity	Whether bid security is valid for a period as stipulated in ITB.	Yes/No
Bid Signatory	Power of Attorney of Signatory of Bid as per Section ITB	Yes/No
	Technical Specification	
1.	Is the material offered according to the specifications required by the purchaser, if not, please state the deviation from the same and deviation statement thereof	Yes/No
2	Have you submitted copies of Type Test Certificates in physical form in respect of material offered?	Yes/No
3	Have you submitted dimension drawings leaflets, descriptive and illustrative catalogues in physical form (if necessary)?	Yes/No

4	Whether product conforms to relevant ISS and our technical particulars?	Yes/No
5	Have you submitted in physical form (i)the copy of NIT duly signed & stamped on each page ,(ii) copies of past supplies and (iii) performance certificates?	Yes/No
6	Whether testing facilities as per IS for conducting various tests are available with you?	Yes/No
	Terms and Condition	
1.	Do you agree to all clauses of General Conditions of our tender documents?	Yes/No
2	If you do not agree to any/all the clauses, please state clearly the clause which you do not agree and state the modification in respect of clauses of which you do not agree.	Yes/No
3	Do you agree to furnish security deposit if order is placed with you?	Yes/No
4	Whether agreeable to DTL's liquidate damages clause for late completion of work.?	Yes/No
5	Are you agreeable to inspection clause?	Yes/No
6	Any further particulars not otherwise covered in the tender specifications submitted physically?	Yes/No
7	Quantity offered against each item be quoted. Are you prepared to accept order for bigger quantity as per NIT ?	Yes/No
Part-I	**Techno-commercial Bid**	
a)	Whether undertaking for corrupt & fraudulent practice signed and submitted as per annexure XIX	Yes/No
b)	Whether Bid form duly completed, signed and submitted.	Yes/No
c)	Whether following Attachments submitted:	Yes/No
d)	Attachment 1 :"Bid security".	Yes/No
e)	Attachment 2: "Power of Attorney".	Yes/No
f)	Attachment 3: "Qualifying Requirement Data".	Yes/No
g)	Attachment 4: "List of approved Subcontractors".	Yes/No
h)	Attachment 5: "Commercial Deviations".	Yes/No
i)	Attachment 6: "Deviations on important Conditions".	Yes/No
j)	Attachment 7: "Technical Deviations".	Yes/No
k)	Attachment 8: "Additional Information".	Yes/No
l)	Attachment 9: "Bought Out and Sub-contracted items"	Yes/No
m)	Attachment 10: "Work completion schedule" .	Yes/No
n)	Attachment 11: "List of Special Tools and Tackles" .	Yes/No
o)	Attachment 12: "Information regarding ex-employees of Employer in	Yes/No

	Bidder's firm".	
p)	Attachment 14:"Price Adjustment Data."	Yes/No
q)	Attachment 15: "Guarantee Declaration".	Yes/No
r)	Attachment 16: "Integrity Pact".	Yes/No
s)	Attachment 18: "Check list".	Yes/No
t)	Attachment 19: Affidavit of Self certification regarding Local Content in line with PPP-MII order (submission of Hard Copy in 'Original'), to be submitted on a non-judicial stamp paper of Rs. 100/-.	Yes/No
u)	Attachment 20: Certificate from statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of Local Content, in line with PPP-MII orders and MoP orders, (submission of Hard Copy in 'Original') to be submitted on the letter head of the auditor/cost accountant/chartered accountant.	Yes/No
v)	Attachment 21: Undertaking for not indulging in Corrupt & Fraudulent practice	Yes/No
w)	Attachment 22: Certificate regarding compliance of Ministry of Finance order no- F.No.6/18/2019-PPD dt 23.07.2020.	Yes/No
Part-II	**Price Bid**	
a)	Whether Price Bid submitted.	Yes/No
b)	Whether Bid form duly completed, signed and submitted.	Yes/No
c)	Whether following Price Schedules submitted:	Yes/No
d)	Schedule 1: " Price break-up Plant and Equipment (including Mandatory Spares) to be supplied."	Yes/No
e)	Schedule 2: "Break-up of Local Transportation, Insurance and other Incidental Services."	Yes/No
f)	Schedule 3: "Price Breakup of Installation Charges."	Yes/No
g)	Schedule 4: "Grand summary of the quoted bid price."	Yes/No
Tender Document/NIT	Whether Tender document along with all amendments duly signed & stamped on each page submitted.	Yes/No

Date :
Place :

(Signature) .....
(Printed Name) .....
(Designation) .....
(Common Seal) .....

Note: **(i)** Continuation sheets of like size and format may be used as per Bidder's requirements and annexed to this Attachment.
(ii) Replies against each item should be complete without any ambiguity. Terms such as refer covering letter etc. shall not be acceptable unless the replies/ information are specific and complete

Attachement-19

Tender No: T20R220201

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

Format for Affidavit of Self certification regarding Minimum Local Content in line with PPP-MII order dt. 04.06.2020 & their latest amendments thereof, read in conjunction with MoP order dt. 28.07.2020 & their latest amendments thereof, if applicable, to be provided on a non-judicial stamp paper of Rs. 100/-.

Date:

I _____S/o, D/o, W/o, _____Resident of_____ hereby solemnly affirm and declare as under:

That I will agree to abide by the terms and conditions of the Public Procurement (Preference to Make in India) Order, 2017 (hereinafter PPP-MII order) of Government of India issued vide Notification Dt. 04.06.2020 & their latest amendments thereof**, 'Public Procurement (Preference to Make in India) to provide for Purchase Preference (linked with local content) in respect of Transmission Power Sector 'order dt. 28.07.2020 & their latest amendments thereof, issued by Ministry of Power (hereinafter MoP orders) and any subsequent modifications/Amendments, if any and**

That the information furnished hereinafter is correct to the best of my knowledge and belief and I undertake to produce relevant records before the procuring entity/Delhi Transco Limited or any other Government authority for the purpose of assessing the local content of goods/services/works supplied by me for **subject package_____.**

That the local content for all inputs which constitute the said goods/services/works has been verified by me and I am responsible for the correctness of the claims made therein.

That the goods/services/works supplied by me for **subject package_____**meet the 'Minimum Local Content 'as defined in the PPP-MII order **and MoP orders.**

That the value addition for the purpose of meeting the 'Minimum Local Content 'has been made by me at …… (Enter the details of the location(s) at which value addition is made).

That in the event of the local content of the goods/services/works mentioned herein is found to be incorrect and not meeting the prescribed Minimum Local Content criteria, based on the assessment of procuring agency (ies)/Delhi Transco Limited /Government Authorities for the purpose of assessing the local content, action shall be taken against me in line with the PPP-MII order, **MoP orders** and provisions of the Integrity pact/ Bidding Documents.

I agree to maintain the following information in the Company's record for a period of 8 years and shall make this available for verification to any statutory authority.

i Name and details of the Local Supplier
(Registered Office, Manufacturing unit location, nature of legal entity)

ii. Date on which this certificate is issued

iii. Goods/services/works for which the certificate is produced

iv. Procuring entity to whom the certificate is furnished

v. Percentage of local content claimed and whether it meets the Minimum Local Content prescribed

vi. Name and contact details of the unit of the Local Supplier (s)

vii. Sale Price of the product

viii Ex-Factory Price of the product

ix. Freight, insurance and handling

x. Total Bill of Material

xi List and total cost value of input used to manufacture the Goods/to provide services/in construction of works

xii. List and total cost of input which are domestically sourced. Value addition certificates from suppliers, if the input is not in-house to be attached

xiii. List and cost of inputs which are imported, directly or indirectly

For and on behalf of…… (Name of firm/entity)

Authorized signatory

(To be duly authorized by the Board of Directors)

<Insert Name, Designation and Contact No.>

Attachment-20

Tender No: T20R220201

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

Certificate from statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of Local Content, in line with PPP-MII orders dt. 04.06.2020 & their latest amendments thereof, read in conjunction with MoP order dt. 28.07.2020 & their latest amendments thereof, if applicable [to be submitted on the letter head of the issuer.]

Dear Sir,

We have read and understood the provisions of "Public Procurement (Preference to Make in India) Order, dt. 04.06.2020 & their latest amendments thereof [hereinafter, " PPP-MII Order"] issued by Department of Industrial Policy and Promotion (DIPP), Ministry of Commerce and Industry, Government of India, ' Public Procurement (Preference to Make in India) to provide for Purchase Preference (linked with local content) in respect of Transmission Power Sector ' order dt. 28. 07.2020 & their latest amendments thereof, issued by Ministry of Power [hereinafter, "MoP order"]and any subsequent modifications/Amendments, if any.

In line with the provisions of the PPP-MII Orders and MoP orders, M/s. ……[Enter the name of the Bidder] [hereinafter, "Local Supplier"] have submitted an Affidavit of self-certification to M/s. Delhi Transco Limited regarding Local Content in Goods/Services/Works to be supplied by the Local Supplier for subject package_____, wherein they have agreed to abide by the terms and conditions of the PPP-MII Orders and MoP orders.

Further, in line with the PPP-MII Orders, the statutory auditor or cost auditor of the company (in the case of companies) or a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) shall provide a certificate giving the percentage of Local Content in the Goods/Service/Works to be supplied by the Local Supplier for subject package_____.

Accordingly, we, the Statutory Auditor(s) / Cost auditor (applicable in the case of companies) of the Local Supplier / a practicing cost accountant or practicing chartered accountant (applicable in respect of suppliers other than companies), certify that the Local Content as defined under the PPP-MII and MoP orders, in the Goods/Service/Works to be supplied by the Local Supplier for subject package_____ is …….. percentage [specify the percentage of Local content].

For and on behalf of, Date:

<<Statutory Auditor's/ Cost auditor's/ Cost accountant's/ Chartered accountant's attestation>>
Firm Reg No. Membership No.

Note: This is a guiding format. In case the bidder submits the certificate in a format different from the above, the same may be considered provided it meets the intent and purpose, as may be ascertained by Delhi Transco Limited

ATTACHMENT-21

Tender No: T20R220201

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

UNDERTAKING FOR NOT INDULGING IN CORRUPT & FRAUDULENT PRACTICE

Bidder's Name & Address:

To,

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in.

We declare that all the documents submitted or would be submitted by us in this tender are/would be genuine, and in case any discrepancy is found in the declaration/documents submitted by us at any stage, action can be taken against us as deemed fit by DTL.

We further declare that in the submission of this tender no agent, middleman or any intermediary has been, or will be engaged to provide any services, or any other item of work related to the award and performance of this contract. We further confirm and declare that no agency commission or any payment which may be construed as an agency commission has been, or will be, paid and that the tender price does not include any such amount.

We acknowledge the right of the employer, if he finds to the contrary, to declare, our tender to be non-compliant and if the contract has been awarded to declare the contract null and void.

STAMP & SIGNATURE OF AUTHORISED SIGNATORY

ATTACHMENT-22

Tender No. T20R220201

Name of Package:

A :- Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

B :- Turnkey package "B" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

C :- Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

Format for Self certification regarding compliance of Ministry of Finance order no-F.No.6/18/2019-PPD dt. 23.07.2020 to be provided.

Bidder's Name and Address:

Name:…….

Address:…….

……

To:

Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002 (India),
Phone: 23230026, Fax No. 011-23232721,
Email: niraj.sharma@dtl.gov.in

Dear Sir,

We have read and understood the provisions of Order no. F.No.6/18/2019-PPD(Order Public Procurement no.1) dated 23/07/2020 regarding "Restriction under Rule 144(xi) of General Financial Rules" and F.No.6/18/2019-PPD (Order Public Procurement no.2) dated 23/07/2020 regarding "Exclusions from Restriction under Rule 144(xi) of General Financial Rules" issued by Public Procurement Division, Department of Expenditure, Ministry of Finance, Government of India [hereinafter collectively "**DoE Order**''] and any subsequent modifications/Amendments, if any.

Particularly, we, the Bidder, have read the clause regarding restrictions on procurement from a 'Bidder of a country which shares a land border with India' and on sub-contracting to contractors from such countries.

We certify that we, the bidder is not from such a country or, if from such a country, has been registered with the Competent Authority and will not subcontract any work to a subcontractor/sub vendor from such countries unless such subcontractor/sub vendor fulfils all requirement in this regard and is eligible to be considered. [*Where applicable, evidence of valid registration by the Competent Authority shall be attached*.]

We further declare that any misrepresentation or submission of false/forged document/information in this regard, this would be ground for immediate termination and further legal action in accordance with law.

Date: Printed Name:

Place: Designation:

SECTION-III

GUARANTEED TECHNICAL PARTICULARS

Guaranteed Technical Particular - GIS

A. Complete GIS Module

1.	Nominal voltage of system	kV
2.	Rated voltage of system	kV
3.	Rated voltage for equipment (*U*r)	kV
4.	**Rated insulation levels phase-to-earth and between phases**	
	Rated short-duration power-frequency withstand voltage (*U*d)	kV
5.	**Rated switching impulse withstand voltage (*U*s)**	
	Phase-to-earth	kV
	Between phases	kV
6.	Rated lightning impulse withstand voltage (*U*p)	
7.	Rated frequency (*fr*)	Hz
8.	Rated normal current (Ir)	A
9.	Rated short-time withstand current (Ik)	kA
10.	Rated peak withstand current (Ip)	kA
11.	Rated duration of short-circuit (tk)	s
12.	Rated supply voltage of closing and opening devices and of auxiliary and control circuits (*U*a)	V
13.	Rated supply frequency of closing and opening devices and of auxiliary circuits	Hz DC or 50 or 60
14.	Neutral earthing Solidly or not solidly	
15.	Number of phases	
16.	Single- or three-phase design	
17.	Maximum SF6 leakage rate	% / year
18.	Rated filling pressure *p*r	
	Circuit-breaker	
	Other compartments	
19.	Alarm pressure *p*a	
	Circuit-breaker	
	Other compartments	
20.	Minimum functional pressure *p*m	
	Circuit-breaker	
	Other compartments	
21.	Design pressure of enclosures	
	Circuit-breaker	
	Other compartments	
22.	Type test pressure of enclosures	
	Circuit-breaker	
	Other compartments	

23. Routine test pressure of enclosures

    Circuit-breaker
    Other compartments

24. Operating pressure of pressure relief device

    Circuit-breaker
    Other compartments

25. Internal fault

    Short-circuit current kA

26. Quantity of SF6 gas of complete GIS at filling pressure kg

27. Quantity of SF6 gas of the largest compartment at filling pressure kg

28. Maximum permissible gas dew point °C

29. Number of gas compartments

30. Length of longest section for transportation m

31. Weight of the heaviest piece of equipment to be handled during installation on-site kg

B. Bus ducts

1. Inductance H/m
2. Capacitance pF/m
3. Resistance of enclosure at *f*r Ω/m
4. Resistance of conductor at *f*r Ω/m
5. Surge impedance Ω

C. Bushing (Outdoor-immersed bushing)

1. Type of internal insulation
2. Type of external insulation
3. Nominal specific creepage distance mm/kV
4. Shed profile Normal or alternating
5. Rated short-duration, power-frequency kV
6. withstand voltage (*U*d)
7. Rated switching impulse withstand voltage (*U*s) kV
8. Rated lightning impulse withstand voltage (*U*p) kV
9. Cantilever test load N
10. Cantilever operation load N
11. Type of line termination

(TO BE FILLED IN AND SIGNED BY THE TENDERER)

SCHEDULE OF THE GUARANTEED TECHNICAL PARTICULARS
SF6 CIRCUIT BREAKER

01.	Name of manufacturer	:
02.	a) Type of circuit breaker	:
	b) Type of tank (Live/Dead)	:
03.	Manufacturer's type and designation	:
04.	Standards applicable	:
05.	Rated voltage (KV)	:
06.	Rated insulation level	:
07.	Rated Frequency (Hz)	:
08.	Class	:
09.	Number of poles	:
10.	Whether 3 pole or single pole unit	:
11.	No. of breaks per pole	:
12.	Normal current rating (amps)	
	(a) Under standard conditions	:
	(b) Under site conditions	:
	(c) De-rating factor, if any for site conditions	:
	(d) Temperature rise at 150% rating for 3 hours.	:
13.	Short time current rating (KA) for 1 second	:
14.	Maximum temperature rise over ambient (C) due to rated current in main contacts, measured after breaking test	:
15.	Rated short circuit breaking current	
	a. Rated short circuit current (Symmetrical AC component) KA (rms)	:
	b. Percentage DC component	:
	c. Asymmetrical breaking Current (including DC component) KA (rms)	:
16.	Making capacity (KA peak)	:
17.	Total break time (Milli-seconds)	
	(a) For interruption of 10% of the rated capacity	:
	(b) For interruption of 30%	:

of the rated capacity

(c) For interruption of 60% : of the rated capacity

(d) For interruption of the full : rated capacity

18. Arcing time (Milli-seconds) :

19. Opening time & break time :

20. Closing time (Milli-second) :

21. Rated Operating Sequence :

22. Minimum re-closing time at rated : interrupted capacity from the instant of the trip coil energisation (Milli-seconds)

23. Minimum dead time
    (a) 3 phase re-closing : (Milli seconds) :
    (b) Limit of adjustment of dead : Time for 3 phase re-closing
    (c) 1 phase re-closing : (Milli seconds)

24. Data on re-striking voltage for 100%, 50% or 30% rated capacity
    (a) Amplitude factor :
    (b) Phase factor :
    (c) Natural frequency (Hz) :
    (d) Rate of rise of re-striking : Voltage (V/Micro sec.)

25. Rated out of phase breaking current :

26. Rated line charging breaking current :

27. Maximum line charging current : breaking capacity and corresponding Over voltage recorded in test
    (a) On supply side :
    (b) On line side :

28. Maximum cable charging current breaking capacity and corresponding over voltage recorded in test
    (a) On supply side :
    (b) On line side :

29. Rated single capacitor bank
    (a) Capacitive in rush current : Handling capability
    (b) Capacitive breaking current :

Capability

30. Rated small inductive breaking current and the corresponding over voltage. :

31. First pole to clear factor :

32. Rated transient recovery voltage for terminal faults :

33. Rated characteristic for short line faults i.e. rate of rise. :

34. Dry-1 minute power frequency test withstand voltage for complete circuit breaker

    (a) Between line terminal and grounded Parts (KV rms.) :

    (b) Between terminals with breakers Contacts open (KV rms.) :

    (c) Between poles. :

35. Wet-1 minute power frequency test withstand voltage

    (a) Between line terminal and grounded parts (KV rms) :

    (b) Between terminals with breakers contacts open (KV rms) :

36. 1.2/50 microsecond wave impulse with stand test voltage for complete circuit breaker

    (a) Between line terminals and ground (KV peak) :

    (b) Between terminals with circuit Breaker contacts :

    (c) Between poles :

37. Minimum clearance

    (a) Between phases (mm) :

    (b) Live parts and earth (mm) :

    (c) Live parts to ground level (mm) :

38. Number of operation possible without maintenance

    (a) At full rated interrupting capacity :

    (b) At 150% of rated current :

    (c) At 100% of rated current :

    (d) At 50% of rated current :

39. **SUPPORTING INSULATORS**

(a) Make and type

(b) Weight

(c) Transport dimensions

(d) Insulation class

(e) Visible corona discharge voltage

(f) Dry-1 minute power frequency
Flash over / voltage

(g) Wet one minute power frequency
Flash over / withstand voltage.

(h) 1.2/50 microsecond impulse
flashover / withstand voltage.

(i) Creepage distance to ground (mm) for
heavily polluted atmosphere :

(i) Total

(ii) Protected

40. No. of poles per circuit breaker :

41. No. of breaks per pole

42. Total length of breaks per phase (mm)

43. Type of main contacts

44. Material of main contacts

45. Whether main contacts silver plated (Yes/No)

46. Thickness of silver coating on main contacts (mm)

47. Contact pressure on arcing contacts (Kg/m2)

48. Type of arcing contacts.

49. Contact pressure on main contacts (Kg/m2)

50. Type of auxiliary switches

51. Whether contacts of auxiliary switches silver plated (Yes / No)

52. No. of auxiliary switch contacts
operating with all three poles of breaker

(a) Which are closed when breaker :
is closed

(b) Which are open when breaker is closed :

(c) Those adjustable with respect to :
the position of main contacts.

53. No. of spare auxiliary switch contacts
operation with all three poles of breaker

(a) Which are closed when :
Breaker is closed.

(b) Which are open when breaker :
Is closed.

(c) Those adjustable with respect to the position of main contacts :

54. Number of spare terminal block :

55. Tripping and closing circuit voltage(V) :

56. Power required for trip coil :

57. Power required for closing coil :

58. Contingencies for which alarm Provided :

59. Design data for supporting structure :

60. Weight of supporting steel structure for breaker :

61. Whether descriptive leaflets enclosed (Yes/No) :

FOR SF6 GAS CIRCUIT BREAKER:

62. Rated pressure of SF6 Gas in the gas cylinder (Kg./cm2) :

63. Quantity of SF6 gas required per single pole unit (Kg.) :

64. a) Quantity of SF6 gas per cylinder (Kg.) :

b) Guaranteed maximum leakage rate per year (kg / sq. cm) :

65. Weight of empty cylinder (Kg.) :

66. Quantity of absorbent required per pole (Kg) :

67. Recommended interval for renewal of absorbent in case of outdoor Circuit breaker operating in tropical conditions. :

68. Chemical composition of the absorbent :

69. Quantity of absorbent covered in the scope of supply (including spare qty (Kg) :

70. Limit of gas pressure for proper operation of circuit breaker :

71. Pressure at which the temperature compensated gas pressure switch will

(a) Give alarm :

(b) Cut off :

72. Name of SF_6 supplier and country of origin :

73. Quantity of SF_6 gas supplied for

(a) Actual use in breakers (Kg.) :

(b) As spare (Kg.) :

74. Chemical composition of gas

(a) Qty. of air by weight (ppm) :

(b) Qty of H_2O by weight (ppm) :

	(c) Qty of CF4 by weight (ppm)	:	
75.	Type of operating mechanism offered	:	
76.	Dimension of the control cabinets	:	
78.	Weight of control cabinet	:	
79	Seismic level for which Breaker is designed (g)	:	
80.	Compliance to technical specification	:	
	w.r.t parameters specified for		
	i) Control Cabinet		i) YES / NO
	ii) Bushing/support Insulator		ii) YES / NO
	iii)Terminal connector.		iii) YES / NO
	iv) SF6 Gas		iv) YES / NO

81. Detailed Literature

a) Whether similar equipment are type tested as per IEC/IS and are in successful operation for atleast 2 (two) years (If yes, furnish type test reports)

b) Furnish data on capabilities of circuit breaker in terms of time and number of operations at duties ranging from 100 % fault currents to load currents of the lowest possible value without requiring any maintenance or checks

c) Furnish details of effect of non simultaneity between contacts within a pole or between poles and also show how it is covered in the guaranteed rated break time.

d) Overall General Arrangement drawing of circuit breaker is to be enclosed.

WEIGHT AND SPACE REQUIREMENT:

82. Weight of 3-phase breaker complete with operating mechanism, insulating supports frame work etc.

83. Impact loading for foundation design to include dead load plus impact value on opening at maximum interrupting rating in terms of equivalent of static load.

84. Weight of heaviest package.

GUARANTEED TECHNICAL PARTICULARS

ISOLATORS

01. Name and address of the manufacturer
02. Manufacturer's type designation
03. Standard applicable
04. Type and catalogue No. of Isolators.
05. Rated current under site conditions
    at 50 deg. C ambient. (Amps)
06. System voltage.
07. Rated voltage
08. Rated frequency (Hz)
09. Number of poles
10. Whether all 3 poles are ganged mechanically YES / NO
11. Pole to pole spacing (mm)
12. Rated short time current of isolator and
    earth switch for 1(one) second and
    dynamic current
13. Opening time of isolator and earth switch
14. Closing time of isolator and earth switch
15. Rated mechanical terminal load
16. Dielectric withstand capacity
    of completely assembled isolator/ earth switch
17. One minute dry power frequency withstand test voltage
    i) against ground (kVrms)
    ii) across isolating distance (kVrms)
18. 1.2/50 micro sec impulse withstand test voltage
    i) against ground (kVp)
    ii) across isolating distance **(**kVp)
19. Maximum magnetizing current make/break capacity.
20. Earthing switch making capacity for discharging line charge.
21. Construction Rate:
    a) Number of break per circuit per pole.
    b) No. of Isolators pedestals on one phase.
    c) Type of contacts
    d) Contact Area (sq.cm)
    e) Type of hearing or rotating insulator.
    f) Material for rotating blade.
    g) Material for contact.
    h) Max. Current density
    i) Thickness of silver plating (Microns)
22. Minimum clearance in air:
    a) Between poles
    b) Between live parts and earth
23. Number of auxiliary switches in operating mechanism:
    a) Normally close
    b) Normally open.
24. Earthing device:
    a) Short time current rating.
    b) One second.

25. Total weight of one complete triple pole isolator.
26. Mounting structure weight.
27. Terminal connectors.
28. Operating device details.
29. Operating Mechanism
    i) For main blades
    ii) For earth switches
30. Controls
    i) Rated DC control voltage (V)
    ii) Limits of voltage
31. Rated Insulation level.
32. Radio interference level at 1.1 Ur/ root 3 (in micro volts) at 1 MHz
33. Corona Extinction voltage (kV rms)
34. Compliance to Technical specification w.r.t
    i) MOM Box — i) YES / NO
    ii) Support insulators — ii) YES / NO
    iii) Terminal Connectors — iii) YES / NO
35. Whether similar equipment are type tested as per IEC / IS and are in successful operation for at least 2 (two) years — YES / NO
36. Overall General Arrangement drawing of Isolator/ Earthswitch is to be enclosed.

TECHNICAL DATA REQUIREMENT

……
(Bidder's Name)

CURRENT TRANSFORMERS

1.	Name and address of manufacturer	……
2.	Manufacturer's type designation	……
3.	Standards applicable	……
4.	Type of CT (Live or Dead Tank Type)	……
5.	Rated frequency (Hz)	……
6.	Rated voltage Ur (kV)	……
7.	Rated current	
	i) Rated continuous current (Amps)	……
	ii) Rated extended primary current (Amps)	……
8.	Short time thermal current withstand for 1 sec(kA)	……
9.	Dynamic current withstand (kAp)	……
10.	1.2/50 micros impulse withstand voltage (kVp)	……
11.	250/2500 micro sec switching surge withstand voltage (dry and wet) (kVp)	……
12.	One minute dry and wet power frequency withstand voltage (kV rms)	……
13.	No. of primary winding	……
14.	No. cores per CT	……
15.	Current ration (for all cores)	……
16.	Output Burden (for all cores)	……
17.	Accuracy class (for all cores)	……
18.	Knee point voltage at different taps (v) (for all cores)	……
19.	Instrument security factor at different ratios for meeting cores	……
20.	Radio intereference voltage at 1.1 Ur/3 at 1.0 MHz (Micro Volts)	……
21.	Corona extinction voltage (kV rms)	……
22.	Partial discharge level (PC)	……
23.	Standard to which oil conforms generally	……
24.	Total weight (kg)	……
25.	Whether similar equipment are type tested	YES / NO

and in successful operation for at least 2 years.

26.	Maximum exciting current at knee point voltage at different ratios (for all cores) (mA)	……
27.	Secondary winding resistance at all different ratios (for all cores) (Ohms)	……
28.	Overall General arrangement drawing of CT is to be enclosed	……

VOLTAGE / POTENTIAL TRANSFORMERS

GUARANTEED TECHNICAL PARTICULARS

1. Type
2. Manufacturer's Type
3. Designation
4. Rated Voltage
5. Rated Primary Voltage
6. Rated Secondary Voltage
7. Number of cores

		Rated Output	Class of Accuracy	Ratio Error	Phase Angle Error
	CORE-I				
	CORE-II				
	CORE-III				

8. One minute power frequency dry withstand test voltage — KV rms
9. One minute power frequency wet withstand test voltage — KV rms
10. 1.2/50 microsecond impulse withstand crest voltage — KV peak
11. One minute power frequency withstand voltage on secondaries — KV rms
12. Temp. rise of winding at rated voltage factor :
    - i) At 1.2 voltage factor for continuous rating :
    - ii) At 1.5 voltage factor for 30 seconds rating :
13. Creepage distance of Bushing
14. Protected creepage distance
15. Weight of oil — Kg.
16. Weight of core — Kg.
17. Total Weight — Kg.
18. Mounting details
19. Overall dimensions

GUARANTED TECHNICAL PARTICULARS LIGHTING ARRESTOR

1. Name of the Manufacturer :
2. Type
3. Model
4. No. of the Units
5. Rated Voltage of Arrester : KV (rms)
6. Nominal Discharge Current : Amps.
7. Minimum Power frequency discharge voltage : KV (rms)
8. Dry & wet power frequency withstand voltage of arrester insulation : KV (rms)
9. Max. continuous operating voltage : KV (rms)
10. Protective level of the arrester :
11. Ratio of system voltage with stand level to protection level of surge arrestor :
12. Max. residual voltage for discharge current of (8/20 micro second wave) :KV (Peak)
    (i) 5000 Amps.
    (ii) 10000 Amps.
    (iii) 20000 mps
13. High current impulse with stand 4/10 micro second peak value :KV
14. Leakage current through Arrestor at COV:
    (i) Capacitive
    (ii) Resistive
    (iii) Total
15. Long Duration current test
    (i) Current peak :
    (ii) Virtual duration :
16. Creep age distance (suitable for heavily polluted atmosphere) :
17. Pressure relief class :
18. Long duration discharge class :
19. Type & specification of the surge counters :
20. Type & range of mili ampere meter :
21. Mounting flanges dimensional details :
22. Earthing arrangement provided for earthing side of arrestor :
23. Clearance required from grounded equipment at various heights of arresters unit: mm
24. Min. recommended spacing between arresters center to center :

25. Height of complete unit from base to the line side : mm
26. Weight of complete unit :

GUARANTEED AND OTHER PARTICULARS FOR DISTRIBUTION TRANSFORMERS
(To be furnished by the Manufacturer)

Sl. No. Description

1. Make
2. Name of Manufacturer
3. Place of Manufacture
4. Voltage Ratio
5. Rating in kVA
6. Core Material used and Grade:
   a) Flux denisity
   b) Over fluxing without saturation
      (Curve to ber furnished by the Manufacturer in support of his claim)
7. Maximum temperature rise of:
   a) Windings by resistance method
   b) Oil by thermometer
8. Managetising (no-load) current at:
   a) 90% Voltage
   b) 100% voltage
   c) 110% Voltage
9. Core loss in watts:
   a) Normal voltage
   b) Maximum voltage
10. Resistance of windings at 20 C
    (with 5% tolerance):
    a. HV Winding (ohms)
    b. LV Winding (ohms)
11. Full load losses (watts) at 75 deg C
12. Total Losses at 100% load at 75 deg C
13. Total Losses at 50% load at 75 deg C
14. Current density used for : (Amper/sq mm)
    a) HV Winding
    b) LV Winding
15. Clearances : (mm)
    a) Core and LV
    b) LV and HV
    c) HV phase to phase
    d) End insulation clearance to earth
    e) Any point of winding to tank
16. Efficiency at 75 deg C:
    a) Unity P.F. and
    b) 0.8 P.F.
    1) 125% load

2) 100% load
3) 75% load
4) 50% load
5) 25% load

17. Regulation at:
    a) Unity P.F.
    b) 0.8 P.F. at 75 deg C
18. % Impedance at 75 deg C
19. Flash Testy:
    i) HV 28 kV/50 HZ for 1 minute
    ii) LV3 kV/50 Hz for 1 minute
20. Over potential Test (Double Voltage and Double frequency for 1 minute)
21. Impulse test
22. Mass of :(kg)
    a) Core lamination (minimum)
    b) Winding (minimum)
    c) Tank and fittings
    d) Oil
    e) Oil quantity (minimum) (litre)
    f) Total weight
23. Oil Data:
    1. Quantity for first filling (minimum) (litre)
    2. Grade of oil used
    3. Maker's Name
    4. BDV at the time of filling (kV)
24. Transformer:
    1) Overall length x breadth x height (mm x mm x mm)
    2) Tank length x breadth x height
    3) Thickness of plates for
        a) Side plate (min)
        b) Top and bottom plate (min)

    4) Conservator Dimensions

25. Radiation:
    1. Heat dissipation by tank walls excluding top and bottom
    2. Heat dissipation by cooling tune
    3. Diameter and thickness of cooling tube
    4. Whether calculation sheet for selecting cooling Area to ensure that the transformer is capable of giving continuous rated output without Exceeding temperature rise is enclosed.
26. Inter layer insulation provided in design for:
    1) Top and bottom layer
    2. In between all layer
    3) Details of end insulation

4) Whether wedges are provided at 50% turns of the HV coil

27. Insulation materials provided
    a) For Conductors
        1) HV
        2) LV
    b) For Core

28. Material and size of the wire used
    1. HV Dia (mm) (SWF)
    2. LV a) strip size
        b) No. of Conductors in parallel
        c) Total area of cross section (sq mm)

29. Whether the name plate gives all particulars as required in Tender

30. Particulars of bushings HV/LV
    1) Maker's name
    2) Type IS-3347/IS-2099/S7421
    3) Rating as per IS
    4) Dry power frequency voltage withstands testy
    5) Wet power frequency voltage withstand test

GUARANTEED TECHNICAL PARTICULARS FOR D.G. SET.

1.00.0 General

1.01.0 Contract's Name & Address

1.02.0 Manufacturer's, type and address

a. Diesel Engine.

b. Alternator

c. Exciter

d. Battery

2.00 Engine

2.01 Rating

2.02 Revolutions per min.

2.03 Number and arrangement of cylinder.

2.04 No. of strokes. .

2.05 Method of starting.

2.06 Time required for starting

2.07 Auxiliary Power consumption

2.08 Type of Governor

2.09 Sensitivity of Governor

2.10 Guaranteed limits of Governing

a. Permanent variation

b. Full Load thrown off

c. Full load put on.

2.11 Total speed variation

2.12 Specification of fuel oil.

2.13 Specification of Lub oil

2.14 Guaranteed fuel consumption

a. At full load

b. At ¾ load

c. At ½ load

d. At ¼ load

2.15 Lub. oil consumption

2.16 Mechanical efficiency

2.17 Thermal efficiency

2.18 Method of aspiration

2.19 Method of cooling of engine and lub. oil.

2.20 Amount of water required for cooling system.

2.21 Total weight.

2.22 Space requirement including clearances

2.23 Maker's name, type and technical literature for the following:

a. Air filter & silencer.

b. Thermometer.
c. Pressure Gauges.
d. Level indicator
e. Tachometer.
f. Fuel oil pump.

2.24 Mechanical auxiliaries loads connected on Radiator fans 5 HP Main shaft with wiring.

2.25 Rated engine power and the ambient conditions at which rated power is defined.

2.26 Direction of rotation.

3.00 Storage Tank. (Outside)

a. Type and shade.
b. Capacity
c. Number Specifies.
d. Material of construction.
e. Overall dimensions.
f. Plate thickness.
g. Installation paint.

4.00 Alternator.

4.01 Rated KW capacity.
4.02 Rated KVA capacity.
4.03 Rated Terminal Voltage.
4.04 Rated Power Factor.
4.05 Rated Stator Current.
4.06 Rated Speed.
4.07 Rated Frequency
4.08 No. of phases/ Terminals brought outside
4.09 Excitation current and voltage at rated 3 Amp DC power output and power factor.
4.10 Efficiencies at 0.8 power factor at

a. 100% load
b. 75% load.
c. 50% load.
d. 25% load.

4.11 Inherent regulation (%)
4.12 Impedance

a. X_a dir axis synchronous.
b. X'd dir axis transient.
c. X^n dir axis sub transient.
d. X_q quad axis reactance.
e. X^n_q quad axis sub transient.

4.13 Type of exciter used; capacity &rating of exciter
4.14 Class of Insulation.

4.15 Permissible Temp. Rise of.

a. Armature winding.

b. Field winding.

c. Bearing

4.16 Short circuit ratio

4.17 Rotor air gap

4.18 Overload capacity

4.19 Insulation level test voltage

4.20 Total weight &dimensions.

4.21 Applicable standard.

4.22 Automative voltage regulator type, technical specifications and characteristics curves.

4.23 Electrical auxiliaries load connected to generator terminals with rating.

5.00 Engine Alternator Set.

5.01 Starting time.

5.02 Interval between staring impulse.

5.03 No. of starting impulse.

5.04 Time for picking up the load.

5.05 Voltage variation

5.06 Frequency variation

5.07 Duration of continuous full load operation.

5.08 Noise level.

6.00 Battery.

6.01 Type

6.02. Name of manufacturer and address

6.03. No. of Cells

6.04. Capacity in AH

6.05 Capacity current of

a. Full charged battery.

b. Fully discharged battery.

6.06 Average life in years.

6.07 Applicable standard.

6.08 Weight of the battery.

SCHEDULE OF GUARANTEED PARTICULARS
(RELAY & PROTECTION PANEL)

I. RELAY & PROTECTION PANELS:

1. Name & Address of Manufacturer of panels

2. Manufacturer's type and designation

3. Type of construction (simplex / duplex)

4. Dimensions of the panels.

5. Dimensions of supporting channel.

6. Thickness of the steel plates proposed four use on panels.

   (a) Front
   (b) Rear
   (c) Sides, top and bottom

7. Degree of protection

8. Confirm whether offered manufacturer of relay & Protection panels and protective relays have tested commissioned and they are in successful operation for at least two years in 220 KV system.

II. CONTROL SWITCHES FOR CIRCUIT BREAKERS:

1. Name & Address of Manufacturer of panels

2. Manufacturer's type and designation

3. Type of handle provided.

4. No. of Positions.

5. No. of contracts.

   (i) Normally closed
   (ii) Normally open.

6. Rating of contacts
   (i) Make and carry continuously.
   (ii) Make and carry for 0.5sec.
   (iii) Break resistive load in amps (DC).
   (iv) Break inductive load in amps (DC).

7. Life of switch in terms of million mechanical Operation.

III. POSITION INDICATORS

		For circuit Breaker	For Isolating & earth switches
1.	Name & Address of Manufacturer of panels		
2.	Manufacturer's type and designation		
3.	Diameter of the disc.	mm	mm

4.	Operating voltage	Volts	Volts
5.	Burden Watts (DC)	Watts (DC)	Watts (DC)

IV. INDICATING LAMPS:

1. Name & Address of Manufacturer of panels
2. Manufacturer's type and designation
3. Rating

   (i) Operating Voltage
   (ii) Operating Current
   (iii) Wattage of lamp
4. Size of Lamp
5. Whether series resistors provided?
6. If series resistors provided, give

   (i) Ohmic value
   (ii) Wattage
7. Colour of lamp.
8. Life of lamp in burning hours.
9. Permissible voltage variation.

V. SWITCH BOARD WIRING:

1. Insulation of wiring.
2. Size of wiring conductor of following :
   i) P.T. Circuits

   ii) C.T. Circuits.

   iii) DC Supply circuits

   iv) Other circuits
3. Size of earthing bar of safety earthing.
4. Type of terminals provided on wiring.
5. Wiring conductor aluminium / corner.

VI. DIGITAL MULTI FUNCTION METER

1. Maker's Name and country.
2. Type of Instrument
3. Size
4. Whether magnetically shielded or not
5. Limits of error in the effective range.
6. V.A. Burden (VA)

(i) Current coil (VA)

(ii) Potential coil (VA)

7. Power Consumption

i)Current coil (Watts)

ii) Potential coil (Watts)

8. Temperature at which the instruments are calibrated.

9. Description of leaflet reference Nos. submitted.

10. Range.

11. Ratings

i) CT Secondary
ii) VT Secondary
iii) DC auxiliary
iv) Frequency range
v) Operating principal
vi) Thermal rating

12. Accuracy class

13. Display of (YES / NO)

(a) Real time rms value of amp.
(b) Real time rms value of voltage
(c) Real time average pf
(d) Real time frequency
(e) Real time average power in MW, MVAr (Ig),(Id) and MVA

14. Type of connection

VII. ENERGY METER

1. Maker's Name and country.

2. Type of Instrument

3. Size

4. Whether magnetically shielded or not

5. Limits of error in the effective range.

6. V.A. Burden (VA)

i) Current coil (VA)

ii) Potential coil (VA)

7. Power Consumption

i) Current coil (Watts)

ii) Potential coil (Watts)

8. Temperature at which the instruments are calibrated.

9. Description of leaflet reference Nos. submitted.

10. Range

11. Ratings
    i) CT Secondary
    ii) VT Secondary
    iii) Frequency range
    iv) Thermal rating

12. Accuracy class

13. Display of (YES/ NO)

    (a) LCD test
    (b) Real time with date
    (c) Inst. Line current
    (d) Inst. phase voltage
    (e) Inst. Average power factor
    (f) maximum demand in MW/ MVA
    (g) Cumulative energy parameters in different resistors for
        i) MWh
        ii) MVArh
        iii) MVArh(Id)
        iv) MVAh

14. Type of connection

VIII ANNUNCIATOR:

1. Maker's name and country.

2. Type of selector switch.

3. Type of annunciator.

4. Type and particulars of window.

5. No. of lamps per window.

6. Lamps

    (i) Voltage
    (ii) Wattage

7. Particulars of wiring.

8. Rated voltage Volts.

9. Power consumption Watts.

10. Instantaneous making capacity contacts.

11. Breaking capacity.

12. Type of reset Manual / Self

13. Overall dimensions of annunciator.

14. Descriptive leaflets No.

IX. <u>TRANSMISSION LINE PROTECTION</u>

IX. (A) NUMERICAL DISTANCE PROTECTION RELAYS:

		Over current Relay	Earth Fault relay
1.	Name & Address of Manufacturer		
2.	Manufacturer's type and designation		
3.	Switched or non switched type (is it with separate measurements for single/ three phase faults)		
4.	Setting range of offset feature		
5.	Whether the relay is having self monitoring feature		
6.	Whether relay is compatible for SCADA Equipments and can be used for Permissive Under reach/Over reach/Blocking scheme etc.		
7.	Suitable for single and three phase trip		
8.	Type of shaped characteristic		
9.	IDMT earth fault relay meeting Normal Inverse Characteristic as per IEC 60253 is Being offered as built in feature for lines		
10.	If No, Type of IDMT being offered.		
11.	Built in feature offered with the relay(Yes/No)		
	i) Disturbance Recorder		
	ii) Over-Voltage(One stage only)		
	iii) Auto reclose along with deadline charging and check synchronizing.		

IX.(B)	**Backup Directional over current and earth fault relay :**	Overcurrent relay	Earth Fault relay
1.	Name & Address of Manufacturer		
2.	Manufacturer's type and designation		
3.	Whether characteristic will confirm to IEC 255-3		
4.	Two O/C and one E/F elements Are whether independent or composite unit?		
5.	Polarisation		
a.	Current		
b.	Potential		
6.	Current coil rating		
7.	Tap range		
8.	Potential rating		
9.	VA burden		

a. Current coil

b. Highest tap

c. Lowest tap.

10. Directional sensitivity

11. VT fuse failure relay/feature included
For alarm.

12. Unit setting range

(i) Inverse time
(ii) High set

13. Time of operation at maximum time dial wetting at :

(i) 10 times tap setting.

14. Trip contact rating (Amps.)

15. Whether seal in contact provided or not

16. Descriptive leaflets ref.

IX(C) DISTURBANCE RECORDER

(a) Acquisition unit

1. Name & Address of Manufacturer

2. Manufacturer's type and designation

3. Number of analogue channels

4. Number of digital recording channels

5. Built in feature of main-1 distance relay is offered

6. Pre-fault memory(msec.)

7. Post-fault memory(msec.)

8. Total storage memory in sec.

9. Sampling Frequency

10. resolution of the event channels(ms)

11. Time display present?

12. data output in COMTRADE is available

(b) Evaluation unit

1. Name & Address of Manufacturer

2. Manufacturer's type and designation

3. Number of acquisition unit that can be connected

to one evaluation unit

4. Technical parameter of evaluation unit

   a. processor and speed
   b. RAM and hard disk capacity
   c. additional facility
   d. details of printer

5. Details of power supply arrangement for acquisition unit (including printer)

IX(d) AUTO RECLOSE RELAY

1. Name & Address of Manufacturer

2. Manufacturer's type and designation

3. Electromechanical/ststic/numerical

4. Auto reclose relay alongwith deadline charging and check synchronizing relay for line offered as a part of distance relay

5. Suitable for single and three phase?

6. Single phase dead time setting range

7. Three phase dead time setting range

8. Reclaim time setting range

X. TRANSFORMER PROTECTION

X(A) DIFFERENTIAL RELAYS:

1. Name & Address of Manufacturer

2. Manufacturer's type and designation

3. Current coil rating

4. Tap range (Bias setting range)

   Coil 1

   Coil 2

   Coil 3

5. Maximum VA Burden

   (i) Operating Coil

   (ii) Restraining Coil

6. Power consumption

   (i) Operating Coil
   (ii) Restraining Coil

7. Whether three instantaneous units provided? Yes / No

8. Second Harmonic restraint provided or not.

9. Range of H.T.L.T. ratios over which the relay can be used.

10. Operating time.

11. Trip contact rating.

12. Whether seal in contacts provided or not.

13. How ratio/phase angle correction are being done (interposing transformer/internal feature in the relay)

14. Descriptive leaflet No.

X(B)	**Directional over current and earth fault relay :**	Over current relay	Earth Fault relay

1. Name & Address of Manufacturer

2. Manufacturer's type and designation

3. Whether the relay is having self monitoring feature

4. Directional sensitivity

5. Unit setting range

   a) Inverse time
   b) High set

XI	**BUS BAR PROTECTION RELAY**	Phase fault relay	Earth Fault relay

1. Name and Address of Manufacturer

2. Manufacturer's type and designation

3. Type of relay

4. Principle of operation

5. Current coil rating

6. Max VA Burden

7. Setting Ranges

   i) Current
   ii) Time

8. Power consumption

9. Operating time

10. Trip contact rating

11. Descriptive leaflet No.

BATTERIES AND BATTERY CHARGERS

GUARANTEED TECHNICAL PARTICULARS

1.0 GENERAL

1.1	Name of the bidder			
1.2	Specification & Standards			
1.3	Location			
1.4	Design ambient temp			
1.5	System			
1.6	Input supply to battery			
1.7	Control supply			
1.8	Supply for charger panel Space heater and illumination			

2.0 BATTERIES

2.1	Manufacturer's type designation			
2.2	Type desgination of cells as per IS.			
2.3	Ampere-hour capacity at Ten (10) hour rate of dis-Charge and twenty seven (27) degrees centigrade electrolyte temperature.			
2.4	Rated voltage			
2.4.1	Nominal	:	…….v	
2.4.2	Maximum	:	……..v	
2.4.3	Minimum	:	……..v	
2.5	Number of positive plates per cell.			
2.6	Total number of plates per cell.			
2.7	Discharge current of cell and end voltage of battery for	:	Amperes	Cell end voltage
2.7.1	One(1) minute load	:	_____A	_____V

2.7.2	Half(1/2) hour load	:	_____A	_____V
2.7.3	Two(2) hour load	:	_____A	_____V
2.7.4	Three(3) hour load	:	_____A	_____V
2.7.5	Five(5) hour load	:	_____A	_____V
2.7.6	Eight(8) hour load	:	_____A	_____V
2.7.7	Ten(10) hour load	:	_____A	_____V
2.7.8	Twelve(12) hour load	:	_____A	_____V
2.7.9	Current versus time characteristic curve (attach curve and state curve reference No.)			
2.8	Recommended charging rate :			
	i) Initial	:	_____A	
	ii) Finish	:	_____A	
2.9	Nominal cell voltage	:	_____V	
2.10	Internal resistance of each cell			
	i) Fully charge	:	_____micro ohms.	
	ii) Fully discharge	:	_____micro ohms.	
	iii) Floating	:	_____micro ohms.	
2.12	Resistance of the battery	:	_____ohms.	
2.13	Short circuit current	:	_____KA	
2.14	Container			
2.14.1	Material			
2.14.2	Thickness	:	_____mm	
2.15	Terminal Connector			
2.15.1	Type			
2.15.2	Material			
2.16	Separator	:	_____mm	
2.16.1	Type			
2.16.2	Material			
2.16.3	Thickness	:	_____mm	
2.17	Electrolyte			

2.17.1	Quantity for first	:	_____Ltrs.
2.17.1	Quantity for first Filling : Plus ten (10) Per cent extra.	:	_____Ltrs.
2.17.2	Specific gravity at twenty seven (27) degrees centrigrade		
	i) with all cells fully charged.		
	ii) At the end of discharge at ten (10) hour rate.		
2.18	Max. electrolyte temp. that the cell will withstand without injurious effect. i) Continuously ii) For a short period.		
2.19	Positive plates	:	
2.19.1	Type	:	
2.19.2	Construction	:	
2.19.3	Dimensions	:	_____mmLx_____mmWx____mmTH
2.19.4	Surface	:	_____mm2
2.20	Method of connections	:	
	i) Bolted		
	ii) Burnt		
2.21	Negative Plates		
2.21.1	Type		
2.21.2	Construction details		
2.21.3	Dimensions	:	_____mmLx_____mmWx_____mmTH
2.21.4	Surface Area	:	_____mm2
2.22	Method of Supporting elements	:	
2.23	Clearance between		
2.23.1	Edges of plates and inner surface of container	:	_____mm
2.23.2	Bottom of negative plates	:	_____mm

2.23.3	Top of plates and top of container	:	_____mm
2.24	Sediment space (depth)	:	_____mm
2.25	Dimensions of each cell	:	
2.25.1	Length :		_____mm
2.25.2	Width	:	_____mm
2.25.3	Height	:	_____mm
2.26	Distance between centres of cells when erected	:	_____mm
2.27	Net weight of each cell	:	_____kg.
2.27.1	With electrolyte	:	_____kg.
2.27.2	Without electrolyte	:	_____kg.
2.28	Recommended max. period of storage before first charge		
2.29	Whether explosion-proof vent plugs are provided (in case of sealed container).	:	Yes/No
2.30	Expected life span of battery		
2.31	Rack details		
2.31.1	Description		
2.31.2	Number of units		
2.31.3	Unit length	:	_____mm
2.31.4	Unit width	:	_____mm
2.31.5	Unit Height	:	_____mm
2.31.6	Unit shipping weight	:	_____kg.
2.31.7	Material of supporting stand		
2.31.8	Arrangement and foundation Details of supporting stands		
2.31.9	Weight of one complete Set of supporting stand.		
2.31.10	Details of painting.		
2.31.11	Details of insulators		

	support of battery leakage		
2.32	Proposed layout (attach) layout drawing & state drawing no.)		
2.33	Ventilation required in battery room	:	_____cu.mm./minute
2.34	Ampere hour efficiency	:	_____percent
2.35	Watt hour efficiency	:	_____percent
2.36	Recommended float charge	:	
2.36.1	Current	:	_____A
2.36.2	Voltage	:	_____V
2.37	Recommended boost charge	:	
2.37.1	Current	:	_____A
2.37.2	Voltage	:	_____V
2.37.3	Time required for boost charging from discharge conditions	:	_____hours

3.0 BATTERY CHARGERS

3.1	Name of manufacturer	:	
3.2	Manufacturer's type designation	:	
3.3	Degree of protection	:	
3.4	Type of rectifier	:	
3.5	AC Input	:	
3.5.1	Voltage	:	_____V
3.5.2	Voltage Variation	:	_____percent
3.5.3	Number of phases	:	
3.5.4	Frequency	:	_____Hz.
3.5.5	Frequency variation	:	_____percent
3.5.6	Combined voltage and frequency variation	:	_____percent
3.5.7	Current	:	_____A
3.5.8	Power factor	:	

3.6	Percentage of taps provided on transformer		
3.6.1	Primary winding		
3.6.2	Secondary winding		
3.7	DC output ratings	:	
3.7.1	Boost Charger		
	i) Power output	:	_____KW
	ii) Voltage	:	_____V
	iii) Current	:	_____A
	iii) Range of current control :		
3.7.2	Float charger		
	i) Power output	:	_____KW
	ii) Voltage	:	_____V
	iii) Current	:	_____A
	iv) Range of current control :		
3.8	DC output voltage regulation from no load to full load		
3.9	Maximum ripple current	:	_____percent
3.10	Maximum permissible temp. rise over an ambient temp. of fifty (50) degrees centigrade	:	_____C
3.11	Overall efficiency	:	_____percent
3.12	Load limiting feature (attach characteristic curve showing variation of voltage with increase in load).		
3.13	List of major accessories provided		
3.14	Battery charger panel		
3.14.1	Thickness of sheet steel	:	_____mm
3.14.2	Dimensions	:	___mmLx____mmWx___mmD
3.14.3	Total weight	:	_____kg.

3.15	Rectifier	:	Trickle charge	Quick charge
3.15.1	Name of manufacturer			
3.15.2	Address :			
3.15.3	Type of semi conducting Material			
3.15.4	Continuous rating in Amps.			
3.15.5	Short time rating in Amp. and time.			
3.15.6	Rated AC input voltage			
3.15.7	Rated DC output voltage			
3.15.8	Ripple factor			
3.15.9	Voltage factor			
3.15.10	Current factor			

4.0 D.C. PANELS

4.1	Name of manufacturers	
4.2	Address	
4.3	Continuous current of Amp.	
	i) Main circuit breaker	
	ii) Bus bar	
4.4	Short time rating in Amp. and time	
4.5	Rated DC output voltage	
4.6	Material of Bus Bar	
4.7	Type & Manufacturer of HRC Cartridge fuse	

5.0 INSTRUMENT & INDICATING DEVICES

5.1	Type	
5.2	Name of Manufacturer	
5.3	Accuracy class	

TECHNICAL DATA REQUIREMENT

INSULATOR, HARDWARES & ACCESSORIES

……

(Bidder's Name)

A. **INSULATOR STRINGS**

			220 KV (NA)
1.	Manufacturer's name and address		……
2.	Applicable Standards		……
3.	No. of Units per String		……
4.	Weight		
	a)	Each Disc (Kg)	……
	b)	Complete String (kg)	……
5.	Creepage Distance		
	a)	Each Disc. (Kg)	……
	b)	Complete String (mm0	……
6.	Power Frequency Withstand Voltage of the complete String with corona control ring		
	i)	Dry (KV rms)	……
	ii)	Wet (KV rms)	……
7.	Lightining Impulse (dry) Withstand Voltage of the Complete string for Both positive and negative peaks (kVp).		……
8.	Switching Surge withstand Voltage of the Complete string With corona control (Wet) (kVp)		……
9.	Power Frequency Puncture Withstand Voltage (Dry & Wet) Of each Disc (KV rms)		……
10.	Electro Mechanical Strength of each Disc (Kg)		……
11.	Minimum Corona extinction (kVrms) voltage level of the complete string with corona control ring (Dry Condition)		……
12.	RIV level of the complete (micro-volts) String with corona control ring at 1 MHz When subjected to a test voltage.		……
13.	Confirm whether string type tested with offered disc insulator as per IS		……

B. INSULATOR

1. Manufacturer's Name and Address ……

2. Applicable Standards ……

3. Ultimate Strength

   a. Complete assembly (kg) ……

   b. Suspension/drop clamp (kg) ……

C. TUBULAR BUS CONDUCTOR

1. Manufacturer's name and address ……

2. Applicable Standards ……

3. Material……

4. Size of Tubular Bus ……

   i) Standard pipe size-IPS (mm) ……

   ii) Outside diameter (mm) ……

   iii) Tolerance on outside ……

   iv) Thickness (mm) ……

   v) Tolerance on Thickness ……

5. D.C. Resistance of 20 deg. C. ……

6. Current rating at ambient temperature of 50 deg. C. ……

7. Short circuit current rating for 1 sec. Duration (kA) ……

8. Radio Interference at rated voltage (micro volts) ……

9. Weight (kg/m) ……

10. Final allowable tubular bus conductor temperature due to short circuit. ……

D. MARSHALLING KIOSK

1. Manufacturer's Name and Address ……

2. Thickness of sheet steel (mm) ……

3. Degree of protection provided ……

E. BUS POST INSULATIONS

1. Manufacturer's name and address ……

2. Applicable Standards ……

3. No. of Units per Stack ……

4. Whether corona ring provided or not ……

5.	Diameter (mm)		……
6.	Creepage Distance		……
	a.	Total (mm)	……
	b.	Protected (mm)	……
7.	Power Frequency withstand Voltage of Insulator		……
	a.	One Complete stack	……
	i.	Dry (kV rms)	……
	ii)	Wet (kV rms)	……
8.	1.2/50 micro sec. Impulse withstand Voltage on complete stack (kVp)		……
9.	250/2500 micro second switching Surge withstand voltage		……
	i)	One complete stack	……
	ii)	We (kV peak)	……
10.	Radio interference Voltage of complete stack		
	i)	Test Voltage (kV rms)	……
	ii)	Radio interference voltage (micro volt)	……
11.	Weight-of complete stack (Kg)		……
12.	Cantilever Strength of Complete Stack		……
13.	Torsional Strength (Kg.m)		……
14.	Compression Strength (Kg)		……
15.	Confirm whether type tested as per IS/IEC and are in successful operation for at least 2 (Two) years.		……

E. ACSR CONDUCTOR

1.	Name and address of manufacturer	……
2.	Standards Applicable	……
3.	Name & Type of Conductor	……
4.	No. & diameter of various strands	……
5.	Overall diameter of the conductor (mm)	……
6.	Current rating capacity of the Conductor at 75 deg. C (Amps)	……
7.	Confirm whether type tested as per IS	……

F. GALVANISED STEEL EARTHWIRE

1.	Name and Address of the Manufacture	……
2.	Standards Applicable	……
3.1	UTS of the Earthwire (kN)	……
3.2	Lay length of outer steel layer (mm)	……
3.3	DC Resistance of earthwire at 20 deg. C (ohms)	……
3.4	Standard length of earthwire in the drum (metres)	……
3.5	Diameter of earthwire	……

SECTION-IV

PRICE SCHEDULES

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be Supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
	66kV GIS Sub-Station at BTPS substation											
A	**Main Equipment.**											
1	**66KV GIS Equipment and associated equipment**											
1.1	**66kV GIS Equipment**											
1	72.5 kV SF6 GIS **Outgoing Line Feeder Circuit Breaker Bay Module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(D) of Section Project]	85359030		Set	14					18%		
2	72.5 kV SF6 GIS **Transformer I/C Circuit Breaker Bay Module**. [Module description as per Technical Specification, Cl. 3.0,A(I),(C) of Section Project]	85359030		Set	4					18%		
3	72.5 kV SF6 GIS **Bus Coupler Bay Module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(B) of Section Project]	85359030		Set	2					18%		
4	72.5kV SF6 GIS **Bus Sectionliser bay module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(E) of Section Project]	85359030		Set	2					18%		
5	72.5 kV SF6 GIS **Bus-bar Module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(A) of Section Project]	85359030		Set	2					18%		
	Sub-Total (1.1)											
1.2.1	**MATERIAL FOR 160 MVA TRANSFORMER AND ASSOCIATED EQUIPMENTS**											
1	Steel for support structure	73089090		LS	1					18%		
2	ACSR conductor	85446090		LS	1					18%		
3	216KV, 10KA, Lighting Arrestor (L.A.) with surge/discharge counter, milli-ampere meter and suitable terminal connectors etc.	85354010		Nos.	9					18%		
1.2.2	**MATERIAL FOR 220KV TRANSFORMER BAY**											
1	220kV,2500A, 40KA SF6 Circuit Breaker alongwith terminal connectors, and supporting structure.	8535912		Nos.	1					18%		

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be Supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
2	220kV, 1600A, 3 pole motor operated isolator with double earth switch and terminal connectors	85353090		Nos.	3					18%		
3	220kV,1600 A, 3 pole motor operated isolator with out earth switch & terminal connectors(Tandam type)	85353090		Nos.	3					18%		
4	220kV, 1600A, 3 pole motor operated isolator with earth switch & terminal connectors	85353090		Nos.	3					18%		
5	3 inch IPS Al. tube	85446090		LS	1					18%		
	Sub-Total (1.2)											
1.3	**LT Transformer**											
1	630 KVA,11/0.433KV,170kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	85042100		No.	1					18%		
2	630 KVA,11/0.433KV,95kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	85042100		No.	1					18%		
	Sub-Total (1.3)											
1.4	**Sub-Station Automation System and Relay & Protection Panels**											
1.4.1	**220kV Control and Relay Panels**											
(a)	220kV C&R panel for transformer	85372000		Nos.	3					18%		
(b)	Time Synchronization equipment and Other common equipments pertaining to Relay & Protection System (Time Sychronisation equipment)	85372000		Lot	1					18%		
1.4.2	**66kV Control and Relay Panels**											
(a)	Feeder Protection Panel	85372000		Nos.	14					18%		
(b)	Transformer Incomer Protection panel	85372000		Nos.	4					18%		
(c)	Bus-Coupler Protection panel	85372000		Nos.	2					18%		
(d)	Bus- Section Protection Panel	85372000		Nos.	2					18%		
(e)	Other/Common equipments pertaining to Relay & Protection System	85372000		Lot	1					18%		
1.4.3	**Automation & SCADA**											
(a)	Substation automation equipment, Optic Fibre and other interface/ converter equipment	85176290		Set	1					18%		

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be Supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
(b)	SCADA Equipments	85176290		Set	1					18%		
(c)	FOTE Equipments along with teleprotection card (for remote end substation also)	85176290		Set	1					18%		
(d)	Testing & Maintenance equipment	85176290		Set	1					18%		
(e)	Remote HMI alongwith monitor for DTL control room	85176290		Set	1					18%		
(f)	Inverter of suitable capacity for station HMI and peripheral devices i. e. printer etc.	85176290		Set	1					18%		
1.4.4	**Air conditioning system**											
a)	Split AC (5 star rating) 66kV Relay & Protection Panels Room,Battery Room.	84151010		Lot	1					28%		
b)	Ventilation system for 66 kV GIS hall	84151010		Lot	1					28%		
	Sub-Total (1.4)											
1.5	**LT Switchgear& other items**											
1.5.1	**LT Switchgear**											
a)	415V ACDB	85371000		Set	1					18%		
b)	415V Emergency LDB	85371000		Set	1					18%		
c)	415V Air-conditioning & Ventilation DB	85371000		Set	1					18%		
d)	220V DCDB	85371000		Set	1					18%		
1.5.2	**Batteries and Battery Chargers**											
a)	220V, ---------AH Battery	85072000		Set	1					18%		
1.5.3	**DG Set along with control panel (250kVA, 440V)**	85021310		Set	1					18%		
1.5.4	**Fire prevention & extinguishing system**											
a)	Fire Protection for GIS building, etc. (Portable type fire extinguishers system)	85318000		Lot	1					18%		
1.5.5	**Illumination System (*)**											
a)	GIS Building etc.Illumination.with LED base Lamp	85395000		LS	1					18%		

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be Supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
1.5.6	**1.1 kV Grade PVC insulated Al. conductor armoured power cables and copper conductor armoured control cables alongwith lugs, Glands and straight joints (Included in above)**											
a)	Power cables (XLPE)(*)	85446020		LS	1					18%		
b)	Power cables (PVC) (*)	85446020		LS	1					18%		
c)	Control Cable (PVC) (*)	85446020		LS	1					18%		
	(*) The bidder has to estimate and quote as per his own assessment.											
1.5.7	**66kV Feeder and Transformer Termination Arrangement**											
(a)	66 KV XLPE 1000 sq.mm. size Power Cable (Double Run) for connecting 3 Nos. transformer to 66KV GIS and 14 nos. feeders to 66KV GIS (Single Run)	85446090		LS	1					18%		
(b)	66kV indoor terminations suitable for above cable	85449090		No.	60					18%		
(c)	66kV outdoor terminations suitable for above cable	85449090		No.	60					18%		
(d)	Steel structure for H-Pole arrangement for termination of 66 KV feeders	73089090		LS	1					18%		
1.5.8	Petty items like Clamps & Connectors , Support Insulators etc.and all required material for completion of Job	85051190		LS	1					18%		
1.5.9	60 KV, 10 KA outdoor Surge arrester	85354010		No.	9					18%		
1.5.10	**Grounding/ Earthing System**											
a)	40mm MS rod for Earthmat	73089090		LS	1					18%		
b)	Lightning Mast/ GS Shield Wire	73121090		LS	1					18%		
1.5.11	**EOT Crane for 66kV GIS Hall**	84261100		set	1					18%		
1.5.12	**Tertiary loading equipments for one 160 MVA transformer**											
a)	33KV, O/D type isolator with earth switch MOM type	85353090		No	1					18%		
b)	33KV, O/D type CT, ratio 400-200-100/1-1-1A	85043100		No	3					18%		
c)	33KV, O/D type 630A, SF6 Circuit Breaker	85352112		No	1					18%		
d)	Control & Relay protection scheme	85372000		No	1					18%		
e)	11KV, O/D type PT, ratio Potential Transformer of ratio 11KV/√3)/(110V/√3)/(110V/√3)	85043100		No	3					18%		
f)	11kV Surge Arrester	85354010		No	3					18%		

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be Supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
1.5.13	**11 KV equipments for loading of 630 KVA Auxilary Transformer**											
a)	11kV switchgear, 2 Panel Board (1 incomer and 1 outgoing) alongwith associated control & relay system, 11kV cables etc.	85372000		LS	1					18%		
	Sub-Total (1.5)											
1.6	**CCTV System with remote Operations***											
1	Supply of compact type day and night network PTZ camera with outdoor housing - as per specifications	85258010		Nos.	5					18%		
2	Supply of compact type day and night network fixed camera with outdoor housing - as per specifications	85258010		Nos.	5					18%		
3	Network Video Management Software for 32 cameras as per specifications	85299090		Nos.	1					18%		
4	NVMS client License Pack for 2 users as per specifications	85299090		Nos.	1					18%		
5	Video management workstation Server with Storage hardware with 1 TB capacity for continuous recording for 30 Days Minimum as per specifications	85299090		Nos.	1					18%		
6	Video analytic software for fixed type cameras (2camera per site)	85299090		Nos.	2					18%		
7	The contractor is responsible for supplying and laying of armoured Fibre Optics cables through HDPE Conduit by digging and laying through cable trench as per the site requirements including the supply of converters and other accessories (suitable for outdoor application) required to complete the connectivity in all respect as per the direction of Engineer-in-Charge.	85299090		LS	1					18%		
8	Auxiliary structure with all required poles/mast & related mount with all accessories. Pole/Mart (G.I.) : Length - 9 mtrs and should be ISI make Mounting : to be grounded in concrete structure should be self-supporting in the ground.	73089090		Lot	1					18%		
9	32" LCD monitor Diagonal Industrial Grade Panel for 24x7 applications as per specification.	85312000		Nos.	1					18%		
10	24" Client PC TFT LCD monitor as per specification	85312000		Nos.	2					18%		

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be Supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
11	16 port Network Switch with fibre optic connectivity along with all related accessories - as per specifications.	85176990		Nos.	1					18%		
12	Heavy duty with weather proof Power supply units for outdoor cameras	85229000		Nos.	11					18%		
13	2 KVA On line UPS system for Power distribution with 60 Minutes power back up with all related accessories at all locations - as per specifications	85043200		Nos.	1					18%		
14	Supply & laying of 3Core X 1.5 sq mm armoured Power cable - as per specifications	85446090		LS	1					18%		
15	Supply and laying of Twisted pair shielded un-armored cable (CAT-6) - as per specification (from Terminal box to camera etc.)	85444999		LS	1					18%		
16	Supply and laying of 25 mm GI conduits with all necessary accessories - ISI mark	85479090		LS	1					18%		
17	Control console wooden table cabinet along with computer chair to accommodate Video Management Work station, Network switch, UPS - Godrej	44219190		Nos.	1					18%		
	* quantity may vary depending on actual drawing approval/site layout											
	Sub-Total (1.6)											
	SUB-TOTAL I : MAIN EQUIPMENTS [(1.1) to (1.6)]											
2.0	**Testing/ Maintenance Equipments & Mandatory Spares**											

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be Supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
2.1	**Testing/Maintenance equipments for GIS**											
2.1.1	SF6 Gas filling and evacuating plant	85437019		Set	1					18%		
2.1.2	SF6 Gas analyzer	85352119		Set	1					18%		
2.1.3	SF6 gas leak detector	90271000		Set	1					18%		
2.1.4	Partial Discharge Monitoring System	85437019		Set	1					18%		
2.1.5	Gas masks	90200000		Nos	10					12%		
	SUB-TOTAL II : TESTING EQUIPMENTS(2.1)											
2.2	**MANDATORY SPARES**											
2.2.1	**Spares for 66kV GIS**											
2.2.1.1	GIS	85389000		LS	1					18%		
2.2.1.2	Circuit Breaker	85389000		LS	1					18%		
2.2.1.3	Isolator	85389000		LS	1					18%		
2.2.1.4	CT	85043100		LS	1					18%		
2.2.1.5	Voltage transformer	85043100		LS	1					18%		
2.2.1.6	SurgeArrestor	85354010		LS	1					18%		
2.2.2	Spares for Battery bank	85072000		LS	1					18%		
2.2.3	Spares forSub station Automation System	85389000		LS	1					18%		
2.2.4	Spares for Relay & Protection Panels	85364900		LS	1					18%		
2.2.5	Spares for DG Set	85021310		LS	1					18%		
	SUB-TOTAL III : MANDATORY SPARES (2.2)											
	TOTAL [I+II+III]											

Note : Bidder is required to quote prices in this Schedule for all the individual items/sub-items.
HSN Code shall be filled/confirmed by Bidder
Currency shall be only in INDIAN Rupee in accordance with clause 14.2 Section-ITB Volume I of the bidding documents.
Please refer NIT/Tender Document for List of Manadatoty Spare
In case any additional equipment is required, the same should be included in the scope with no additional payment and the offer should be complete and comprehensive.

Date : **Signature : _____**

Place : **Printed Name _____**

Designation _____

Common Seal _____

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Local Transportation,Insurance and other Incidental Services

S.No.	Item Description	Unit	Qty	Transportation, Insurance and other Incidental Services						
				SAC Code	Whether SAC code is confirmed Yes/No If not, indicate applicable SAC code	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties GST Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST	Amount
1	2	3	4	5	6	7	8=4*7	9	10	11=8*(9or10)
	66kV GIS Sub-Station at BTPS substation									
A	**Main Equipment.**									
1	**66KV GIS Equipment and associated equipment**									
1.1	**66kV GIS Equipment**									
1	72.5 kV SF6 GIS **Outgoing Line Feeder Circuit Breaker Bay Module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(D) of Section Project]	Set	14	996519				18%		
2	72.5 kV SF6 GIS **Transformer I/C Circuit Breaker Bay Module**. [Module description as per Technical Specification, Cl. 3.0,A(I),(C) of Section Project]	Set	4	996519				18%		
3	72.5 kV SF6 GIS **Bus Coupler Bay Module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(B) of Section Project]	Set	2	996519				18%		
4	72.5kV SF6 GIS **Bus Sectionliser bay module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(E) of Section Project]	Set	2	996519				18%		
5	72.5 kV SF6 GIS **Bus-bar Module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(A) of Section Project]	Set	2	996519				18%		
	Sub-Total (1.1)									
1.2.1	**MATERIAL FOR 160 MVA TRANSFORMER AND ASSOCIATED EQUIPMENTS**									
1	Steel for support structure	LS	1	996519				18%		
2	ACSR conductor	LS	1	996519				18%		
3	216KV, 10KA, Lighting Arrestor (L.A.) with surge/discharge counter, milli-ampere meter and suitable terminal connectors etc.	Nos.	9	996519				18%		
1.2.2	**MATERIAL FOR 220KV TRANSFORMER BAY**									
1	220kV,2500A, 40KA SF6 Circuit Breaker alongwith terminal connectors, and supporting structure.	Nos.	1	996519				18%		
2	220kV, 1600A, 3 pole motor operated isolator with double earth switch and terminal connectors	Nos.	3	996519				18%		
3	220kV,1600 A, 3 pole motor operated isolator with out earth switch & terminal connectors(Tandam type)	Nos.	3	996519				18%		
4	220kV, 1600A, 3 pole motor operated isolator with earth switch & terminal connectors	Nos.	3	996519				18%		
5	3 inch IPS Al. tube	LS	1	996519				18%		
	Sub-Total (1.2)									
1.3	**LT Transformer**									
1	630 KVA,11/0.433KV,170kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	No.	1	996519				18%		

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Local Transportation,Insurance and other Incidental Services

				Transportation, Insurance and other Incidental Services						
					Whether SAC			**Taxes & Duties**		
								GST		
2	630 KVA,11/0.433KV,95kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	No.	1	996519				18%		
	Sub-Total (1.3)									
1.4	**Sub-Station Automation System and Relay & Protection Panels**									
1.4.1	**220kV Control and Relay Panels**									
(a)	220kV C&R panel for transformer	Nos.	3	996519				18%		
(b)	Time Synchronization equipment and Other common equipments pertaining to Relay & Protection System (Time Sychronisation equipment)	lot	1	996519				18%		
1.4.2	**66kV Control and Relay Panels**									
(a)	Feeder Protection Panel	Nos.	14	996519				18%		
(b)	Transformer Incomer Protection panel	Nos.	4	996519				18%		
(c)	Bus-Coupler Protection panel	Nos.	2	996519				18%		
(d)	Bus- Section Protection Panel	Nos.	2	996519				18%		
(e)	Other/Common equipments pertaining to Relay & Protection System	lot	1	996519				18%		
1.4.3	**Automation & SCADA**									
(a)	Substation automation equipment, Optic Fibre and other interface/ converter equipment	Set	1	996519				18%		
(b)	SCADA Equipments	Set	1	996519				18%		
(c)	FOTE Equipments along with teleprotection card (for remote end substation also)	Set	1	996519				18%		
(d)	Testing & Maintenance equipment	Set	1	996519				18%		
(e)	Remote HMI along with monitor for DTL control room	Set	1	996519				18%		
(f)	Inverter of suitable capacity for station HMI and peripheral devices i. e. printer etc.	Set	1	996519				18%		
1.4.4	**Air conditioning system**									
a)	Split AC (5 star rating) 66kV Relay & Protection Panels Room,Battery Room,	Lot	1	996519				18%		
b)	Ventilation system for 66 kV GIS hall	Lot	1	996519				18%		
	Sub-Total (1.4)									
1.5	**LT Switchgear& other items**									
1.5.1	**LT Switchgear**									
a)	415V ACDB	Set	1	996519				18%		
b)	415V Emergency LDB	Set	1	996519				18%		
c)	415V Air-conditioning & Ventilation DB	Set	1	996519				18%		
d)	220V DCDB	Set	1	996519				18%		
1.5.2	**Batteries and Battery Chargers**									
a)	220V, ---------AH Battery	Set	1	996519				18%		
1.5.3	**DG Set along with control panel (250kVA, 440V)**	Set	1	996519				18%		
1.5.4	**Fire prevention & extinguishing system**									
a)	Fire Protection for GIS building, etc. (Portable type fire extinguishers system)	lot	1	996519				18%		
1.5.5	**Illumination System (*)**									
a)	GIS Building etc.Illumination.with LED base Lamp	LS	1	996519				18%		

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Local Transportation,Insurance and other Incidental Services

				Transportation, Insurance and other Incidental Services						
					Whether SAC			Taxes & Duties		
								GST		
1.5.6	**1.1 kV Grade PVC insulated Al. conductor armoured power cables and copper conductor armoured control cables alongwith lugs, Glands and straight joints (Included in above)**									
a)	Power cables (XLPE)(*)	LS	1	996519				18%		
b)	Power cables (PVC) (*)	LS	1	996519				18%		
c)	Control Cable (PVC) (*)	LS	1	996519				18%		
	(*) The bidder has to estimate and quote as per his own assessment.									
1.5.7	**66kV Feeder and Transformer Termination Arrangement**									
(a)	66 KV XLPE 1000 sq.mm. size Power Cable (Double Run) for connecting 3 Nos. transformer to 66KV GIS and 14 nos. feeders to 66KV GIS (Single Run)	LS	1	996519				18%		
(b)	66kV indoor terminations suitable for above cable	No.	60	996519				18%		
(c)	66kV outdoor terminations suitable for above cable	No.	60	996519				18%		
(d)	Steel structure for H-Pole arrangement for termination of 66 KV feeders	LS	1	996519				18%		
1.5.8	**Petty items like Clamps & Connectors , Support Insulators etc.and all required material for completion of Job**	LS	1	996519				18%		
1.5.9	60 KV, 10 KA outdoor Surge arrester	No.	9	996519				18%		
1.5.10	**Grounding/ Earthing System**									
a)	40mm MS rod for Earthmat	LS	1	996519				18%		
b)	Lightning Mast/ GS Shield Wire	LS	1	996519				18%		
1.5.11	**EOT Crane for 66kV GIS Hall**	set	1	996519				18%		
1.5.12	**Tertiary loading equipments for one 160 MVA transformer**									
a)	33KV, O/D type isolator with earth switch MOM type	No	1	996519				18%		
b)	33KV, O/D type CT, ratio 400-200-100/1-1-1A	No	3	996519				18%		
c)	33KV, O/D type 630A, SF6 Circuit Breaker	No	1	996519				18%		
d)	Control & Relay protection scheme	No	1	996519				18%		
e)	11KV, O/D type PT, ratio Potential Transformer of ratio 11KV/ $\sqrt{3}$)/(110V/$\sqrt{3}$)/(110V/$\sqrt{3}$)	No	3	996519				18%		
f)	11kV Surge Arrester	No	3	996519				18%		
1.5.13	**11 KV equipments for loading of 630 KVA Auxilary Transformer**									
a)	11kV switchgear, 2 Panel Board (1 incomer and 1 outgoing) alongwith associated control & relay system, 11kV cables etc.	LS	1	996519				18%		
	Sub-Total (1.5)									
1.6	**CCTV System with remote Operations***									
1	Supply of compact type day and night network PTZ camera with outdoor housing - as per specifications	Nos.	5	996519				18%		
2	Supply of compact type day and night network fixed camera with outdoor housing - as per specifications	Nos.	5	996519				18%		
3	Network Video Management Software for 32 cameras as per specifications	Nos.	1	996519				18%		
4	NVMS client License Pack for 2 users as per specifications	Nos.	1	996519				18%		
5	Video management workstation Server with Storage hardware with 1 TB capacity for continuous recording for 30 Days Minimum as per specifications	Nos.	1	996519				18%		
6	Video analytic software for fixed type cameras (2camera per site)	Nos.	2	996519				18%		

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Local Transportation,Insurance and other Incidental Services

				Transportation, Insurance and other Incidental Services						
					Whether SAC			**Taxes & Duties**		
								GST		
7	The contractor is responsible for supplying and laying of armoured Fibre Optics cables through HDPE Conduit by digging and laying through cable trench as per the site requirements including the supply of converters and other accessories (suitable for outdoor application) required to complete the connectivity in all respect as per the direction of Engineer-in-Charge.	LS	1	996519				18%		
8	Auxiliary structure with all required poles/mast & related mount with all accessories. Pole/Mart (G.I.) : Length - 9 mtrs and should be ISI make Mounting : to be grounded in concrete structure should be self-supporting in the ground.	Lot	1	996519				18%		
9	32" LCD monitor Diagonal Industrial Grade Panel for 24x7 applications as per specification.	Nos.	1	996519				18%		
10	24" Client PC TFT LCD monitor as per specification	Nos.	2	996519				18%		
11	16 port Network Switch with fibre optic connectivity along with all related accessories - as per specifications.	Nos.	1	996519				18%		
12	Heavy duty with weather proof Power supply units for outdoor cameras	Nos.	11	996519				18%		
13	2 KVA On line UPS system for Power distribution with 60 Minutes power back up with all related accessories at all locations - as per specifications	Nos.	1	996519				18%		
14	Supply & laying of 3Core X 1.5 sq mm armoured Power cable - as per specifications	LS	1	996519				18%		
15	Supply and laying of Twisted pair shielded un-armored cable (CAT-6) - as per specification (from Terminal box to camera etc.)	LS	1	996519				18%		
16	Supply and laying of 25 mm GI conduits with all necessary accessories - ISI mark	LS	1	996519				18%		
17	Control console wooden table cabinet along with computer chair to accommodate Video Management Work station, Network switch, UPS - Godrej	Nos.	1	996519				18%		
	* quantity may vary depending on actual drawing approval/site layout									
	Sub-Total (1.6)									
	SUB-TOTAL I : MAIN EQUIPMENTS [(1.1) to (1.6)]									
2.0	**Testing/ Maintenance Equipments & Mandatory Spares**									

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Local Transportation,Insurance and other Incidental Services

				Transportation, Insurance and other Incidental Services						
					Whether SAC			Taxes & Duties		
								GST		
2.1	**Testing/Maintenance equipments for GIS**									
2.1.1	SF6 Gas filling and evacuating plant	Set	1	996519				18%		
2.1.2	SF6 Gas analyzer	Set	1	996519				18%		
2.1.3	SF6 gas leak detector	Set	1	996519				18%		
2.1.4	Partial Discharge Monitoring System	Set	1	996519				18%		
2.1.5	Gas masks	Nos	10	996519				18%		
	SUB-TOTAL II : TESTING EQUIPMENTS(2.1)									
2.2	**MANDATORY SPARES**									
2.2.1	**Spares for 66kV GIS**									
2.2.1.1	GIS	LS	1	996519				18%		
2.2.1.2	Circuit Breaker	LS	1	996519				18%		
2.2.1.3	Isolator	LS	1	996519				18%		
2.2.1.4	CT	LS	1	996519				18%		
2.2.1.5	Voltage transformer	LS	1	996519				18%		
2.2.1.6	SurgeArrestor	LS	1	996519				18%		
2.2.2	Spares for Battery bank	LS	1	996519				18%		
2.2.3	Spares forSub station Automation System	LS	1	996519				18%		
2.2.4	Spares for Relay & Protection Panels	LS	1	996519				18%		
2.2.5	Spares for DG Set	LS	1	996519				18%		
	SUB-TOTAL III : MANDATORY SPARES (2.2)									
2.3	**Dismantling of existing 220 & 66 kV equipments**									
2.3.1	Dismantling of 220kV equipments i.e, Transformers, Reactor , Breaker, CT, PT, LA, Isolator, fittings etc. alongwith support structure & other equipment as per the dismantling scope and transportation to DTL store or any other site of DTL	LS	1	996519				18%		
	SUB-TOTAL IV: Dismantling (2.3)									
	TOTAL [I+II+III+IV]									

Note : Bidder is required to quote prices in this Schedule for all the individual items/sub-items.
SAC Code shall be filled/confirmed by Bidder
Currency shall be only in INDIAN Rupee in accordance with clause 14.2 Section-ITB Volume I of the bidding documents.
In case any additional equipment is required, the same shalll be supplied without any additional payment and the offer should be complete and comprehensive.
Please refer NIT/Tender Document for List of Manadatoty Spare

Date : **Signature :** _____

Place : **Printed Name** _____

Designation _____

Common Seal _____

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8=6x7	9	10	11
	66kV GIS Sub-Station at BTPS substation									
A	**Main Equipment.**									
1	**66KV GIS Equipment and associated equipment**									
1.1	**66kV GIS Equipment**									
1	72.5 kV SF6 GIS **Outgoing Line Feeder Circuit Breaker Bay Module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(D) of Section Project]	998736		Set	14			18%		
2	72.5 kV SF6 GIS **Transformer I/C Circuit Breaker Bay Module**. [Module description as per Technical Specification, Cl. 3.0,A(I),(C) of Section Project]	998736		Set	4			18%		
3	72.5 kV SF6 GIS **Bus Coupler Bay Module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(B) of Section Project]	998736		Set	2			18%		
4	72.5kV SF6 GIS **Bus Sectionliser bay module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(E) of Section Project]	998736		Set	2			18%		
5	72.5 kV SF6 GIS **Bus-bar Module**.[Module description as per Technical Specification, Cl. 3.0,A(I),(A) of Section Project]	998736		Set	2			18%		
	Sub-Total (1.1)									
1.2.1	**MATERIAL FOR 160 MVA TRANSFORMER AND ASSOCIATED EQUIPMENTS**									
1	Steel for support structure	995455		LS	1			18%		
2	ACSR conductor	998736		LS	1			18%		
3	216KV, 10KA, Lighting Arrestor (L.A.) with surge/discharge counter, milli-ampere meter and suitable terminal connectors etc.	998736		Nos.	9			18%		
1.2.2	**MATERIAL FOR 220KV TRANSFORMER BAY**									
1	220kV,2500A, 40KA SF6 Circuit Breaker alongwith terminal connectors, and supporting structure.	998736		Nos.	1			18%		
2	220kV, 1600A, 3 pole motor operated isolator with double earth switch and terminal connectors	998736		Nos.	3			18%		
3	220kV,1600 A, 3 pole motor operated isolator with out earth switch & terminal connectors(Tandam type)	998736		Nos.	3			18%		
4	220kV, 1600A, 3 pole motor operated isolator with earth switch & terminal connectors	998736		Nos.	3			18%		
5	3 inch IPS Al. tube	998736		LS	1			18%		
	Sub-Total (1.2)									
1.3	**LT Transformer**									
1	630 KVA,11/0.433KV,170kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	998736		No.	1			18%		
2	630 KVA,11/0.433KV,95kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	998736		No.	1			18%		
	Sub-Total (1.3)									

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
1.4	**Sub-Station Automation System and Relay & Protection Panels**									
1.4.1	**220kV Control and Relay Panels**									
(a)	220kV C&R panel for transformer	998736		Nos.	3			18%		
(b)	Time Synchronization equipment and Other common equipments pertaining to Relay & Protection System (Time Sychronisation equipment)	998736		lot	1			18%		
1.4.2	**66kV Control and Relay Panels**									
(a)	Feeder Protection Panel	998736		Nos.	14			18%		
(b)	Transformer Incomer Protection panel	998736		Nos.	4			18%		
(c)	Bus-Coupler Protection panel	998736		Nos.	2			18%		
(d)	Bus- Section Protection Panel	998736		Nos.	2			18%		
(e)	Other/Common equipments pertaining to Relay & Protection System	998736		Set	1			18%		
1.4.3	**Automation & SCADA**									
(a)	Substation automation equipment, Optic Fibre and other interface/ converter equipment	998736		No.	16			18%		
(b)	SCADA Equipments									
(c)	FOTE Equipments alongewith teleprotection card (for remote end substation also)									
(d)	Testing & Maintenance equipment	998736		No.	4			18%		
(e)	Remote HMI alongwith monitor for DTL control room	998736		No.	4			18%		
(f)	Inverter of suitable capacity for station HMI and peripheral devices i. e. printer etc.									
1.4.4	**Air conditioning system**									
a)	Split AC (5 star rating) 66kV Relay & Protection Panels Room,Battery Room,	995463		Lot	1			18%		
b)	Ventilation system for 66 kV GIS hall	995463		Lot	1			18%		
1.5	**LT Switchgear& other items**									
1.5.1	**LT Switchgear**									
a)	415V ACDB	998736		Set	1			18%		
b)	415V Emergency LDB	998736		Set	1			18%		
c)	415V Air-conditioning & Ventilation DB	998736		Set	1			18%		
d)	220V DCDB	998736		Set	1			18%		
1.5.2	**Batteries and Battery Chargers**									
a)	220V, ---------AH Battery	998736		Set	1			18%		
1.5.3	**DG Set along with control panel (250kVA, 440V)**	998736		Set	1			18%		
1.5.4	**Fire prevention & extinguishing system**									
a)	Fire Protection for GIS building, etc. (Portable type fire extinguishers system)	995468		lot	1			18%		
1.5.5	**Illumination System (*)**									
a)	GIS Building etc.Illumination.with LED base Lamp	998731		LS	1			18%		
1.5.6	**1.1 kV Grade PVC insulated Al. conductor armoured power cables and copper conductor armoured control cables alongwith lugs, Glands and straight joints (Included in above)**									
a)	Power cables (XLPE)(*)	998736		LS	1			18%		
b)	Power cables (PVC) (*)	998736		LS	1			18%		
c)	Control Cable (PVC) (*)	998736		LS	1			18%		
	(*) The bidder has to estimate and quote as per his own assessment.									

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
1.5.7	**66kV Feeder and Transformer Termination Arrangement**									
(a)	66 KV XLPE 1000 sq.mm. size Power Cable (Double Run) for connecting 3 Nos. transformer to 66KV	998736		LS	1			18%		
(b)	66kV indoor terminations suitable for above cable	998736		No.	60			18%		
(c)	66kV outdoor terminations suitable for above cable	998736		No.	60			18%		
(d)	Steel structure for H-Pole arrangement for termination of 66 KV feeders	998736		LS	1			18%		
1.5.8	Petty items like Clamps & Connectors , Support Insulators etc.and all required material for completion of Job	998736		LS	1			18%		
1.5.9	60 KV, 10 KA outdoor Surge arrester	998736		No.	9			18%		
1.5.10	**Grounding/ Earthing System**									
a)	40mm MS rod for Earthmat	994728		LS	1			18%		
b)	Lightning Mast/ GS Shield Wire	995455		LS	1			18%		
1.5.11	**EOT Crane for 66kV GIS Hall**	998736		set	1			18%		
1.5.12	**Tertiary loading equipments for one 160 MVA transformer**									
a)	33KV, O/D type isolator with earth switch MOM type	998736		No	1			18%		
b)	33KV, O/D type CT, ratio 400-200-100/1-1-1A	998736		No	3			18%		
c)	33KV, O/D type 630A, SF6 Circuit Breaker	998736		No	1			18%		
d)	Control & Relay protection scheme	998736		No	1			18%		
e)	11KV, O/D type PT, ratio Potential Transformer of ratio 11KV/ √3)/(110V/√3)/(110V/√3)	998736		No	3			18%		
f)	11kV Surge Arrester	998736		No	3			18%		
1.5.13	**11 KV equipments for loading of 630 KVA Auxilary Transformer**									
a)	11kV switchgear, 2 Panel Board (1 incomer and 1 outgoing) alongwith associated control & relay system, 11kV cables etc.	998736		LS	1			18%		
	Sub-Total (1.5)									
1.6	**CCTV System with remote Operations***									
1	Supply of compact type day and night network PTZ camera with outdoor housing - as per specifications	995468		Nos.	5			18%		
2	Supply of compact type day and night network fixed camera with outdoor housing - as per specifications	995468		Nos.	5			18%		
3	Network Video Management Software for 32 cameras as per specifications	995468		Nos.	1			18%		
4	NVMS client License Pack for 2 users as per specifications	995468		Nos.	1			18%		

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
5	Video management workstation Server with Storage hardware with 1 TB capacity for continuous recording for 30 Days Minimum as per specifications	995468		Nos.	1			18%		
6	Video analytic software for fixed type cameras (2camera per site)	995468		Nos.	2			18%		
7	The contractor is responsible for supplying and laying of armoured Fibre Optics cables through HDPE Conduit by digging and laying through cable trench as per the site requirements including the supply of converters and other accessories (suitable for outdoor application) required to complete the connectivity in all respect as per the direction of Engineer-in-Charge.	995468		LS	1			18%		
8	Auxiliary structure with all required poles/mast & related mount with all accessories. Pole/Mart (G.I.) : Length - 9 mtrs and should be ISI make Mounting : to be grounded in concrete structure should be self-supporting in the ground.	995468		Lot	1			18%		
9	32" LCD monitor Diagonal Industrial Grade Panel for 24x7 applications as per specification.	995468		Nos.	1			18%		
10	24" Client PC TFT LCD monitor as per specification	995468		Nos.	2			18%		
11	16 port Network Switch with fibre optic connectivity along with all related accessories - as per specifications.	995468		Nos.	1			18%		
12	Heavy duty with weather proof Power supply units for outdoor cameras	995468		Nos.	11			18%		
13	2 KVA On line UPS system for Power distribution with 60 Minutes power back up with all related accessories at all locations - as per specifications	995468		Nos.	1			18%		
14	Supply & laying of 3Core X 1.5 sq mm armoured Power cable - as per specifications	995468		LS	1			18%		
15	Supply and laying of Twisted pair shielded un-armored cable (CAT-6) - as per specification (from Terminal box to camera etc.)	995468		LS	1			18%		
16	Supply and laying of 25 mm GI conduits with all necessary accessories - ISI mark	995468		LS	1			18%		
17	Control console wooden table cabinet along with computer chair to accommodate Video Management Work station, Network switch, UPS - Godrej	995468		Nos.	1			18%		
	* quantity may vary depending on actual drawing approval/site layout									
	Sub-Total (1.6)									
	SUB-TOTAL I : MAIN EQUIPMENTS [(1.1) to (1.6)]									
2	**Dismantling of existing 220 & 66 kV equipments**									
2.1	Dismantling of 220kV equipments i.e, Transformers, Reactor , Breaker, CT, PT, LA, Isolator, fittings etc. alongwith support structure & other equipment as per the dismantling scope and transportation to DTL store or any other site of DTL	995468		LS	1			18%		
	Sub-total (2.0)									

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
3	**CIVIL WORKS**									
3.1	**Foundtion and other civil work**									
(a)	160 MVA 220/66/11KV Transformer with soak pit and sump well ,NIFPES etc.	995416		No.	3			18%		
(b)	630KVA, 11/0.433 kV LT Transformer	995416		No.	2			18%		
(c)	66kV Surge arrester	995416		No.	9			18%		
(d)	66kV GIS building as per design requirement, Office rooms , store room,01 no. Battery bank,display sign board,etc .	995416		LS	1			18%		
(e)	Provision for erecting new C&R panels in existing control room building.	995416		LS	1			18%		
(f)	RCC in foundation including earth work in excavating disposal of surplus earth PCC, RCC reinforcement steel, for structures and equipments	995416		LS	1			18%		
(g)	Cable Trench including all types of crossings	995416		LS	1			18%		
(h)	Soil Investigation	995416		LS	1			18%		
(i)	Site surfacing (gravelling) & Anti weed Treat-ment	995416		LS	1			18%		
(j)	Roads near 66kV GIS building,etc & Main road infront of ICTs with connecting rail	995416		LS	1			18%		
(k)	Storm Water drainage & Rain water Harvesting System	995416		LS	1			18%		
(l)	Transformer fire walls	995416		No.	3			18%		
(m)	RCC frame Boundary wall with brick panneling,concertina wire ,etc.	995416		LS	1			18%		
(n)	Land filling (If any)	995416		LS	1			18%		
3.2	**Modification in foundations for following equipments:**									
(a)	220kV CB	995416		No.	1			18%		
(b)	220kV LA	995416		No.	9			18%		
(c)	220kV Isolators	995416		No.	9			18%		
(d)	250kVA DG Set	995416		No.	1			18%		
3.3	**Dismantling Work**									
(a)	Store Shed	995416		LS	1			18%		
(b)	Firewalls	995416		LS	1			18%		
(c)	Any other dismantling work required for the job(if any)	995416		LS	1			18%		
	SUB-TOTAL (3.0) : CIVIL WORKS									
	TOTAL [SUB-TOTAL (1.0) +SUB-TOTAL (2.0) + SUB-TOTAL(3.0)]									

Note : Bidder is required to quote prices in this Schedule for all the individual items/sub-items.
SAC Code shall be filled/confirmed by Bidder
Currency shall be only in INDIAN Rupee in accordance with clause 14.2 Section-ITB Volume I of the bidding documents.
In case any additional equipment is required, the same shalll be supplied without any additional payment and the offer should be complete and comprehensive.

Signature :

Date
Place :

Printed Name

Designation

Common Seal

Turnkey package "A" for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 220kV BTPS Sub-station, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

GRAND SUMMARY OF THE QUOTED BID PRICE.

S.No		DESCRIPTION	Total Price (INR)
1		**TOTAL SCHEDULE NO. 1**	
		Plant and Equipment (including Mandatory Spares) to be Supplied	
2		**TOTAL SCHEDULE NO. 2**	
		Local Transportation, Insurance and other Incidental Services	
3		**TOTAL SCHEDULE NO. 3**	
		Installation Charges	
		GRAND TOTAL 'A ' = [1 + 2 + 3]	
		*currency in accordance with ITB clause 14.2, Vol.-I of the Bidding Documents.	

II.We declare that the following are our quoted bid price in INR for the entire Scope of work as specified in the specifications and documents.

A. Quoted Bid Price :

i. In figures
ii. In Words
Excluding taxes & duties
(Grand Summary of the quoted Bid Price as in I above.)

B. Applicable Taxes & Duties and other levies, payable additionally, in respect of the transaction between the Owner and the Contractor (Total Amount to be mentioned).

i. GST (Total Amount to be mentioned)
ii. Total taxes & duties(i) : ……..

C. Total Quoted Bid Price including Taxes and Duties and other levies, if contract is awarded to us
i.e. A+B above
i. In figures:INR
ii. In words: INR

Date :

Place :

Signature : _____

Printed Name _____

Designation _____

Common Seal _____

TENDER NO. T20R220201 **Price Schedule-1**

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
	66kV GIS Bays at Dwarka substation											
A	**Main Equipment.**											
1	**66KV GIS Equipment and associated equipment**											
1.1	**66kV GIS Equipment**											
1	72.5 kV SF6 GIS **Outgoing Line Feeder Circuit Breaker Bay Module**. [Module description as per Technical Specification, Cl. 3.0,B(I),(D) of Section Project]	85359030		Set	12					18%		
2	72.5 kV SF6 GIS **Transformer I/C Circuit Breaker Bay Module**. [Module description as per Technical Specification, Cl. 3.0,B(I),(C) of Section Project]	85359030		Set	4					18%		
3	72.5 kV SF6 GIS **Bus Coupler Bay Module**.[Module description as per Technical Specification, Cl. 3.0,B(I),(B) of Section Project]	85359030		Set	2					18%		
4	72.5kV SF6 GIS **Bus Sectionliser bay module**.[Module description as per Technical Specification, Cl. 3.0,B(I),(E) of Section Project]	85359030		Set	2					18%		
5	72.5 kV SF6 GIS **Bus-bar Module**.[Module description as per Technical Specification, Cl. 3.0,B(I),(A) of Section Project]	85359030		Set	2					18%		
	Sub-Total (1.1)											
1.2	**MATERIAL FOR 160 MVA TRANSFORMER AND ASSOCIATED EQUIPMENTS**											
1	Steel for support structure	73089090		LS	1					18%		
2	ACSR conductor along with fittings	76042910		LS	1					18%		
3	216KV, 10KA, Lighting Arrestor (L.A.) with surge/discharge counter, milli-ampere meter and suitable terminal connectors etc.	85354010		Nos.	9					18%		
	Sub-Total (1.2)											
1.3	**LT Transformers**											
1	400 KVA,11/0.433KV,170kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	85042100		No.	1					18%		
2	400 KVA,11/0.433KV,95kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	85042100		No.	1					18%		
	Sub-Total (1.3)											

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
1.4	**Sub-Station Automation System and Relay & Protection Panels**											
1.4.1	**220kV Control and Relay Panels**											
(a)	Transformer Protection panel (for HV side)	85371000		Nos.	4					18%		
(b)	Time Synchronization equipment and Other common equipments pertaining to Relay & Protection System (Time Sychronisation equipment)	85381090		Lot	1					18%		
1.4.2	**66kV Control and Relay Panels**											
(a)	Feeder Protection Panel	85371000		Nos.	12					18%		
(b)	Transformer Incomer Protection panel	85371000		Nos.	4					18%		
(c)	Bus-Coupler Protection panel	85371000		Nos.	2					18%		
(d)	Bus- Section Protection Panel	85371000		Nos.	2					18%		
(e)	Other/Common equipments pertaining to Relay & Protection System	85381090		Lot	1					18%		
1.4.3	**Automation & SCADA**											
(a)	Substation automation equipment, Optic Fibre and other interface/	85176290		Set	1					18%		
(b)	Testing & Maintenance equipment	85176290		Set	1					18%		
(c)	Remote HMI alongwith monitor for DTL control room	85176290		Set	1					18%		
(d)	Inverter of suitable capacity for station HMI and peripheral devices i. e. printer etc.	85176290		Set	1					18%		
1.4.4	**Air conditioning system**											
a)	Split AC (5 star rating) 66kV Relay & Protection Panels Room	84151010		Lot	1					28%		
b)	Ventilation system for 66 kV GIS hall	84158390		Lot	1					28%		
	Sub-Total (1.4)											
1.5	**LT Switchgear & other items**											
1.5.1	**LT Switchgear**											
a)	415V ACDB (sub panels for extension and distribution from 220kV GIS building)	85371000		Set	1					18%		
b)	415V Emergency LDB	85371000		Set	1					18%		
c)	415V Air-conditioning & Ventilation DB	85371000		Set	1					18%		
d)	220V DCDB (For extension and distribution from 220kV GIS Building)	85371000		Set	2					18%		
1.5.2	**DG Set along with control panel (250kVA, 440V)**	85021310		Set	1					18%		
1.5.3	**Fire prevention & extinguishing system**											
a)	Fire Protection for GIS building, etc. (Portable type fire extinguishers system)	85318000		Lot	1					18%		
1.5.4	**Illumination System (*)**											
a)	GIS Building etc.Illumination.with LED base Lamp	85395000		LS	1					18%		
b)	Switchyard/Street light system (High Mast lighting System)	85393220		LS	1					18%		

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
1.5.5	**1.1 kV Grade PVC insulated Al. conductor armoured power cables and copper conductor armoured control cables alongwith lugs, Glands and straight joints (Included in above)**											
a)	Power cables (XLPE)(*)	85446020		LS	1					18%		
b)	Power cables (PVC) (*)	85446020		LS	1					18%		
c)	Control Cable (PVC) (*)	85446020		LS	1					18%		
	(*) The bidder has to estimate and quote as per his own assessment.											
1.5.6	**66kV Feeder and Transformer Termination Arrangement**											
(a)	66 KV XLPE Suitable size Power Cable (Double Run) for connecting 3 Nos. transformer to 66KV GIS and 12 nos. feeders to 66KV GIS (Single Run)	85446090		LS	1					18%		
(b)	66kV indoor terminations suitable for above cable	85479090		No.	54					18%		
(c)	66kV outdoor terminations suitable for above cable	85479090		No.	54					18%		
(d)	Steel structure for H-Pole arrangement for termination of 66 KV	73089090		LS	1					18%		
(e)	Petty items like Clamps & Connectors , Support Insulators etc.and all required material for completion of Job	85369090		LS	1					18%		
(f)	60 KV, 10 KA outdoor Surge arrester	85354010		No.	9					18%		
1.5.7	**Grounding/ Earthing System**											
a)	40mm MS rod for Earthmat	73089090		LS	1					18%		
b)	Lightning Mast/ GS Shield Wire	73121090		LS	1					18%		
1.5.8	**EOT Crane for 66kV GIS Hall**	84261100		Set	1					18%		
1.5.9	**Tertiary loading equipments for one 160 MVA transformer**											
a)	33KV, O/D type isolator with earth switch MOM type	85353090		No	1					18%		
b)	33KV, O/D type CT, ratio 25/1-1A	85043100		No	3					18%		
c)	33KV, O/D type 630A, SF6 Circuit Breaker	85352112		No	1					18%		
d)	Control & Relay protection scheme	85371000		No	1					18%		
e)	11KV, O/D type PT, ratio Potential Transformer of ratio 11KV/√3)/(110V/√3)/(110V/√3)	85043100		No	3					18%		
f)	11kV Surge Arrester	85354010		No	3					18%		
1.5.10	**11 KV equipments for loading of 400 KVA Auxilary Transformer**											
a)	11kV switchgear, 2 Panel Board (1 incomer and 1 outgoing) alongwith associated control & relay system, 11kV cables etc.	85372000		LS	1					18%		
	Sub-Total (1.5)											

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
1.6	**CCTV System with remote Operations***											
1	Supply of compact type day and night network PTZ camera with outdoor housing - as per specifications	85258010		Nos.	2					18%		
2	Supply of compact type day and night network fixed camera with outdoor housing - as per specifications	85258010		Nos.	2					18%		
3	Network Video Management Software for 20 cameras as per specifications	85299090		Nos.	1					18%		
4	NVMS client License Pack for 2 users as per specifications	85299090		Nos.	1					18%		
5	Video management workstation Server with Storage hardware with 1 TB capacity for continuous recording for 30 Days Minimum as per specifications	85299090		Nos.	1					18%		
6	Video analytic software for fixed type cameras (2camera per site)	85299090		Nos.	1					18%		
7	The contractor is responsible for supplying and laying of armoured Fibre Optics cables through HDPE Conduit by digging and laying through cable trench as per the site requirements including the supply of converters and other accessories (suitable for outdoor application) required to complete the connectivity in all respect as per the direction of Engineer-in-Charge.	85299090		LS	1					18%		
8	Auxiliary structure with all required poles/mast & related mount with all accessories. Pole/Mart (G.I.) : Length - 9 mtrs and should be ISI make Mounting : to be grounded in concrete structure should be self-supporting in the ground.	73089090		Lot	1					18%		
9	32" LCD monitor Diagonal Industrial Grade Panel for 24x7 applications as per specification.	85312000		Nos.	1					18%		
10	24" Client PC TFT LCD monitor as per specification	85312000		Nos.	2					18%		
11	16 port Network Switch with fibre optic connectivity along with all related accessories - as per specifications.	85176990		Nos.	1					18%		
12	Heavy duty with weather proof Power supply units for outdoor cameras	85229000		Nos.	5					18%		

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
13	2 KVA On line UPS system for Power distribution with 60 Minutes power back up with all related accessories at all locations - as per specifications	85043200		Nos.	1					18%		
14	Supply & laying of 3Core X 1.5 sq mm armoured Power cable - as per specifications	85446090		LS	1					18%		
15	Supply and laying of Twisted pair shielded un-armored cable (CAT-6) - as per specification (from Terminal box to camera etc.)	85444999		LS	1					18%		
16	Supply and laying of 25 mm GI conduits with all necessary accessories - ISI mark	85479090		LS	1					18%		
17	Control console wooden table cabinet along with computer chair to accommodate Video Management Work station, Network switch, UPS - Godrej	44219190		Nos.	1					18%		
	* quantity may vary depending on actual drawing approval/site layout											
	Sub-Total (1.6)											
	SUB-TOTAL I : MAIN EQUIPMENTS [(1.1) to (1.6)]											
2.0	**Testing/ Maintenance Equipments & Mandatory Spares**											
2.1	**Testing/Maintenance equipments for GIS**											
2.1.1	SF6 Gas filling and evacuating plant	85437019		Set	1					18%		
2.1.2	SF6 Gas analyzer	85352119		Set	1					18%		
2.1.3	SF6 gas leak detector	90271000		Set	1					18%		
2.1.4	Partial Discharge Monitoring System	85437019		Set	1					18%		
2.1.5	Automatic Primary Current (AC) injection test kit	85352119		Set	1					18%		
2.1.6	Gas masks	90200000		Nos	10					12%		
	SUB-TOTAL II : TESTING EQUIPMENTS(2.1)											
2.2	**MANDATORY SPARES**											
2.2.1	**Spares for 66kV GIS**											
2.2.1.1	GIS	85389000		LS	1					18%		
2.2.1.2	Circuit Breaker	85389000		LS	1					18%		
2.2.1.3	Isolator	85389000		LS	1					18%		
2.2.1.4	CT	85043100		LS	1					18%		
2.2.1.5	Voltage transformer	85043100		LS	1					18%		
2.2.1.6	SurgeArrestor	85354010		LS	1					18%		
2.2.2	**Batteries**	85072000		LS	1					18%		
2.2.3	**Sub station Automation System**	85389000		LS	1					18%		

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

Plant and Equipment (including Mandatory Spares) to be supplied

S.No.	Item Description	HSN Code	Whether HSN is confirmed. If not, indicate applicable HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	Whether rate of GST is confirmed. If not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9=6x8	10	11	12	13
2.2.4	**Relay & Protection Panels**	85364900		LS	1					18%		
2.2.5	**DG Set**	85021310		LS	1					18%		
	SUB-TOTAL III : MANDATORY SPARES (2.2)											
	TOTAL [I+II+III]											

Note : Bidder is required to quote prices in this Schedule for all the individual items/sub-items.
HSN Code shall be filled/confirmed by Bidder
Currency shall be only in INDIAN Rupee in accordance with clause 14.2 Section-ITB Volume I of the bidding documents.
Please refer NIT/Tender Document for List of Manadatoty Spare
In case any additional equipment is required, the same should be included in the scope with no additional payment and the offer should be complete and comprehensive.

Date :

Place :

Signature :

Printed Name

Designation

Common Seal

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Local Transportation,Insurance and other Incidental Services

S.No.	Item Description	Unit	Qty	Transportation, Insurance and other Incidental Services						
				SAC Code	Whether SAC code is confirmed Yes/No If not, indicate applicable SAC code	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST	Amount
1	2	3	4	5	6	7	8=4*7	9	10	11=8*(9or10)
	66kV GIS Bays at Dwarka substation									
A	**Main Equipment.**									
1	**66KV GIS Equipment and associated equipment**									
1.1	**66kV GIS Equipment**									
1	72.5 kV SF6 GIS **Outgoing Line Feeder Circuit Breaker Bay Module**. [Module description as per Technical Specification, Cl. 3.0,B(I),(D) of Section Project]	Set	12	996519				18%		
2	72.5 kV SF6 GIS **Transformer I/C Circuit Breaker Bay Module**. [Module description as per Technical Specification, Cl. 3.0,B(I),(C) of Section Project]	Set	4	996519				18%		
3	72.5 kV SF6 GIS **Bus Coupler Bay Module**.[Module description as per Technical Specification, Cl. 3.0,B(I),(B) of Section Project]	Set	2	996519				18%		
4	72.5kV SF6 GIS **Bus Sectionliser bay module**.[Module description as per Technical Specification, Cl. 3.0,B(I),(E) of Section Project]	Set	2	996519				18%		
5	72.5 kV SF6 GIS **Bus-bar Module**.[Module description as per Technical Specification, Cl. 3.0,B(I),(A) of Section Project]	Set	2	996519				18%		
	Sub-Total (1.1)									
1.2	**MATERIAL FOR 160 MVA TRANSFORMER AND ASSOCIATED EQUIPMENTS**									
1	Steel for support structure	LS	1	996519				18%		
2	ACSR conductor along with fittings	LS	1	996519				18%		
3	216KV, 10KA, Lighting Arrestor (L.A.) with surge/discharge counter, milli-ampere meter and suitable terminal connectors etc.	Nos.	9	996519				18%		
	Sub-Total (1.2)									
1.3	**LT Transformers**									
1	400 KVA,11/0.433KV,170kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	No.	1	996519				18%		
2	400 KVA,11/0.433KV,95kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	No.	1	996519				18%		
	Sub-Total (1.3)									
1.4	**Sub-Station Automation System and Relay & Protection Panels**									
1.4.1	**220kV Control and Relay Panels**									
(a)	Transformer Protection panel (for HV side)	Nos.	4	996519				18%		
(b)	Time Synchronization equipment and Other common equipments pertaining to Relay & Protection System (Time Sychronisation equipment)	Lot	1	996519				18%		
1.4.2	**66kV Control and Relay Panels**									
(a)	Feeder Protection Panel	Nos.	12	996519				18%		
(b)	Transformer Incomer Protection panel	Nos.	4	996519				18%		
(c)	Bus-Coupler Protection panel	Nos.	2	996519				18%		

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Local Transportation,Insurance and other Incidental Services

				Transportation, Insurance and other Incidental Services						
					Whether SAC			Taxes & Duties GST		
(d)	Bus- Section Protection Panel	Nos.	2	996519				18%		
(e)	Other/Common equipments pertaining to Relay & Protection System	Lot	1	996519				18%		
1.4.3	**Automation & SCADA**									
(a)	Substation automation equipment, Optic Fibre and other interface/ converter equipment for 66kV GIS	Set	1	996519						
(b)	Testing & Maintenance equipment	Set	1	996519				18%		
(c)	Remote HMI alongwith monitor for DTL control room	Set	1	996519				18%		
(d)	Inverter of suitable capacity for station HMI and peripheral devices i. e. printer etc.	Set	1	996519				18%		
1.4.4	**Air conditioning system**									
a)	Split AC (5 star rating) 66kV Relay & Protection Panels Room	Lot	1	996519				18%		
b)	Ventilation system for 66 kV GIS hall	Lot	1	996519				18%		
	Sub-Total (1.4)									
1.5	**LT Switchgear & other items**									
1.5.1	**LT Switchgear**									
a)	415V ACDB (sub panels for extension and distrubution from 220kV GIS building)	Set	1	996519				18%		
b)	415V Emergency LDB	Set	1	996519				18%		
c)	415V Air-conditioning & Ventilation DB	Set	1	996519				18%		
d)	220V DCDB (For extension and distrubution from 220kV GIS Building)	Set	2	996519				18%		
1.5.2	**DG Set along with control panel (250kVA, 440V)**	Set	1	996519				18%		
1.5.3	**Fire prevention & extinguishing system**									
a)	Fire Protection for GIS building, etc. (Portable type fire extinguishers system)	Lot	1	996519				18%		
1.5.4	**Illumination System (*)**									
a)	GIS Building etc.Illumination.with LED base Lamp	LS	1	996519				18%		
b)	Switchyard/Street light system (High Mast lighting System)	LS	1	996519				18%		
1.5.5	**1.1 kV Grade PVC insulated Al. conductor armoured power cables and copper conductor armoured control cables alongwith lugs, Glands and straight joints (Included in above)**									
a)	Power cables (XLPE)(*)	LS	1	996519				18%		
b)	Power cables (PVC) (*)	LS	1	996519				18%		
c)	Control Cable (PVC) (*)	LS	1	996519				18%		
	(*) The bidder has to estimate and quote as per his own assessment.									
1.5.6	**66kV Feeder and Transformer Termination Arrangement**									
(a)	66 KV XLPE Suitable size Power Cable (Double Run) for connecting 3 Nos. transformer to 66KV GIS and 12 nos. feeders to 66KV GIS (Single Run)	LS	1	996519				18%		
(b)	66kV indoor terminations suitable for above cable	No.	54	996519				18%		
(c)	66kV outdoor terminations suitable for above cable	No.	54	996519				18%		
(d)	Steel structure for H-Pole arrangement for termination of 66 KV feeders	LS	1	996519				18%		
(e)	Petty items like Clamps & Connectors , Support Insulators etc.and all required material for completion of Job	LS	1	996519				18%		
(f)	60 KV, 10 KA outdoor Surge arrester	No.	9	996519				18%		
1.5.7	**Grounding/ Earthing System**									
a)	40mm MS rod for Earthmat	LS	1	996519				18%		

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Bidder's Name and Address :

Local Transportation,Insurance and other Incidental Services

				Transportation, Insurance and other Incidental Services						
								Taxes & Duties		
					Whether SAC			GST		
b)	Lightning Mast/ GS Shield Wire	LS	1	996519				18%		
1.5.8	**EOT Crane for 66kV GIS Hall**	set	1	996519				18%		
1.5.9	**Tertiary loading equipments for one 160 MVA transformer**									
a)	33KV, O/D type isolator with earth switch MOM type	No	1	996519				18%		
b)	33KV, O/D type CT, ratio 25/1-1A	No	3	996519				18%		
c)	33KV, O/D type 630A, SF6 Circuit Breaker	No	1	996519				18%		
d)	Control & Relay protection scheme	No	1	996519				18%		
e)	11KV, O/D type PT, ratio Potential Transformer of ratio 11KV/ √3)/(110V/√3)/(110V/√3)	No	3	996519				18%		
f)	11kV Surge Arrester	No	3	996519				18%		
1.5.10	**11 KV equipments for loading of 400 KVA Auxilary Transformer**									
a)	11kV switchgear, 2 Panel Board (1 incomer and 1 outgoing) alongwith associated control & relay system, 11kV cables etc.	LS	1	996519				18%		
	Sub-Total (1.5)									
1.6	**CCTV System with remote Operations***									
1	Supply of compact type day and night network PTZ camera with outdoor housing - as per specifications	Nos.	2	996519				18%		
2	Supply of compact type day and night network fixed camera with outdoor housing - as per specifications	Nos.	2	996519				18%		
3	Network Video Management Software for 20 cameras as per specifications	Nos.	1	996519				18%		
4	NVMS client License Pack for 2 users as per specifications	Nos.	1	996519				18%		
5	Video management workstation Server with Storage hardware with 1 TB capacity for continuous recording for 30 Days Minimum as per specifications	Nos.	1	996519				18%		
6	Video analytic software for fixed type cameras (2camera per site)	Nos.	1	996519				18%		
7	The contractor is responsible for supplying and laying of armoured Fibre Optics cables through HDPE Conduit by digging and laying through cable trench as per the site requirements including the supply of converters and other accessories (suitable for outdoor application) required to complete the connectivity in all respect as per the direction of Engineer-in-Charge.	LS	1	996519				18%		
8	Auxiliary structure with all required poles/mast & related mount with all accessories. Pole/Mart (G.I.) : Length - 9 mtrs and should be ISI make Mounting : to be grounded in concrete structure should be self-supporting in the ground.	Lot	1	996519				18%		
9	32" LCD monitor Diagonal Industrial Grade Panel for 24x7 applications as per specification.	Nos.	1	996519				18%		
10	24" Client PC TFT LCD monitor as per specification	Nos.	2	996519				18%		
11	16 port Network Switch with fibre optic connectivity along with all related accessories - as per specifications.	Nos.	1	996519				18%		
12	Heavy duty with weather proof Power supply units for outdoor cameras	Nos.	5	996519				18%		
13	2 KVA On line UPS system for Power distribution with 60 Minutes power back up with all related accessories at all locations - as per specifications	Nos.	1	996519				18%		
14	Supply & laying of 3Core X 1.5 sq mm armoured Power cable - as per specifications	LS	1	996519				18%		
15	Supply and laying of Twisted pair shielded un-armored cable (CAT-6) - as per specification (from Terminal box to camera etc.)	LS	1	996519				18%		
16	Supply and laying of 25 mm GI conduits with all necessary accessories - ISI mark	LS	1	996519				18%		
17	Control console wooden table cabinet along with computer chair to accommodate Video Management Work station, Network switch, UPS - Godrej	Nos.	1	996519				18%		
	* quantity may vary depending on actual drawing approval/site layout									
	Sub-Total (1.6)									

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Local Transportation,Insurance and other Incidental Services

				Transportation, Insurance and other Incidental Services						
					Whether SAC			Taxes & Duties		
								GST		
	SUB-TOTAL I : MAIN EQUIPMENTS [(1.1) to (1.6)]									
2.0	**Testing/ Maintenance Equipments & Mandatory Spares**									
2.1	**Testing/Maintenance equipments for GIS**									
2.1.1	SF6 Gas filling and evacuating plant	Set	1	996519				18%		
2.1.2	SF6 Gas analyzer	Set	1	996519				18%		
2.1.3	SF6 gas leak detector	Set	1	996519				18%		
2.1.4	Partial Discharge Monitoring System	Set	1	996519				18%		
2.1.5	Automatic Primary Current (AC) injection test kit	Set	1	996519				18%		
2.1.6	Gas masks	Nos	10	996519				18%		
	SUB-TOTAL II : TESTING EQUIPMENTS(2.1)									
2.2	**MANDATORY SPARES**									
2.2.1	**Spares for 66kV GIS**									
2.2.1.1	GIS	LS	1	996519				18%		
2.2.1.2	Circuit Breaker	LS	1	996519				18%		
2.2.1.3	Isolator	LS	1	996519				18%		
2.2.1.4	CT	LS	1	996519				18%		
2.2.1.5	Voltage transformer	LS	1	996519				18%		
2.2.1.6	SurgeArrestor	LS	1	996519				18%		
2.2.2	**Batteries**	LS	1	996519				18%		
2.2.3	**Sub station Automation System**	LS	1	996519				18%		
2.2.4	**Relay & Protection Panels**	LS	1	996519				18%		
2.2.5	**DG Set**	LS	1	996519				18%		
	SUB-TOTAL III : MANDATORY SPARES (2.2)									
	TOTAL [I+II+III]									

Note : Bidder is required to quote prices in this Schedule for all the individual items/sub-items.
SAC Code shall be filled/confirmed by Bidder

Currency shall be only in INDIAN Rupee in accordance with clause 14.2 Section-ITB Volume I of the bidding documents.
In case any additional equipment is required, the same shalll be supplied without any additional payment and the offer should be complete and comprehensive.
Please refer NIT/Tender Document for List of Manadatoty Spare

Date
Place :

Signature :

Printed Name

Designation

Common Seal

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8=6x7	9	10	11
	66kV GIS Bays at Dwarka substation									
A	**Main Equipment.**									
1	**66KV GIS Equipment and associated equipment**									
1.1	**66kV GIS Equipment**									
1	72.5 kV SF6 GIS **Outgoing Line Feeder Circuit Breaker Bay Module**. [Module description as per Technical Specification, Cl. 3.0,B(I),(D) of Section Project]	998736		Set	12			18%		
2	72.5 kV SF6 GIS **Transformer I/C Circuit Breaker Bay Module**. [Module description as per Technical Specification, Cl. 3.0,B(I),(C) of Section Project]	998736		Set	4			18%		
3	72.5 kV SF6 GIS **Bus Coupler Bay Module**.[Module description as per Technical Specification, Cl. 3.0,B(I),(B) of Section Project]	998736		Set	2			18%		
4	72.5kV SF6 GIS **Bus Sectionliser bay module**.[Module description as per Technical Specification, Cl. 3.0,B(I),(E) of Section Project]	998736		Set	2			18%		
5	72.5 kV SF6 GIS **Bus-bar Module**.[Module description as per Technical Specification, Cl. 3.0,B(I),(A) of Section Project]	998736		Set	2			18%		
	Sub-Total (1.1)									
1.2	**MATERIAL FOR 160 MVA TRANSFORMER AND ASSOCIATED EQUIPMENTS**									
1	Steel for support structure	995455		LS	1			18%		
2	ACSR conductor along with fittings	998736		LS	1			18%		
3	216KV, 10KA, Lighting Arrestor (L.A.) with surge/discharge counter, milli-ampere meter and suitable terminal connectors etc.	998736		Nos.	9			18%		
	Sub-Total (1.2)									
1.3	**LT Transformers**									
1	400 KVA,11/0.433KV,170kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	998736		No.	1			18%		
2	400 KVA,11/0.433KV,95kVp BIL at 11 KV side, three phase, transformer including bushing accessories and first filling of oil	998736		No.	1			18%		
	Sub-Total (1.3)									

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
1.4	**Sub-Station Automation System and Relay & Protection Panels**									
1.4.1	**220kV Control and Relay Panels**									
(a)	Transformer Protection panel (for HV side)	998736		Nos.	4			18%		
(b)	Time Synchronization equipment and Other common equipments pertaining to Relay & Protection System (Time Sychronisation equipment)	998736		Lot	1			18%		
1.4.2	**66kV Control and Relay Panels**									
(a)	Feeder Protection Panel	998736		Nos.	12					
(b)	Transformer Incomer Protection panel	998736		Nos.	4			18%		
(c)	Bus-Coupler Protection panel	998736		Nos.	2			18%		
(d)	Bus- Section Protection Panel			Nos.	2					
(e)	Other/Common equipments pertaining to Relay & Protection System	998736		Lot	1			18%		
1.4.3	**Automation & SCADA**									
(a)	Substation automation equipment, Optic Fibre and other interface/ converter equipment for 66kV GIS	998736		Set	1			18%		
(b)	Testing & Maintenance equipment	998736		Set	1			18%		
(c)	Remote HMI alongwith monitor for DTL control room	998736		Set	1			18%		
(d)	Inverter of suitable capacity for station HMI and peripheral devices i. e. printer etc.	998736		Set	1			18%		
1.4.4	**Air conditioning system**									
a)	Split AC (5 star rating) 66kV Relay & Protection Panels Room	998736		Lot	1			18%		
b)	Ventilation system for 66 kV GIS hall	998736		Lot	1			18%		
	Sub-Total (1.4)									
1.5	**LT Switchgear & other items**									
1.5.1	**LT Switchgear**									
a)	415V ACDB (sub panels for extension and distrubution from 220kV GIS building)	998736		Set	1			18%		
b)	415V Emergency LDB	998736		Set	1			18%		
c)	415V Air-conditioning & Ventilation DB	998736		Set	1			18%		

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
d)	220V DCDB (For extension and distrubution from 220kV GIS Building)	998736		Set	2			18%		
1.5.2	**DG Set along with control panel (250kVA, 440V)**	998736		Set	1			18%		
1.5.3	**Fire prevention & extinguishing system**									
a)	Fire Protection for GIS building, etc. (Portable type fire extinguishers system)	998736		Lot	1			18%		
1.5.4	**Illumination System (*)**									
a)	GIS Building etc.Illumination.with LED base Lamp	995468		LS	1			18%		
b)	Switchyard/Street light system (High Mast lighting System)	995468		LS	1			18%		
1.5.5	**1.1 kV Grade PVC insulated Al. conductor armoured power cables and copper conductor armoured control cables alongwith lugs, Glands and straight joints (Included in above)**									
a)	Power cables (XLPE)(*)	998736		LS	1			18%		
b)	Power cables (PVC) (*)	998736		LS	1			18%		
c)	Control Cable (PVC) (*)	998736		LS	1			18%		
	(*) The bidder has to estimate and quote as per his own assessment.									
1.5.6	**66kV Feeder and Transformer Termination Arrangement**									
(a)	66 KV XLPE Suitable size Power Cable (Double Run) for connecting 3 Nos. transformer to 66KV GIS and 12 nos. feeders to 66KV GIS (Single Run)	998736		LS	1			18%		
(b)	66kV indoor terminations suitable for above cable	998736		No.	54			18%		
(c)	66kV outdoor terminations suitable for above cable	998736		No.	54			18%		
(d)	Steel structure for H-Pole arrangement for termination of 66 KV feeders	998736		LS	1			18%		
(e)	Petty items like Clamps & Connectors , Support Insulators etc.and all required material for completion of Job	998736		LS	1			18%		
(f)	60 KV, 10 KA outdoor Surge arrester	998736		No.	9			18%		
1.5.7	**Grounding/ Earthing System**									
a)	40mm MS rod for Earthmat	994728		LS	1			18%		
b)	Lightning Mast/ GS Shield Wire	995455		LS	1			18%		
1.5.8	**EOT Crane for 66kV GIS Hall**	998736		set	1			18%		

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
1.5.9	**Tertiary loading equipments for one 160 MVA transformer**									
a)	33KV, O/D type isolator with earth switch MOM type	998736		No	1			18%		
b)	33KV, O/D type CT, ratio 25/1-1A	998736		No	3			18%		
c)	33KV, O/D type 630A, SF6 Circuit Breaker	998736		No	1			18%		
d)	Control & Relay protection scheme	998736		No	1			18%		
e)	11KV, O/D type PT, ratio Potential Transformer of ratio 11KV/ √3)/(110V/√3)/(110V/√3)	998736		No	3			18%		
f)	11kV Surge Arrester	998736		No	3			18%		
1.5.10	**11 KV equipments for loading of 400 KVA Auxilary Transformer**									
a)	11kV switchgear, 2 Panel Board (1 incomer and 1 outgoing) alongwith associated control & relay system,	998736		LS	1			18%		
	Sub-Total (1.5)									
1.6	**CCTV System with remote Operations***									
1	Supply of compact type day and night network PTZ camera with outdoor housing - as per specifications	995468		Nos.	2			18%		
2	Supply of compact type day and night network fixed camera with outdoor housing - as per specifications	995468		Nos.	2			18%		
3	Network Video Management Software for 20 cameras as per specifications	995468		Nos.	1			18%		
4	NVMS client License Pack for 2 users as per specifications	995468		Nos.	1			18%		
5	Video management workstation Server with Storage hardware with 1 TB capacity for continuous recording for 30 Days Minimum as per specifications	995468		Nos.	1			18%		
6	Video analytic software for fixed type cameras (2camera per site)	995468		Nos.	1			18%		
7	The contractor is responsible for supplying and laying of armoured Fibre Optics cables through HDPE Conduit by digging and laying through cable trench as per the site requirements including the supply of converters and other accessories (suitable for outdoor application) required to complete the connectivity in all respect as per the direction of Engineer-in-Charge.	995468		LS	1			18%		
8	Auxiliary structure with all required poles/mast & related mount with all accessories. Pole/Mart (G.I.) : Length - 9 mtrs and should be ISI make Mounting : to be grounded in concrete structure should be self-supporting in the ground.	995468		Lot	1			18%		
9	32" LCD monitor Diagonal Industrial Grade Panel for 24x7 applications as per specification.	995468		Nos.	1			18%		

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
10	24" Client PC TFT LCD monitor as per specification	995468		Nos.	2			18%		
11	16 port Network Switch with fibre optic connectivity along with all related accessories - as per specifications.	995468		Nos.	1			18%		
12	Heavy duty with weather proof Power supply units for outdoor cameras	995468		Nos.	5			18%		
13	2 KVA On line UPS system for Power distribution with 60 Minutes power back up with all related accessories at all locations - as per specifications	995468		Nos.	1			18%		
14	Supply & laying of 3Core X 1.5 sq mm armoured Power cable - as per specifications	995468		LS	1			18%		
15	Supply and laying of Twisted pair shielded un-armored cable (CAT-6) - as per specification (from Terminal box to camera etc.)	995468		LS	1			18%		
16	Supply and laying of 25 mm GI conduits with all necessary accessories - ISI mark	995468		LS	1			18%		
17	Control console wooden table cabinet along with computer chair to accommodate Video Management Work station, Network switch, UPS - Godrej	995468		Nos.	1			18%		
	* quantity may vary depending on actual drawing approval/site layout									
	Sub-Total (1.6)									
	SUB-TOTAL 1.0 : MAIN EQUIPMENTS [(1.1) to (1.6)]									
2	**CIVIL WORKS**									
1	**Foundations for**									
a)	160 MVA 220/66/11KV Transformer with soak pit and sump well etc.	995416		Nos.	3			18%		
b)	400KVA, 11/0.433 kV LT Transformer	995416		Nos.	2			18%		
c)	66kV GIS Building as per design requirement	995416		LS	1			18%		
d)	220kV surge arrester	995416		Nos.	12			18%		
e)	66kV Surge arrester	995416		Nos.	9			18%		
f)	Pump House	995416		Set	1			18%		
g)	250KVA DG Set	995416		No.	1			18%		
3	RCC in foundation including earth work in excavating disposal of surplus earth PCC, RCC reinforcement steel, for structures and equipments	995416		LS	1			18%		
4	Cable Trench including all types of crossings	995416		LS	1			18%		
5	Soil Investigation	995416		LS	1			18%		
6	Site surfacing (gravelling) & Anti weed Treat-ment	995416		LS	1			18%		
7	Roads (including all crossings), Main road infront of ICTs with connecting rail	995416		LS	1			18%		
8	Storm Water drainage & Rainwater Harvesting	995416		LS	1			18%		
9	Switchyard Fencing along with gates	995416		LS	1			18%		

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).
(Schedule of rates and prices)

Bidder's Name and Address :

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
10	**Buildings**									
a)	66kV GIS-cum-Control Room Building as per design requirement	995416		LS	1			18%		
b)	Pump House along with Pump Set	995416		Set	1			18%		
11	Transformer fire walls	995416		Nos.	3			18%		
12	RCC frame Boundary wall with brick panneling including gate(if any required)	995416		LS	1			18%		
13	Land filling (If any)	995416		LS	1			18%		
14	**Furniture of Reputed make i.e. Godrej/Rittal/Pyrotech**									
a)	Control room table	995416		No.	1			18%		
b)	Tables for executives	995416		Nos.	2			18%		
c)	Chairs	995416		Nos.	19			18%		
d)	Lockers	995416		Nos.	16			18%		
e)	Almirah	995416		Nos.	3			18%		
	Sub-total (2.0)									
	TOTAL [SUB-TOTAL (1.0) +SUB-TOTAL (2.0)]									

Note : Bidder is required to quote prices in this Schedule for all the individual items/sub-items.
SAC Code shall be filled/confirmed by Bidder
Currency shall be only in INDIAN Rupee in accordance with clause 14.2 Section-ITB Volume I of the bidding documents.
In case any additional equipment is required, the same shalll be supplied without any additional payment and the offer should be complete and comprehensive.

Signature :

Date
Place :

Printed Name

Designation

Common Seal

Turnkey package (B) for Design, Engineering, Supply, Erection, Testing & Commissioning of 66kV GIS Sub-Station with complete civil works & automation at 400/220/66 kV GIS Sub-station Dwarka Sec-5, Delhi (India).

(Schedule of rates and prices)

Bidder's Name and Address :

GRAND SUMMARY OF THE QUOTED BID PRICE.

S.No		DESCRIPTION	Total Price (INR)
1		**TOTAL SCHEDULE NO. 1**	
		Plant and Equipment (including Mandatory Spares) to be supplied	
2		**TOTAL SCHEDULE NO. 2**	
		Local Transportation, Insurance and other Incidental Services	
3		**TOTAL SCHEDULE NO. 3**	
		Installation Charges	
		GRAND TOTAL 'A ' = [1 + 2 + 3]	
		*currency in accordance with ITB clause 14.2, Vol.-I of the Bidding Documents.	

II.We declare that the following are our quoted bid price in INR for the entire Scope of work as specified in the specifications and documents.

A. Quoted Bid Price :

i. In figures
ii. In Words
Excluding taxes & duties
(Grand Summary of the quoted Bid Price as in I above.)

B. Applicable Taxes & Duties and other levies, payable additionally, in respect of the transaction between the Owner and the Contractor (Total Amount to be mentioned).

i. GST (Total Amount to be mentioned)
ii. Total taxes & duties(i) : ……..

C. Total Quoted Bid Price including Taxes and Duties and other levies, if contract is awarded to us i.e A+B above
i. In figures:INR
ii. In owrds: INR

Date : **Signature : _____**

Place : **Printed Name _____**

Designation _____

Common Seal _____

TENDER NO. T20R220201 — **PRICE SCHEDULE-1**

Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

(Schedule of Rates and Prices)

Bidder's Name and Address	**To**
M/s	**Delhi Transco Limited** **Shakti Sadan, Kotla Road** **New Delhi-110002**

Plant and Equipment (including Mandatory Spares) to be supplied

S.No.	Item Description	HSN Code	#Whether HSN is confirmed. if not, indicate applicable the HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	*Whether rate of GST is confirmed.if not, indicate applicable rate of GST	Amount
1	2	3	4	5	6	7	8	9	10	11	12	13
A	**66kV GIS Equipment**											
i	72.5 kV SF6 GIS **Outgoing Line Feeder Circuit Breaker Bay Module**.[Module description as per Technical Specification, Cl. 3.0,C(I),(B) of Section Project]	85359030		Set	6	INR				18%		
ii	72.5 kV SF6 GIS **Bus-bar Module**.[Module description as per Technical Specification, Cl. 3.0,C(I),(A) of Section Project]	85359030		Set	2	INR				18%		
B	**66kV Control and Relay Panels**	85371000		Set	6	INR				18%		
C	**Substation Automation equipment, optic fibre and other interface/converter equipments etc for integration of these six feeder bays with existing SAS system**	85176290		Set	1	INR				18%		
D	**1.1 kV Grade PVC insulated Al. conductor armoured power cables and copper conductor armoured control cables alongwith lugs, Glands and straight joints (included in above)**											
i	Power Cables (XLPE)	85446090		LS	1	INR				18%		
ii	Power Cable (PVC)	85446020		LS	1	INR				18%		
iii	Control Cable (PVC)	85446020		LS	1	INR				18%		
E	**Fire prevention & extinguishing system**											
i	Fire protection for extended 66kV GIS and C&R Panel Room etc (Portable type fire extinguisher system)	84241000		Lot	1	INR				18%		
F	**Illumination System**											
i	For extended GIS Building etc. illumination with LED base/ Metal Halide Lamp	85395000		LS	1	INR				18%		

TENDER NO. T20R220201 — **PRICE SCHEDULE-1**

Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

(Schedule of Rates and Prices)

Bidder's Name and Address	**To**
M/s	**Delhi Transco Limited** **Shakti Sadan, Kotla Road** **New Delhi-110002**

Plant and Equipment (including Mandatory Spares) to be supplied

S.No.	Item Description	HSN Code	#Whether HSN is confirmed. if not, indicate applicable the HSN code	Unit	Qty	Currency (INR)	EX-WORKS PRICE		Mode of Transaction Direct/ Bought Out	Taxes & Duties (Not included in Ex Works Price Component)		
							Unit Price	Total Price		GST		
										Rate	*Whether rate of GST is confirmed.if not, indicate applicable rate of GST	Amount
1	2	3	4	5	6	7	8	9	10	11	12	13
G	**Air conditioning system**											
i	Split AC (5 star rating) for extended 66kV Relay & Protection Panel Room	84151010		Lot	1	INR				28%		
ii	Ventilation system for extended 66kV GIS Hall	84158390		Lot	1	INR				28%		
H	**Petty Items**	73082011		LS	1	INR				18%		
	GRAND TOTAL OF PRICE SCHEDULE-1 (A to H), Indian Rupee											

Note : Bidder is required to quote prices in this Schedule for all the individual items/sub-items.

HSN Code shall be filled/confirmed by Bidder

Currency shall be only in INDIAN Rupee in accordance with clause 14.2 Section-ITB Volume I of the bidding documents.

Please refer NIT/Tender Document for List of Manadatoty Spare

In case any additional equipment is required, the same should be included in the scope with no additional payment and the offer should be complete and comprehensive.

Date :

Place :

Signature : _____

Printed Name _____

Designation _____

Common Seal _____

TENDER NO. T20R220201 | **PRICE SCHEDULE-2**

Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

(Schedule of Rates and Prices)

Bidder's Name and Address :

M/s .....

To,

Delhi Transco Limited
Shakti Sadan, Kotla Road
New Delhi-110002

Local Transportation, Insurance and other Incidental Services

S.No.	Item Description	Unit	Qty	Transportation, Insurance and other Incidental Services						
				SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST	Amount
1	**2**	**3**	**4**	**5**	**6**	**7**	**8= (4X7)**	**9**	**10**	**11= 8*(9 or 10)**
A	**66kV GIS Equipment**									
i	72.5 kV SF6 GIS **Outgoing Line Feeder Circuit Breaker Bay Module**.[Module description as per Technical Specification, Cl. 3.0,C(I),(B) of Section Project]	Set	6	995619				18%		
ii	72.5 kV SF6 GIS **Bus-bar Module**.[Module description as per Technical Specification, Cl. 3.0,C(I),(A) of Section Project]	Set	2	995619				18%		
B	**66kV Control and Relay Panels**	Set	6	995619				18%		
C	**Substation Automation equipment, optic fibre and other interface/converter equipments etc for integration of these six feeder bays with existing SAS system**	Set	1	995619				18%		
D	**1.1 kV Grade PVC insulated Al. conductor armoured power cables and copper conductor armoured control cables alongwith lugs, Glands and straight joints (included in above)**									
i	Power Cables (XLPE)	LS	1	995619				18%		
ii	Power Cable (PVC)	LS	1	995619				18%		
iii	Control Cable (PVC)	LS	1	995619				18%		
E	**Fire prevention & extinguishing system**									

i	Fire protection for extended 66kV GIS and C&R Panel Room etc (Portable type fire extinguisher system)	Lot	1	995619				18%		
F	**Illumination System**									
i	For extended GIS Building etc. illumination with LED base/ Metal Halide Lamp	LS	1	995619				18%		
G	**Air conditioning system**									
i	Split AC (5 star rating) for extended 66kV Relay & Protection Panel Room	Lot	1	995619				18%		
ii	Ventilation system for extended 66kV GIS Hall	Lot	1	995619				18%		
H	**Petty Items**	LS	1	995619				18%		
	GRAND TOTAL OF PRICE SCHEDULE-2 (A to H), Indian Rupee									

Note : Bidder is required to quote the prices in this Schedule for all the individual items/sub-items.
SAC Code shall be filled by Bidder
Currency shall be only in INDIAN Rupee in accordance with clause 14.2 Section-ITB Volume I of the bidding documents.
In case any additional equipment is required, the same should be included in the scope with no additional payment and the offer should be complete and comprehensive.

Please refer NIT/Tender Document for List of Manadatoty Spare

Date :
Place :

TENDER NO. T20R220201								PRICE SCHEDULE-3
Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).								
(Schedule of Rates and Prices)								
Bidder's Name and Address :							**To**	
M/s							**Delhi Transco Limited Shakti Sadan, Kotla Road New Delhi-110002**	

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9	10	11
A	**66kV GIS Equipment**									
i	72.5 kV SF6 GIS **Outgoing Line Feeder Circuit Breaker Bay Module**.[Module description as per Technical Specification, Cl. 3.0,C(I),(B) of Section Project]	998736		Set	6			18%	18%	
ii	72.5 kV SF6 GIS **Bus-bar Module**.[Module description as per Technical Specification, Cl. 3.0,C(I),(A) of Section Project]	998736		Set	2			18%	18%	
B	**66kV Control and Relay Panels**	998736		Set	6			18%	18%	
C	**Substation Automation equipment, optic fibre and other interface/converter equipments etc for integration of these six feeder bays with existing SAS system**	998736		Set	1			18%	18%	
D	**1.1 kV Grade PVC insulated Al. conductor armoured power cables and copper conductor armoured control cables alongwith lugs, Glands and straight joints (included in above)**									
i	Power Cables (XLPE)	998736		LS	1			18%	18%	
ii	Power Cable (PVC)	998736		LS	1			18%	18%	
iii	Control Cable (PVC)	998736		LS	1			18%	18%	
E	**Fire prevention & extinguishing system**									
i	Fire protection for extended 66kV GIS and C&R Panel Room etc (Portable type fire extinguisher system)	995468		Lot	1			18%	18%	
F	**Illumination System**									
i	For extended GIS Building etc. illumination with LED base/ Metal Halide Lamp	998731		LS	1			18%	18%	
G	**Air conditioning system**									
i	Split AC (5 star rating) for extended 66kV Relay & Protection Panel Room	995463		Lot	1			18%	18%	
ii	Ventilation system for extended 66kV GIS Hall	995463		Lot	1			18%	18%	
H	**Petty Items**	998736		LS	1			18%	18%	
I	**CIVIL WORKS**									
(a)	Extension/ Construction of RCC framed structure GIS-cum-control room building including foundation, superstructure, furniture, U/G tank, submersible pump, finishing an all other necessary works.									
i	Ground Floor	995423		No.	1			18%	18%	
ii	Basement Floor	995423		No.	1			18%	18%	
	GRAND TOTAL OF PRICE SCHEDULE-3 (A to I), Indian Rupee									

Note :

Bidder is required to quote prices in this Schedule for all the individual items / sub-items.

SAC Code shall be filled by Bidder

Currency shall be only in INDIAN Rupee in accordance with clause 14.2 Section-ITB Volume I of the bidding documents.

TENDER NO. T20R220201								PRICE SCHEDULE-3
Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).								
(Schedule of Rates and Prices)								
Bidder's Name and Address :							**To**	
M/s							**Delhi Transco Limited Shakti Sadan, Kotla Road New Delhi-110002**	

Installation Charges

S.No.	Item Description	SAC Code	Whether SAC code is confirmed. If not, indicate applicable SAC code	Unit	Qty	Unit Charges (INR)	Total Charges (INR)	Taxes & Duties		
								GST		
								Rate	Whether rate of GST is confirmed.if not, indicate applicable rate of GST #	Amount
1	2	3	4	5	6	7	8	9	10	11

In case any additional equipment is required, the same should be included in the scope with no additional payment and the offer should be complete and comprehensive.

Date :
Place :

Signature : _____
Printed Name _____
Common Seal _____

TENDER NO. T20R220201 **PRICE SCHEDULE 4**

Turnkey package "C" for Design, Engineering, Supply, Erection, Testing & Commissioning of 06 Nos. 66 kV GIS Feeder Bays (extension of existing GIS) along with complete civil works & automation at 400/220/66 kV Sub-station Harsh Vihar, Delhi (India).

Bidder's Name and Address :
M/s .....

GRAND SUMMARY OF THE QUOTED BID PRICE.

S.No	DESCRIPTION	Total Price (INR)
1	**TOTAL PRICE SCHEDULE-1** Plant and Equipment (including Mandatory Spares) to be supplied	
2	**TOTAL PRICE SCHEDULE-2** Local Transportation, Insurance and other Incidental Services	
3	**TOTAL PRICE SCHEDULE-3** Installation Charges	
	GRAND TOTAL 'A ' = [1 + 2 + 3]	-
	*currency in accordance with ITB clause 14.2, Vol.-I of the Bidding Documents.	

We declare that the following are our quoted bid price in INR for the entire Scope of work as specified in the specifications and documents:

A. Quoted Bid Price Excluding taxes & duties (Grand Summary of the quoted Bid Price as in I above.):

i. In Figures:INR	□ -
ii. In Words: INR:	

B. Applicable Taxes & Duties and other levies, payable additionally, in respect of the transaction between the Owner and the Contractor (Total Amount to be mentioned).

i. GST (Total Amount to be mentioned)	□ -
ii. Total taxes & duties(i) :	□ -

C. Total Quoted Bid Price including Taxes and Duties and other levies, if contract is awarded to us i.e A+B above

i. In Figures:INR	□ -
ii. In Words: INR:	

Date :

Place :

Signature : _____

Printed Name _____
Designation _____

Common Seal _____